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Treatment Effects of the Mandibular Anterior Repositioning Appliance (MARA) and Conventional Orthodontic Mechanics on Temporomandibular Joint Morphology: A Comparison Using Cone Beam Computed Tomography

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Treatment Effects of the Mandibular Anterior Repositioning Appliance (MARA) and Conventional Orthodontic Mechanics on Temporomandibular Joint Morphology: A Comparison Using Cone Beam Computed Tomography

Abstract

Introduction: An ongoing debate exists in orthodontics about the amount of condylefossa remodeling and growth seen in Class II patients using functional appliance therapy. Some clinicians and researchers have found that the use of functional appliances increases the amount of condylar growth and subsequent Class II skeletal correction; others believe that the mandible has a preset amount of growth and that conventional orthodontics will result in a similar amount of condylar growth to functional appliance therapy. **Purpose:** The aim of this study was to compare condylar remodeling in functional appliance treatment using the mandibular anterior repositioning appliance (MARA) to conventional fixed orthodontic therapy by measuring changes using Cone Beam Computed Tomography (CBCT).

Methods: This retrospective study was an analysis of cone beam computed tomography images taken on 65 subjects with Class II division 1 malocclusions at the beginning and end of their comprehensive orthodontic treatment. Thirty-three subjects (13 females, 20 males; average age 11.93 years) were treated with the MARA plus edgewise mechanics, and a sample of thirtyone subjects (18 females, 13 males; average age 12.37 years) were treated with full fixed conventional orthodontic appliances and class II intermaxillary elastics. The CBCT scans were evaluated using Dolphin3D®. Temporomandibular joint (TMJ) measurements were recorded in the sagittal, axial, and coronal axes, and lateral cephalograms were extracted to compare groups and evaluate treatment differences. A total of 98 variables were measured.

Results: Slightly more mandibular advancement was seen in the MARA group versus the conventional group. In looking at the TMJ dimensions, the joint spaces were relatively constant throughout treatment, but more resorption of the condylar head was observed in the MARA group versus conventional treatment. The condylar head angle decreased for both treatment groups, showing a forward remodeling. Lengthening of the condylar process was statistically greater in the MARA group than the conventional Edgewise treatment group, although both increased on average. The slope of the posterior border of the articular eminence became more acute in the MARA group and more obtuse in the conventional Edgewise group. Overall, there was a relative increase and forward advancement of the temporomandibular apparatus in both treatment groups.

Conclusions: Both treatment groups were successful in correcting the Class II malocclusion skeletally and dentally. However, the MARA group had slightly more mandibular advancement and condylar growth than the conventional treatment group. In both groups, the TMJ structures increased and came downward and forward partly due to treatment and, to some extent, growth in the adolescent subjects.

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**Treatment Effects of the Mandibular Anterior Repositioning Appliance (MARA)
and Conventional Orthodontic Mechanics on Temporomandibular Joint
Morphology: A Comparison Using Cone Beam Computed Tomography**

A Thesis
Presented for
The Graduate Studies Council
The University of Tennessee
Health Science Center

In Partial Fulfillment
Of the Requirements for the Degree
Master of Dental Science
From The University of Tennessee

By
Brenton E. Glassell
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LIST OF ABBREVIATIONS

AAE	Area of articular eminence
ACP	Area of condylar head
AE	Articular eminence
AGF	Area of glenoid fossa
AJS	Anterior joint space
AP	Anteroposterior condylar length
APCD	Anteroposterior condylar difference
ATA	Articular tubercle angle
Ax	Axial plane
CA	Condylar angulation
CBCT	Cone beam computed tomography
Cd	Condylion
CH	Condylar process height
CHA	Condylar head angle
CHH	Condylar head height
CHW	Condylar head width
Co	Coronal plane
EAM	External auditory meatus
EAM-AE	External auditory meatus to articular eminence
EAM-C	External auditory meatus to center of condyle
EAM-P	External auditory meatus to posterior wall of glenoid fossa
F	Final
FD	Fossa depth
FW	Fossa width
I	Initial
Inc	Sigmoid notch
KS	Kansas
L	Left
LACP	Largest area of condylar process
LJS	Lateral joint space
M	M point
MARA	Mandibular Anterior Repositioning Appliance
MJS	Medial joint space (Coronal)
MJS	Middle joint space (Sagittal)
ML	Mediolateral condylar length
MLCP	Mediolateral condylar position
MSP	Midsagittal plane
OB	Overbite
OJ	Overjet
PJS	Posterior joint space
R	Right
Sa	Sagittal plane
Sella-V	Sella point vertical as related to Frankfort plane

Sella-V-to-M	Anteroposterior distance from Sella-V to M point
SF	Superior aspect of glenoid fossa
SJS	Superior joint space
TMJ	Temporomandibular joint

CHAPTER 1. INTRODUCTION

Class II skeletal malocclusion is a common orthodontic problem, with one third of adolescents having this relationship (Cozza *et al.* 2006). This skeletal disharmony can be due to maxillary jaw prognathism or mandibular retrognathism, though the more common feature in this malocclusion is insufficient mandibular length (Graber *et al.* 2005). Several forms of treatment can be used to correct this discrepancy. Traditional forms include extra-oral appliances such as headgear, surgical procedures such as tooth extractions and orthognathic surgery, intraoral elastics, and functional orthopedic appliances. Each of these treatment modalities “differ in their effect on the skeletal structures of the craniofacial region, sometimes accelerating or limiting the growth of the various structures involved” (McNamara and Brudon 1993). Functional appliances may provide treatment for the growing patient with retrognathic profile features (Allen-Noble 2005).

The term “functional appliance” refers to the variety of removable and fixed appliances designed to alter the development of muscle groups that influence the function and position of the mandible. This is usually obtained by altering the mandible sagittally and vertically with the intent of creating orthodontic and orthopedic changes (Bishara 1989).

Functional appliances have been designed to position the mandible forward with the intent of enhancing mandibular growth. The mandible is directed into a protruded position and held there. Consequently, the condyle, also, is displaced anteriorly in its glenoid fossa. Proffit *et al.* state that, when using a functional appliance, “lengthening of the mandible has much less than the expected effect on Class II skeletal malocclusion because the temporomandibular joint (TMJ) remodels posteriorly at the same time the mandible is growing longer” (2007). Studies have shown that functional appliances have effectively enhanced growth of the mandible in skeletal Class II patients. Published research in humans has reported anterior and inferior relocation of the glenoid fossa, minor increased mandibular length, and posterior redirection of condylar growth associated with fixed functional appliance treatment (Popowich *et al.* 2003). Histological studies using laboratory animals have repeatedly shown an increase in cellular activity in the TMJ due to fixed functional appliance therapy (Woodside *et al.* 1987; Charlier *et al.* 1969).

Other investigators have discounted these statements, believing that redirection of mandibular growth does not occur in humans with functional appliance therapy. Some studies have suggested that the changes might be only those expected with normal growth or conventional edgewise therapy (Creekmore *et al.* 1983; Gianelly *et al.* 1983). Several researchers have considered that the Class II correction observed with functional appliances was caused by a “headgear” effect restraining maxillary growth along with a combination of dentoalveolar changes such as retroclination of the maxillary incisors and proclination of the mandibular incisors (Creekmore *et al.* 1983; Hotz 1970).

Several studies have analyzed condyle-fossa modification in human subjects with fixed functional appliance treatment. Most of the studies have used lateral cephalograms or computed tomography to measure mandibular growth in fixed functional appliance cases (Woodside *et al.* 1987; Voudouris *et al.* 2003; VanLaeken *et al.* 2006). These forms of radiography, however, have been shown to be inaccurate. Lateral cephalograms have been shown to vary from real values of objects over half the time (Hilgers *et al.* 2005), and computed tomography has been shown to be less diagnostic than cone beam computed tomography (CBCT) (Honey *et al.* 2007). No study has used CBCT images to measure TMJ changes in humans receiving fixed functional appliance treatment.

A fixed functional appliance used in clinical orthodontics is the mandibular anterior repositioning appliance (MARA). This appliance has increased in popularity over the last decade due to having similar results to the Herbst appliance while having less breakage and cheek irritation (Allen-Noble 2005). Due to its recent emergence in clinical orthodontics, few studies have evaluated the MARA.

The purpose of the present study was to obtain measurements of the condyle relative to the glenoid fossa in patients treated with the MARA. Pre- and post-treatment CBCT images were measured, and these changes were compared with those obtained from conventional Edgewise orthodontic treatment with Class II intermaxillary elastics.

CHAPTER 2. LITERATURE REVIEW

Structure of the Temporomandibular Joint

Introduction to the Joint

The articulation of the mandible with the cranium is unlike any other joint in the body. The mandible effectively bridges a bilateral articulation composed of left and right temporomandibular joints that form a functioning unit. Each joint influences the other, and each joint cannot function separately.

Each temporomandibular joint is a diarthroidial joint which permits more freedom of movement between the parts than in a fibrous joint (*i.e.*, suture) or gomphosis (*i.e.*, tooth in socket). The articular surfaces of the TMJs are made of tissues that are capable of bearing a compressive load and movement simultaneously. Because of the need to withstand compressive forces, the articular tissues are without blood vessels and nerve receptors in load bearing areas. The inner lining of the capsule that surrounds the articular tissues secretes synovial fluid to supply the nutrient needs to the nonvascularized articular tissues.

Each TMJ is compound, involving more than two bones. In the TMJ, the articular disc serves as the “third bone” (Bell 1982). In essence, each joint is a double joint composed of a lower ginglymoid joint and an upper arthroidial joint. The TMJ has been described as a hinge joint with a moveable socket (Sicher 1949). It is ginglymoid because the disc-condyle complex is a hinge joint, where the condyle articulates with the disc. It is arthroidial due to the disc-condyle complex sliding down the temporal bone. The lower joint is a hinge, while the upper joint is designed for sliding movement in any direction. The TMJ articulation is the only bilateral ginglymo-arthroidial joint in the human body.

The Condyle

The condyle is the portion of the mandible that articulated with the cranium, around which movement occurs (Okeson 2003). Although a considerable amount of variation exists in its morphology, the articular surface of the mandibular condyle is generally rounded and its long axis is oriented in a mediolateral direction (Graber 2005). The angle of this axis with the frontal plane varies from zero to thirty degrees (Öberg and Carlsson 1979). The articular surface of the condyle is quite convex anteroposteriorly and only slightly convex mediolaterally. The total mediolateral width of the condyle averages about 15 to 20 mm, and the anteroposterior width average is around 8 to 10 mm (Okeson 2003). The condyle's posterior margin extends farther than that of the anterior, which allows for greater posterior rotation of the articular disc (Bell 1982). The anterior and posterior portions of the articular surface slope down from a transverse ridge at the

most superior point of the condyle. From the anterior view, the condyle has a medial and lateral projection called poles. The medial pole is generally more prominent than the lateral pole. These poles are just below the articular surface and are marked by bony tubercles for the attachment of the capsule and disc (Okeson 2003).

Unlike articular surfaces in synovial joints, the condyle's articular surface is not composed of hyaline cartilage; instead, it consists of a dense fibrous connective tissue that is nonvascular and noninnervated. The tissue is quite thin over most of the articular surface, but thickens appreciably in the anterosuperior portion, indicating the area best suited to sustain biomechanical pressure (Öberg and Carlsson 1979; Bell 1982). In contrast with the articular area of growth plate cartilage, the cells of this fibrous connective tissue do not take part in condylar growth and remodeling, but only proliferate as needed to maintain the articular surface (Degroote 1984).

Petrovic *et al.* point out some additional differences between typical cartilage seen in long bones and the mandibular condyle (1975). The chondroblasts of primary cartilage is usually lined up in rows of cells, while the arrangement of condylar cartilage is much more erratic. Also, the prechondroblastic cells are dividing and proliferating in the condylar cartilage, while differentiated chondroblasts do the same in epiphyseal plates (Petrovic *et al.* 1975). The cells dividing in the condylar cartilage are those that are not yet synthesizing cartilaginous matrix.

Immediately below the dense collagenous articulating surface of the condyle is a region of undifferentiated mesenchyme from which the preosteoblasts and prechondroblasts proliferate (Petrovic *et al.* 1975; Öberg and Carlsson 1979; Bell 1982). These cells mature into osteoblasts in areas of slow growth, or into chondroblasts in areas of rapid growth (Öberg and Carlsson 1979). The chondroblasts quickly lose their ability to divide and hypertrophy, leaving a limited deposition of intracellular matrix in the deep part of the proliferative zone or zone of maturation (Petrovic *et al.* 1975). The matrix surrounding the cells in the lower part of the zone of maturation become calcified in a pericellular way (Degroote 1984). This pattern is in contrast to that in epiphyseal cartilage where calcification takes place along vertical lines of cartilaginous matrix.

In the zone of erosion, the chondroblasts degenerate and chondroclasts resorb the cartilaginous matrix that is replaced by endochondral bone. Resorption of this mineralized cartilage is mediated by chondroclasts which are closely associated with the terminal ends of the penetrating blood vessels (Durkin 1972). This is in contrast to the process in primary cartilage when capillaries enter to non-calcified portions of the cartilage while chondroclasts are resorbing the mineralized cartilaginous septa (Degroote 1984). The endochondral formation of bony trabeculae underneath the zone of erosion in the condyle also differs for primary cartilage where bone trabeculae are formed using the calcified cartilage as a matrix (Durkin *et al.* 1973).

Remodeling and Osseous Change

The tissues of the condyle serve the function of true articular cartilage due not only to their ability to withstand movement and a compressive load, but also their capability for regeneration and remodeling (Bell 1982). Structural adaptation of the articular surfaces of the temporomandibular joint is necessary for normal growth and development of the face as well as changing demands in function in the masticatory system throughout life (Öberg and Carlsson 1979; Bell 1982).

Remodeling in the TMJ may be classified as either progressive or regressive. Progressive remodeling involves the proliferation of tissue, while regressive remodeling is characterized by bony resorption. Remodeling is reflected by an increase in the activity of the cells of the proliferative zone, but the composition and thickness of the different cell layers varies in adults owing to the character and location of the remodeling processes. A cartilage layer exists throughout life superiorly and anteriorly on the condyle and posteroinferiorly on the articular eminence of the temporal bone due to the continued functional load (Öberg and Carlsson 1979). Studies have shown that natural changes occur more in the condylar surface than the temporal surface, while little or no remodeling occurs in the articular disc (Hansson *et al.* 1977).

The amount of compressive force acting on the tissue of the tissues of the TMJ is important in influencing the remodeling changes occurring within stress-bearing areas. Moderate loading facilitates normal remodeling, while excessive loading arrests remodeling and may induce metaplasia of the cartilage not only in the articular surface of the condyle but also the temporal surface as well. If compressive stress is even greater, localized resorption can occur (Bell 1982).

All remodeling changes are time dependent (Bell 1982). Time permitting, adaptive changes of the TMJ can occur, but if the demands for change are too rapid, degenerative remodeling may take place instead. Age is a factor related to this process. Adaptive processes are seemingly quite adequate during the developmental period and remain so well into adult life, but in later years the decrease in response suggests a serious decline in adaptive and regenerative capacity (Öberg and Carlsson 1979; Bell 1982). Tissues in older adults require more time than those of younger individuals to affect the same amount of change in the adaptive response.

Functional Appliances

History

Pierre Robin designed the earliest removable functional appliance in the early 20th century. Coined the “monoblock”, it was not intended for mandibular repositioning; its use was for passive positioning of the tongue in neonates with mandibular retrognathism and cleft lip and palate. Vigo Andresen, unaware of the Robin appliance,

created the activator in the 1920s, a passive tooth-borne appliance. He added a horseshoe flange to a Hawley retainer that guided the mandible three to four millimeters forward; this created a sagittal correction primarily in Class II, division I malocclusions (Graber *et al.* 2005). The functional regulator, designed by Fränkel in 1967, was the first tissue-borne removable appliance that stimulated mandibular repositioning. Clark designed the twin-block appliance in 1977, which consisted of maxillary and mandibular plates that guide the mandible forward when the patient closes (Proffit *et al.* 2007).

Emile Herbst introduced the Herbst appliance in the early 1900s. This was the first fixed functional appliance that was used as a bite-jumping device for Class II treatment. Pancherz reintroduced this appliance in the 1970s (VanLaecken *et al.* 2006). The appliance was designed to splint the maxilla and mandible with bonded bands connected by a pin and tube device that held the mandible forward. The appliance was modified to replace the bands with crowns in order to avoid breakage of the appliance (Proffit *et al.* 2007). The appliance treatment time was relatively short compared to previous removable functional appliances and required less patient cooperation since the appliance was fixed in the mouth.

Mandibular Anterior Repositioning Appliance

Douglas Toll of Germany designed the mandibular anterior repositioning appliance, a fixed functional appliance, in 1991. Jim Eckhart, a dentist in California, had been using functional appliances in the 1970s and 80s and sought an appliance that would minimize breakage and misplacement. He used the Herbst fixed functional appliance with some success, but patients were complaining of lip and cheek irritation. Eckhart and Toll experimented with improving the design (Allen-Noble 2005).

The MARA allegedly produces similar effects to the Herbst appliance: mandibular teeth move anterior, maxillary growth is restrained, the glenoid fossa is remodeled, and condylar growth is stimulated (Allen-Noble 2005). A basic MARA consists of the following parts (**Figure 2-1**):

1. Four crowns (or bands) on the first permanent molars,
2. Lower arms soldered to the lower molar crowns to help with positioning of the mandible and buccal cheek comfort,
3. Soldered maxillary and mandibular archwire tubes,
4. Maxillary elbow tubes for placement of MARA elbows,
5. Elbows that are placed with shims in the tubes to provide the amount of desired advancement, and

Figure 2-1. Schematized frontal view and description of MARA.

6. Lower lingual arch attached to lower molars, which is recommended in order to keep the lower molars from tipping mesially and lingually in response to the forces from the elbow.

This design can also be modified to include maxillary and/or mandibular expansion, a transpalatal arch, and adjustment loops for the lower lingual arch (Noble-Allen 2005).

The MARA has been used for various reasons to aid in orthodontic treatment. It is mainly considered for the advancement of the lower jaw in growing children when the position of the upper jaw is acceptable. The MARA also has a reported headgear effect, although it is less noticeable than with use of the Herbst appliance (Pangrazio-Kulbersh *et al.* 2003). The MARA can also be used on adult patients as an alternative if the patient declines orthognathic surgery; however, the change is more dental than skeletal (Allen-Noble 2005).

The MARA has some advantages over traditional functional appliances. Upon introduction of the appliance in the mouth, the profile immediately looks improved. Class II malocclusion are simply treated by inserting different length shims on either elbow, which also help in correcting Class II asymmetries. The MARA also gives a minimal distal movement and the desired mesiobuccal rotation to the maxillary first molars. In comparison to removable appliances, patient cooperation and treatment times are not an issue with the MARA because the appliance is fixed. The MARA also has few breakage concerns, and speech and hygiene are not a problem (Allen-Noble 2005).

In a study by Pangrazio-Kulbersh *et al.* (2003), the MARA was compared to the Herbst and Fränkel II appliances and to an untreated group. The authors used lateral cephalograms at pre- and posttreatment to measure the amount of dental and skeletal changes. The MARA provides more dentoalveolar changes than the Fränkel II appliance

while producing similar effects to the Herbst appliance. They did not study TMJ changes due to functional appliance treatment.

Temporomandibular Changes with Functional Appliances

Several studies have measured the amount of change in the temporomandibular joint under various conditions. These studies involving functional appliances have been initiated to determine the overall efficacy of functional appliances in correction of Class II dental and skeletal malocclusion, and they measure the TMJ to determine if there is any remodeling present.

Proponents of Condylar Remodeling and Modified Growth

In a study of primates, Woodside *et al.* (1987) examined the changes in the condyle and glenoid fossa following a period of gradually activated and constantly maintained advancement of the mandible using the Herbst appliance. The study consisted of six female and one male cynomolgus monkeys, comprised of five adolescents, one juvenile, and one adult subject. The advancement was achieved by adding stops to the telescopic arms of the appliance, with the total activation reaching 7.0 to 10.0 mm, dependent upon the span of the treatment. They measured patient lateral cephalograms pre- and posttreatment and observed decalcified histologic segments of the fossa and condyle in order to determine remodeling of the TMJ. The mandibular advancement was found to produce extensive remodeling and anterior relocation of the glenoid fossa, which contributed to anterior mandibular positioning and altered jaw relationships. The authors state that this remodeling of the glenoid fossa “may create the appearance of an increased mandibular length with or without a true increase”(p. 196).

In a well-documented study by McNamara *et al.* (1987), twenty-three male juvenile rhesus monkeys (*Macaca mulatta*) were used in an experimental study of long-term mandibular adaptations to induced protrusive function. Successive protrusive appliances were placed in 11 experimental animals and mandibular adaptations were monitored cephalometrically. Twelve animals were used as controls. After 48 weeks significant increases in increments of condylar growth and in overall mandibular length were noted in the treated animals. At the end of the 144-week experimental period, the mandibles of the treated animals were 5 to 6 mm longer than those of the control animals. Their results do not support the hypothesis that the mandible has a genetically predetermined length (McNamara *et al.* 1987).

Voudouris *et al.* (2003) also used the Herbst appliance in growing nonhuman primates, and the results were compared with primate and human controls. They used cephalometric analysis plus intravenous tetracycline vital staining, histological assessment, and electromyographic analysis to study the response of the glenoid fossa associated with continuous mandibular protrusion. All experimental primate subjects developed large super Class I malocclusions, the result of many factors including:

headgear effect on the maxillary arch and teeth, an improved horizontal component of condylar growth, and anterior displacement of the mandible and mandibular teeth. The growth modification measured in the glenoid fossa was in an inferior and anterior direction. The authors proposed that constraint of the downward and backward growth of the fossa, which was observed in the control subjects, might additionally contribute to the overall super Class I malocclusion. The authors state that these combined effects could be significant at the fossa; differences in the area and maximum thickness of new bone formation in the glenoid fossa and in condylar growth were statistically significant in experimental subjects. These bony changes in the condyle and the glenoid fossa were correlated with decreased postural electromyographic activity during the experimental period. Results from permanently implanted electromyographic sensors in the primates established that lateral pterygoid muscle hyperactivity was not linked with condyle and glenoid fossa growth modification with functional appliances, and that stretch forces along the fibrocartilage between the displaced condyle and fossa might play a more significant role in new bone formation. This study reaffirmed the growth relativity theory, which states that the stretched soft tissues surrounding the condyle and the glenoid fossa contribute to bone growth (Voudouris *et al.* 2000).

Ruf *et al.* (1999) analyzed and compared the TMJ adaptive mechanisms in 25 adolescent and 14 young adults with Class II malocclusions treated with the Herbst appliance. TMJ remodeling was analyzed by magnetic resonance imaging (MRI). In each subject, 4 magnetic resonance images of both temporomandibular joints were available: before treatment, at the initiation of treatment (when the Herbst appliance was placed), during treatment (6 to 12 weeks after appliance placement), and after treatment (when the appliance was removed). In addition, effective temporomandibular joint changes (the sum of condylar remodeling, fossa remodeling, and condyle-fossa relationship changes) were analyzed with the aid of lateral cephalometric radiographs from before and after treatment. All subjects were treated to a Class I (or overcorrected Class I) dental arch relationship, and their mandibles became significantly more prognathic. After 6 to 12 weeks of Herbst treatment, signs of condylar remodeling were seen at the posterosuperior border in 48 of the 50 adolescent condyles and in 26 of the 28 young adult condyles. Indications of glenoid fossa remodeling at the anterior surface of the postglenoid spine were noted in 36 adolescent and 22 young adult temporomandibular joints. Bilateral remodeling of the mandibular ramus could be detected in 1 adolescent and 2 young adult patients. TMJ changes during treatment were more horizontally directed and larger in both adolescents and young adult patients treated with the Herbst appliance than in an untreated group of subjects with ideal occlusion. The authors believe that mandibular retrognathism correction achieved by Herbst therapy in both adolescents and young adults seemed, in particular, to be a result of condylar and glenoid fossa remodeling. MRI rendered better visualization of the temporomandibular joint remodeling growth processes than traditional radiography such as lateral cephalograms (Ruf *et al.* 1999).

VanLaecken *et al.* (2006) studied 32 subjects (18 females and 14 males) treated with the edgewise Herbst appliance by one of the authors. The position of the condyle relative to the glenoid fossa was determined by using horizontally corrected axis tomograms taken pretreatment and posttreatment. At the end of Herbst treatment, the

tomograms showed only 0.2 mm of forward movement of the condyle within the fossa with no significant change in joint space. The minimal change in the condylar position relative to the fossa suggests a combination of fossa remodeling and redirection of condylar growth after Herbst treatment (VanLaecken *et al.* 2006).

Rabie *et al.* (2002) designed a study to identify the relationship between vascularization and bone formation in the glenoid fossa during natural growth and functional appliance therapy. The sequential pattern of vascular endothelial growth factor (VEGF) expression and bone formation in the glenoid fossa during normal growth was identified and compared with that during forward mandibular positioning with a functional appliance. A close correlation has been found between vascularization and bone formation (Rabie *et al.* 2002). They used 150 female Sprague-Dawley rats averaging 35 days old, and split the subjects into 10 experimental and 10 control groups. Appliances were fitted to position the mandible forward in the experimental groups. The rats were then sectioned and stained with anti-VEGF antibodies to evaluate VEGF expression, and new bone formation was evaluated using Schiff's reagent. The results demonstrated that, during normal growth and forward mandibular positioning, VEGF expression and new bone formation were highest in the posterior region of the glenoid fossa, and significant increases of VEGF and new bone formation were seen in the experimental groups compared with the controls. The highest amount of VEGF expression occurred before the highest amount of bone formation was reached. The authors concluded that forward mandibular positioning cause significant increases in vascularization and new bone formation in the glenoid fossa (Rabie *et al.* 2002).

In a classic study by Pancherz and Ruf (1998), the authors intended to discover tempormandibular growth adaptation due to Herbst treatment by evaluating condylar remodeling, glenoid fossa remodeling, and condyle-fossa relationship changes. The sample included consecutively treated patients with Class II malocclusion and full permanent dentition. Based on hand-wrist radiographs to determine skeletal maturity, the sample was subdivided into adolescents (12 girls, 13 boys) with a mean age of 12.8 years (range, 11.4-15.7) and young adults (19 girls, 4 boys) with a mean age of 16.5 years (range, 13.6-19.8). Parasagittal MRIs were obtained pretreatment, shortly after appliance placement, 6 to 12 weeks after appliance placement, and shortly after appliance removal. They reported "signs of remodeling" described as bone apposition, being the greatest at the inferior part of the glenoid spine. They also noted a slight flattening of the spine. In terms of condyle remodeling, they found that the young adult group had a "double contour" in the superior posterior region of the condylar head, while the adolescents had no change. They also found that the condylar position in the fossa remained unaffected on average.

Opponents of Functional Appliance Therapy

Proponents of functional appliance therapy claim that propulsion on the mandible forward will cause a shift in condylar growth potential that would have not been achieved with conventional, full-banded orthodontic treatment. The following studies argue that

the mandible has a genetically predetermined length and that conventional orthodontic therapy can correct the Class II skeletal patient.

According to Lysle Johnston (1998), the amount an individual can be anticipated to grow during treatment might or might not depend on the particular mode of treatment, yet growth is partly a function of age, sex, and time of treatment. Growth curves from any of the large growth studies (Burlington, Bolton, or Michigan) can provide good estimates of growth intensity. Johnston (1998) studied facial growth from lateral cephalograms of 120 Class II, division 1 patients treated between 1969 and 1980 at St. Louis University as part of a long term comparison between non-extraction and extraction edgewise therapy. Only 12 of the 120 patients studied showed the mandible failing to advance relative to the maxilla during treatment. Six of these 12 were treated by extraction therapy and six were treated by non-extraction therapy. This and thirty years of clinical experience led Johnston to conclude that most Class II patients show a favorable growth pattern during conventional orthodontic treatment (Johnston 1998).

Hotz (1970) described cases that he had treated using a removable functional appliance that was similar to the Andresen activator. These cases were Class II, division I patients that had been treated using the functional appliance, a lower lingual arch, and intermaxillary Class II elastics. While some patients responded with mandibular growth, he concluded that most of the correction was due to dental correction with incisor tipping (Hotz 1970).

Creekmore (1983) compared pre- and posttreatment lateral cephalograms of 20 growing children who had either Class I or Class II Fränkel functional regulator therapy to 50 patients who had undergone conventional orthodontic banding with headgear and an untreated control sample. All of the treated subjects had full Class I correction from whichever mode of therapy was given. He found that there was no significant difference in the forward growth of the mandible in the Class I Frankel, Class II Frankel, and untreated samples. In the edgewise-treated sample the mandible came forward 1 mm less than in the other samples and was statistically significant. The Class II Frankel sample demonstrated a significant reduction in the ANB angle as compared to the untreated sample, and this reduction was significantly less than the reduction that occurred from edgewise treatment. He also noted that the increased protraction of the mandible in the Class II Fränkel sample, compared to the Class I sample, made no significant difference in yearly growth increments for mandibular length, maxillary length, maxillomandibular differential, and lower face height. The horizontal component of growth or movement of the condyle was significantly greater for the Fränkel samples as compared to the edgewise sample, which, in turn, was significantly greater than the untreated sample. The significance of the increased horizontal component is that the direction of condylar growth is more backward for the treated samples. Condylar growth for the Class II Fränkel sample was 8.5 mm at 35 degrees from the vertical, whereas for the untreated control it was 7.4 mm at 13 degrees. However, he argues that if the correction was completely orthopedic, then the amount of condylar growth should have averaged about 13 mm rather than 8.5 mm. He concluded that many of the skeletal changes attributed to treatment occur in untreated persons, and many of the changes are found with equal

facility in the edgewise-treated cases (Creekmore 1983).

Gianelly *et al.* (1983) also compared functional appliance wear to conventional banded orthodontic therapy. They evaluated laminographs pre- and posttreatment of 10 Class II, division 1 patients between the ages of 9 and 13 that wore Fränkel functional regulators for one year. They compared this sample to a sample of 15 Class II, division 1 growing patients that underwent fixed orthodontics with cervical traction. They found a wide range of mandibular growth in both groups, but the average growth for both groups was the same (2.4 mm). SNB also did not change significantly before and after treatment for the Fränkel group. They also measured the amount of space between the most superior point of the condyle and fossa before and after treatment, and they used a leaf gauge to determine whether the condyle was fully seated in the fossa. They found that 6 of the 10 Fränkel subjects did not present with the condyle fully seated in the fossa after appliance therapy, and the average supracondylar space increased by 1.0 mm. Therefore, the authors argue that fixed banded appliances show the same amount of mandibular growth with no increases in condylar space, unlike removable functional appliance wear (Gianelly *et al.* 1983).

Cone Beam Computed Tomography

Modern updates in cone beam computed tomography (CBCT) show potential for future developments in craniofacial imaging. With radiation doses being lower than those of classical computed tomography (CT) imaging, they allow the clinician a viable option of viewing craniofacial structures 3 dimensions. There are several applications in the field of orthodontics (Baumrind 2011).

Like any diagnostic imaging field, there are both advantages and disadvantages of CBCT. The tremendous advantage is that it greatly increases the information about the craniofacial morphology of individual patients that is available to clinicians and clinical investigators. Once the volumetric dataset has been constructed, it can be sliced in any number of desired planes to produce projection images of all the types with which we are already familiar. These include pseudo lateral and frontal cephalograms, panoramic images, or individual periapical images. Moreover, it can also produce types of images that were never possible before, including thin slices through the volume without confounding overlap from structures in front of or behind the slice. Images of this sort can be oriented in any desired plane and are especially valuable for the analysis of temporomandibular joint disorders. The system can also produce projection images of regions of the head with other confounding structures digitally dissected away—for example the condyle separated from the glenoid fossa. Planar images viewed from different perspective—sagittal, para-sagittal, coronal, or oblique—can be generated as desired. It is also possible to produce lateral cephalograms that remove material from one side of the midsagittal plane, allowing the buccal segment dentition on the remaining side to be viewed without overlap from the other side. In addition, the future of this technology is bright, as many new ways of slicing the volumetric dataset will be

developed by innovative clinicians, intended to meet the needs of the clinical practice (Baumrind 2011).

Efficacy of CBCT in Measuring the TMJ

The most commonly used radiographs to assess the temporomandibular joint are panoramic radiographs, transcranial projections, and tomography (Honey *et al.* 2007). Several authors have reported high accuracy in using CBCT to evaluate the TMJ region.

Honey *et al.* (2007) conducted a cross-sectional in-vitro study to compare the diagnostic accuracy of observers viewing images made with CBCT, panoramic radiography, and linear tomography. They measured this by detecting cortical erosions affecting the mandibular condylar head. The sample consisted of 37 TMJ articulations from 30 skulls with either normal condylar morphology or erosion of the lateral pole. They used corrected linear tomography (TOMO), normal and TMJ-specific panoramic radiography, and CBCT in order to image the TMJ region. Images and ten rereads were presented to ten observers on a flat-panel display. CBCT multi-planar images were presented both statically (CBCT-S) and interactively (CBCT-I). The observers were permitted to scroll through axial (0.4 mm) and para-sagittal (1 mm) sections and then independently rate their confidence about the presence or absence of cortical erosion of the TMJ. Pan-N, CBCT-I, and CBCT-S reliability was significantly greater than TOMO. The diagnostic accuracy of CBCT-I and CBCT-S was significantly greater than all other modalities. The authors concluded that CBCT images provide superior reliability and greater accuracy than TOMO and TMJ panoramic projections in the detection of condylar cortical erosion (Honey *et al.* 2007).

Hilgers *et al.* (2005) compared TMJ measurements between iCat CBCT and conventional cephalograms. They used true anatomical sites in dried human skull and compared the true measurements to those found using three orthogonal planes— lateral cephalometric, posteroanterior, and submentovertex— in CBCT and conventional radiographic images. They found that all CBCT images were highly accurate, but over half of the conventional films varied significantly from real values. The authors concluded that custom oblique multi-planar reformatted reconstructions with iCAT CBCT provide accurate and reliable linear measurements of mandibular and TMJ dimensions (Hilgers *et al.* 2005).

Purpose of the Study

An ongoing debate exists in orthodontics about the amount of condyle-fossa remodeling and growth seen in patients using functional appliance therapy. While some clinicians and researchers have found that the use of functional appliances increases the amount of condylar growth and subsequent Class II skeletal correction, others believe that the mandible has a preset amount of growth and that conventional orthodontics will result in a similar amount of condylar growth to functional appliance therapy. The

purpose of this study is to reintroduce this debate by comparing condylar remodeling in functional appliance therapy to conventional fixed orthodontic therapy by measuring changes using CBCT, a more accurate imaging tool than conventional radiography used in the past. We will be looking at changes induced by the MARA, which has not been studied at depth in the condylar region, to conventional full orthodontic treatment using intermaxillary elastics.

CHAPTER 3. MATERIALS AND METHODS

Study Design

The present study was a retrospective analysis of cone beam computed tomography images taken on subjects with Class II malocclusions at the beginning and end of their comprehensive orthodontic treatment. These adolescents received non-extraction treatment with a MARA followed by or coinciding with full fixed Edgewise appliance treatment. Subjects' ages were between nine and fourteen years of age at the initiation of treatment. The study was limited to Class II, division 1 malocclusions by choosing Caucasian subjects with an overjet of at least 3.5 mm and ANB greater than 4 degrees. Patients must have taken the image in maximum intercuspation, and patients with open bites or posterior crossbites were not used due to functional deviations of the condyles. Any patient with a craniofacial anomaly was also excluded from this study. The CBCT images were available at the beginning and end of treatment with the MARA plus conventional Edgewise orthodontic treatment. Thirty-three subjects' records (13 females, 20 males; average age 11.93 years) were acquired from the office of Dr. James K. Dillehay, Wichita, Kansas, who treated all of these MARA cases (from this point known as *Kansas*). The conventional Edgewise-only group consisted of a sample of thirty-one subjects (18 females, 13 males; average age 12.37 years) with Class II malocclusions treated non-extraction with full fixed conventional orthodontic appliances from the office of Dr. Daniel R. Merwin, Jackson, Tennessee (from this point known as *Tennessee*).

The CBCT scans were evaluated using Dolphin 3D (Dolphin Imaging and Management Solutions, Chatsworth, CA). Dolphin 11 is the version that incorporates the 3D module. Each image (pre- and posttreatment) was evaluated at both the right and left TMJ in the axial, sagittal, and frontal planes.

Axial Dimension

Axial plane reconstruction of the condyles was done in the TMJ module of Dolphin 11. First, the CBCT image was oriented in Frankfort Horizontal using Dolphin 11 software. The TMJ module was entered within Dolphin 11, and the axial representation of the image was shown. The axial slice was evaluated where both the right and left condylar heads were viewed in their greatest area dimension. Then, the images were exported into ImageJ64 (NIH, version 1.44 for the PC) for obtaining measurements.

Landmarks

Landmarks used in the axial plane were referenced in Kang *et al.* (2010) and Rodrigues *et al.* (2009). The following anatomic landmarks were used for measuring the condyles in the axial plane:

1. Vomer: an unpaired facial bone in the midsagittal plane that rests between the left and right nasal cavities.
2. Clivus: part of the cranium in the midsagittal plane that is a shallow depression sitting just posterior to the sphenoid sinus.
3. Center of the condyle: geometric center of the condylar heads in the axial plane.

Linear Measurements

Linear measurements of the condyles in the axial plane were measured by exporting the images into ImageJ64 with a read-out precise to 0.1 mm. These measurements were taken from Rodrigues *et al.* (2009) in evaluating the TMJ using CBCT images:

1. Mid-Sagittal Plane (MSP): line connecting the vomer and clivus that separates the face into equal left and right sections.
2. Mediolateral width of left (ML^l) and right (ML^r) condyles: greatest length from medial to lateral pole of condyle.
3. Anteroposterior width of left (AP^l) and right (AP^r) condyles: greatest length anteroposteriorly of condyle in axial plane.
4. Mediolateral condylar position: measurement from the center of the condyle to the mid sagittal plane perpendicularly (**Figure 3-1**).
5. Anteroposterior condylar difference: difference in right and left condylar position as reflected on the midsagittal plane.

The pre- and posttreatment images were compared. The widths of the condyle were measured to determine any change in the condylar head during treatment. The condyles were referenced to the midsagittal plane to determine any mediolateral positional changes due to functional treatment. The anteroposterior condylar difference was measured from the pretreatment records to determine any jaw asymmetry, and this was compared to the post-treatment image to see if the asymmetry was corrected.

Figure 3-1. Measure of condylar distance from the midsagittal plane and the measure of the anteroposterior bilateral asymmetry present.

Angular Measurements

Angular measurements of the condyles in the axial plane will be measured by exporting the images into ImageJ64. The measurement used as referenced by Rodrigues *et al.* (2009) accounts for the angulation of the condylar head (**Figure 3-2**):

1. Condylar angulation: angle formed by the mid-sagittal plane and the line connecting the medial and lateral poles of the condylar head.
2. The change in angulation between pre- and post-treatment condyles should be minimal, unless there is correction in asymmetric patients.

Area Measurements

Area measurements of the condyle in the axial plane were calculated by making different axial slices in the TMJ module. The condyle in these slices was cut and exported into ImageJ64 to measure the area. This measurement was used as stated by Meng *et al.* (2008) in comparing TMJ morphology of children and adults: Largest area of the condylar process (LACP) - area of the condyle in its greatest dimension in the axial plane.

This measurement will be compared in pre- and posttreatment images to determine any changes in the area of the left and right condylar processes in these 2 planes. Changes in the condylar head could provide support for TMJ remodeling.

Figure 3-2. Condylar angulation, anteroposterior width of condyles, and mediolateral width of condyles.

Sagittal Dimension

Sagittal plane reconstruction of the TMJ was done first by referencing the condyles in the axial plane in the TMJ module of Dolphin 11, as stated before in axial reconstruction. The axial image was used to find the axial slice where both the right and left condylar heads are viewed at their greatest area dimension. A reference slice was drawn through the condyle that separated it into equal medial and lateral sections and also accounted for the angle of the condylar head to the midsagittal plane. This slice was processed in both the right and left condyle to produce the proper images for measuring in the “condylar-corrected” sagittal plane for the right and left condyles.

Landmarks

Most of the landmarks for the sagittal plane were taken from Cho *et al.* (2009). He and his colleagues used panoramic radiographs to determine condylar differences in temporomandibular osteoarthritic patients and asymptomatic normal patients. These landmarks were used for the corrected sagittal plane measurements.

1. Cd (Condylion): most superior point on condylar head.
2. Cd⁰: most posterior point on condyle on ramus.

3. Cdⁱ: internal point of condyle formed from the perpendicular of the posterior ramus tangent at Cd^o.
4. Cd^c: center of condyle between Co^o and Coⁱ.
5. Sigmoid notch (Inc): most inferior aspect of mandible between condyle and coronoid notch.
6. Inc': point describing the level of the sigmoid notch measured perpendicular to the posterior ramus tangent.

The following landmarks were taken from Rodrigues *et al.* (2009) in evaluating the TMJ in Class II and Class III patients:

1. Articular Eminence (AE): the most inferior point of the articular eminence.
2. External auditory meatus (EAM): circular radiolucency defining the orifice of the external ear.

Ikeda *et al.* (2009) used the following landmark, superior aspect of glenoid foss (SF), in evaluating ideal condylar position using limited CBCT imaging.

Linear Measurements

Linear measurements were taken in the sagittal plane using the aforementioned landmarks. The images gathered from the corrected sagittal plane reconstruction were measured in the Dolphin 11 TMJ module with the measurement tool with accurate measurements to 0.1 mm. The following linear measurements used were taken from Rodrigues *et al.* (2009) (**Figure 3-3**):

1. Anterior Joint Space (AJS): shortest distance between the most anterior part of condyle and the posterior wall of the articular eminence.
2. Superior Joint Space (SJS): distance from Cd to SF.
3. Posterior Joint Space (PJS): shortest distance between the most posterior part of condyle and the posterior wall of the glenoid fossa.
4. Fossa Width: measured from AE to the most inferior point of the EAM (EAMⁱ).
5. Fossa Depth: measured from SF to the plane formed by the fossa width.

Joint space was measured in pre- and post-treatment images to determine that the condyles were seated properly in the glenoid fossa and that bony apposition of the fossa

Figure 3-3. Joint spaces between condyle and glenoid fossa.

has taken place with advancement of the condyle. Fossa width and depth were measured to show any changes of the fossa in relation to the external auditory meatus (**Figure 3-4**).

The following measurements used were taken from Cho *et al.* (2009) (**Figures 3-5 and 3-6**):

1. Condylar Head Width (CHW): measurement from Cd^o to Cdⁱ.
2. Condylar Head Height (CHH): measurement from Cd to Cd^c.
3. Condylar Height (CH): measurement from Cd to the plane formed from Inc to Inc'.

The following measurements were taken in order to compare the pre- and post-treatment changes seen in the CBCT images taken for each individual: Measurement from EAMⁱ to

1. AE.
2. Cd^c.
3. Posterior wall of glenoid fossa measured from PJS.

The external auditory meatus was used as a reference point due to its relatively constant position posterior to the glenoid fossa (Ricketts 1950). These measurements disclosed any advancement seen in the condyles following treatment. If stable advancement of the condyle was seen, there should be a relatively similar increase in all of the linear measurements. Changes seen in condylar position were verified by superimposing pre- and post-treatment images using the EAM to determine the validity of the axially measured condylar advancement.

Angular Measurements

Angular measurements of the condyles in the sagittal plane were measured by exporting the images into ImageJ64. These angles were used in the condylar-corrected sagittal plane to measure the change of the position of the condylar head and fossa:

1. Articular Tubercle Angle (ATA): angle formed from line connecting the EAMⁱ to the AE and the line from the SF to the AE (**Figure 3-7**).
2. Condylar Head Angle (CHA): angle formed from a line intersecting the condylar process to Cd^c and the line formed by connecting Cd to Cd^c.

The ATA dimension disclosed any changes in the posterior slope of the articular eminence (condylar path) due to functional appliance treatment. The CHA indicated

Figure 3-4. Glenoid fossa depth and height.

Figure 3-5. Condylar head width and height.

Figure 3-6. Condylar height.

Figure 3-7. Articular tubercle angle (ATA).

whether a change occurred in the angle of the condylar process due to bony remodeling of the condylar head.

Area Measurements

Area measurements were constructed in Dolphin 11. Segmentation was used to cut out a specific portion of the CBCT image, and then the cut was exported to ImageJ64 to calculate the area measurements. The following measurements were used to evaluate area measurements in the condylar region (**Figure 3-8**):

1. Area of condylar process (ACP): measured from the outline of the condyle superior to Inc and Inc'.
2. Area of the Articular Eminence (AAE): measured from the outline of the articular eminence inferior to the SF posteriorly and to the point formed by the plane connecting the SF and most superior point of the EAM (EAM^s) on the anterior portion of the articular eminence.
3. Area of the Glenoid Fossa (AGF): measured from the outline of the glenoid fossa superior to the plane formed from the fossa width.

Calculating the areas of these temporomandibular regions gives an understanding of whether TMJ remodeling takes place in functional appliance therapy with the MARA. If stable condylar advancement and remodeling is seen, anticipated in-treatment outcomes should be seen in MARA cases: decreased area of the articular eminence (anterior resorption) and relatively little change in the area of the glenoid fossa. If the AGF has increased, treatment may not be stable due to no posterior bony apposition of

Figure 3-8. Showing the measurements of area of condylar process (AC), area of articular eminence (AAE) and area of glenoid fossa (AGF).

the glenoid fossa and a “double bite” may be present. The area of the condylar process may or may not change with TMJ remodeling.

Coronal Dimension

The coronal plane was reconstructed using the above process for determining the sagittal plane. Once the “condylar-corrected” sagittal plane had been constructed in the TMJ module in Dolphin 11, a coronal slice was placed through the widest aspect of each condyle mediolaterally to produce the coronal image.

As previously done in the sagittal plane, measurements were recorded using the measuring tool in the TMJ module of Dolphin 11. These measurements were taken in the coronal plane to determine joint space in the coronal aspect of the TMJ (**Figure 3-9**):

1. Medial Joint Space (MJS): shortest distance from the most medial aspect of the condylar head to the medial wall of the glenoid fossa.
2. Superior Joint Space (SJS): distance from Cd to SF.
3. Lateral Joint space (LJS): shortest distance from the lateral aspect of the condyle to the lateral wall of the glenoid fossa.

The measurement of these joint spaces has not been previously measured using other conventional forms of radiography. These measurements show any changes to the TMJ in the coronal plane in MARA treatment.

Figure 3-9. Joint space in the coronal plane.

Lateral Cephalometric Dimension

A lateral cephalometric image can be constructed in Dolphin 11 from the full CBCT image. First, the image must be oriented to Frankfort Horizontal. The image can then be measured with the Dolphin 11 software.

Landmarks

The landmarks used on the lateral cephalogram for measurement, as described by Athanasiou (1995), are as follows (**Figure 3-10**):

1. Nasion (Na): the most anterior point on the frontonasal suture.
2. Subspinale (A point): the most posterior point on the curvature of the anterior maxilla.
3. Supramentale (B Point): the most posterior point on the curvature of the anterior mandible.
4. Sella (Se): the center of the hypophyseal fossa (sella turcica).
5. Incision superius (Is): the incisal edge of the most anterior maxillary incisor.
6. Incision inferius (Ii): the incisal edge of the most anterior mandibular incisor.
7. Pterygomaxillary Fissure (Pt): the most superoposterior point of the pterygomaxillary fissure.
8. M point: the most posterior point of the mandibular symphysis.
9. U6C: the tip of the mesiobuccal cusp of the maxillary first molar.
10. L6C: the tip of the mesiobuccal cusp of the mandibular first molar.
11. Functional occlusal plane: line representing position and anteroposterior cant of the occlusal plane drawn through the occlusal contacts of the premolars and first molar.

Linear Measurements

The linear measurements described were measured in Dolphin 11. The following measurements will be taken on pre- and posttreatment images (**Figures 3-11 and 3-12**):

Figure 3-10. Cephalometric landmarks.

Figure 3-11. Illustration showing incisor overjet and overbite.

Figure 3-12. Illustration of the cephalometric measurement Pterygoid-Vertical to M point, where M is the distal-most aspect of the mandibular symphysis.

1. Incisal overjet: the horizontal measurement of the maxillary and mandibular incisal edges as related to the occlusal plane.
2. Incisal overbite: the vertical measurement of the maxillary and mandibular incisors as related to the occlusal plane.
3. Molar relationship: the horizontal measurement of U6 to L6 referenced to the occlusal plane.
4. Total mandibular advancement: linear distance from Sella-V to m point when projected perpendicular to the Frankfort horizontal plane.

Incisal overjet, overbite, and molar relationship were used to evaluate, compare, and equilibrate the two sample groups. Total mandibular advancement was evaluated to show the amount of horizontal advancement of the mandible as related to a stable cranial orthodontic landmark (sella).

Angular Measurements

Angular measurements were measured in Dolphin 11. These angular measurements were taken from both the pre- and posttreatment examinations:

1. SNA: position of the maxilla to the skull base (**Figure 3-13**).
2. SNB: position of the mandible to the skull base (**Figure 3-14**).
3. ANB: relation of the maxilla to the mandible.

These measurements were used to evaluate, equilibrate, and compare the two study groups.

Statistical Design

In order to remove any bias, subjects' images were categorized, numbered and randomized by an independent evaluator. A separate evaluator recorded all the measurements. Measurements were remeasured on a number of random images (twelve) two months later to calculate intraoperator reliability.

Measurements will be exported into a spreadsheet in Microsoft® Excel 2008 (Microsoft Corporation, Redmond, WA). The spreadsheet was used to combine patient information including demographic information (patient's age, sex, jaw asymmetry, functional or conventional treatment). The measurements were then transferred to the statistical package JMP® 9.0 (SAS Institute Inc., Cary, NC). Analysis of covariance

Figure 3-13. Illustration of the cephalometric measurement SNA.

Figure 3-14. Illustration of the cephalometric measurement SNB.

(ANCOVA) was used to simultaneously test for an age difference (the covariate) while controlling for sexual dimorphism. **Appendices A-D** show the overall statistical analysis of the study.

CHAPTER 4. RESULTS

Initial Group Comparability

It seemed important early on in the analysis to document the comparability of the malocclusions. That is, at the start of treatment (before any intervention) that the nature of the malocclusions were comparable. To test this, a two-way factorial ANOVA model was used (**Table 4-1**), where one of the factors was “treatment” (Edgewise mechanics with or without a MARA). The second factor was sex (boy, girl). The full model was calculated, so the interaction effect (treatment-by-sex) was included. There were, then, three F ratio tests for each of the seven cephalometric variables. It is noteworthy that none of these statistical tests was significant ($\alpha = 0.05$, two-tail tests). This comprehensive absence of statistical differences argues for the equal conditions of the initial malocclusions between groups.

Intraobserver Repeatability

It was considered important to quantify the level of intraobserver repeatability (also commonly termed TEM, technical error of measurement) for this study.

The perspective used here is that it is impossible for repeated measurements of the same object to be identical (*e.g.*, Houston 1983; Houston *et al.* 1986). Differences are due in part to human (operator) differences in landmark selection, personal definitions of the variable—that can change over time—and the level of precision (significant digits) recorded (Houston 1983; Houston *et al.* 1986). Another component of the repeatability differences is the measuring instrument. All have some fixed level of digits, beyond which they are not reliable, and machines (calipers, computers) do not always measure consistently or equally precisely in all planes of space. Instrument errors actually can be viewed as coming from two sources, random error and systematic error. Random error occurs because our system of measurements is limited to fixed increments. Systematic errors occur because there is a problem with the instrument. As an example, readings from a computer program where the screen setting is distorted or not at the correct screen resolution will produce false values. If calipers have been bent, they will yield systematically larger or smaller values than the correct ones (*e.g.*, Harris and Smith 2009).

It is valuable to quantify the extent of intraobserver reliability (termed Technical Error of Measurement, TEM) because TEM shows the opportunity for imprecision. It is hoped that repeated measurements would be precise and accurate. Precision (repeatability, reproducibility) is a measure of how consistent (close together) measurements are of the same object. Vierira and Corrente (2011, p 488) stated: “By definition, repeatability is the closeness of agreement between successive readings obtained by the same method on the same material and under the same condition (same operator, same apparatus, same setting and same time).” Accuracy is how closely the

Table 4-1. Two-way factorial ANOVA models testing for comparability of the malocclusions at the initial records examinations.

Malocclusion	Treatment		Patient's Sex		Treatment-by-Sex	
	F Ratio	P Value	F Ratio	P Value	F Ratio	P Value
SNA	0.00	0.9618	0.21	0.6489	0.71	0.4028
SNB	0.01	0.9249	0.02	0.8938	0.26	0.6093
ANB	0.10	0.7588	0.51	0.4772	0.66	0.4191
Overbite	0.20	0.6559	0.03	0.8572	0.03	0.8558
Overjet	0.44	0.5114	0.00	0.9792	1.06	0.3085
Molar Relation	0.55	0.4619	2.92	0.0928	0.00	0.9528
Sella-Vertical-to-M	0.75	0.3900	0.21	0.6450	1.46	0.2320

measured values are to the true value. Using the commonly referenced target analogy (**Figure 4-1**), measurements can be precise but not accurate. Or, they can be accurate but not precise. The goal, of course, is for the measurements to be both precise and accurate, so TEM is small—less than the supposed intergroup differences. This ensures that non-biological TEM effects do not unduly influence the observed biological differences.

It can be hard to determine a quantity's true value, but the larger the sample size, the closer we can get to the true size.

This section of Results analyzed a set of replicate measurements. From the original set of 64 cases, 12 (~ 20%) were remeasured several months later while blinded to the subject's original readings. All variables were remeasured on these 12 cases, so there was a sample size of 12 x 112 or 1,344 replicated pairs of numbers.

Systematic Error

One possibility is that the second set of measurements was systematically different from the first, perhaps because the operator's opinion of where a landmark was located had changed during the interim. Matched (paired) t-tests were used to test for this (two-tail tests).

Random Error

The conventional Dahlberg statistic (Dahlberg 1940) calculated for each variable as:

$$d = \sqrt{\frac{\sum_{i=1}^n (X_{1i} - X_{2i})^2}{2n}}$$

where X_{1j} and X_{2j} are the two measurements for subject j and n is the number of replicated (pairs of) subjects (Dahlberg 1940; Midtgård *et al.* 1974; Knapp 1992). The difference is squared to make them all positive. This is not the mean difference of the measurement error as sometimes claimed; it is the standard error of the measurement difference (Altman and Bland 1983; Bland and Altman 1996, 1999, 2003).

We put considerable reliance on the Dahlberg statistic (**Table 4-2**), but we have also been swayed by the arguments of Vierira and Corrente (2011). They point out that the Dahlberg statistic only holds when the readings are (1) independent, (2) identically distributed random variables, and (3) the average of the differences between readings is on average zero.

The first effort here was to evaluate all 112 variables using paired t tests. Paired t tests are more efficient than group comparison t tests when the data—as here—are

Figure 4-1. A metaphor of a ‘bull’s eye’ characterizes the concepts of precision and accuracy.

(A) The mean of the measurements is close to the center of the bull’s eye, which is the true value. These measurements have low repeatability, however, because of their scatter and individual departures from the true value. (B) The measurements are close together (good precision), but all are approximately equally biased from the true value. For example, calipers might be out of kilter, so all measurements are exaggerated by, say, 0.1 mm. (C) Here the measurements are all close to the measurement (high accuracy) and close to one another (high precision). Modified with permission. Harris EF, Smith RN. Accounting for measurement error: A critical but often overlooked process. Arch Oral Biol 2009, 54, Supplement 1:107-17.

Table 4-2. Listing of the Dahlberg statistic for the 112 variables when remeasured.

Variable	Sample Size	Dahlberg Statistic
ANB Final	12	0.1979
ANB Initial	12	0.1791
Axial AP L Final	12	0.1756
Axial AP L Initial	12	0.3007
Axial AP R Final	12	0.3240
Axial AP R Initial	12	0.3096
Axial APCD Final	12	0.4168
Axial APCD Initial	12	0.4865
Axial CA L Final	12	2.0164
Axial CA L Initial	12	1.7548
Axial CA R Final	12	1.2450
Axial CA R Initial	12	1.3563
Axial LACP L Final	12	5.5403
Axial LACP L Initial	12	3.2763
Axial LACP R Final	12	5.6657
Axial LACP R Initial	12	3.9814
Axial ML L Final	12	0.3149
Axial ML L Initial	12	0.3464
Axial ML R Final	12	0.4052
Axial ML R Initial	12	0.4098
Axial MLCP L Final	12	0.5730
Axial MLCP L Initial	12	0.4486
Axial MLCP R Final	12	0.7613
Axial MLCP R Initial	12	0.4349
Condylar LJS L Final	12	0.1190
Condylar LJS L Initial	12	0.1137
Condylar LJS R Final	12	0.1291
Condylar LJS R Initial	12	0.0707
Condylar MJS L Final	12	0.1671
Condylar MJS L Initial	12	0.1173
Condylar MJS R Final	12	0.1208
Condylar MJS R Initial	12	0.0913
Condylar SJS L Final	12	0.1429
Condylar SJS L Initial	12	0.1339
Condylar SJS R Final	12	0.1486
Condylar SJS R Initial	12	0.1099
Mesial Molar Relation Final	12	0.3878
Mesial Molar Relation Initial	12	0.3851

Continued

Table 4-2. Continued.

Variable	Sample Size	Dahlberg Statistic
Overbite Final	12	0.3060
Overbite Initial	12	0.3298
Overjet Final	12	0.2598
Overjet Initial	12	0.2380
Sagittal AAE L Final	12	0.2380
Sagittal AAE L Initial	12	9.7407
Sagittal AAE R Final	12	7.8852
Sagittal AAE R Initial	12	6.1272
Sagittal ACP L Final	12	3.9894
Sagittal ACP L Initial	12	3.5918
Sagittal ACP R Final	12	3.6309
Sagittal ACP R Initial	12	2.9266
Sagittal AGF L Final	12	5.8100
Sagittal AGF L Initial	12	3.7269
Sagittal AGF R Final	12	7.8119
Sagittal AGF R Initial	12	6.0979
Sagittal AJS L Final	12	0.0842
Sagittal AJS L Initial	12	0.1000
Sagittal AJS R Final	12	0.0979
Sagittal AJS R Initial	12	0.1137
Sagittal ATA L Final	12	4.7394
Sagittal ATA L Initial	12	1.6549
Sagittal ATA R Final	12	0.6889
Sagittal ATA R Initial	12	0.9813
Sagittal CH L Final	12	0.1720
Sagittal CH L Initial	12	0.1732
Sagittal CH R Final	12	0.2951
Sagittal CH R Initial	12	0.2318
Sagittal CHA L Final	12	1.1915
Sagittal CHA L Initial	12	2.3665
Sagittal CHA R Final	12	1.4627
Sagittal CHA R Initial	12	1.4663
Sagittal CHH L Final	12	0.1225
Sagittal CHH L. Initial	12	0.1541
Sagittal CHH R Final	12	0.1658
Sagittal CHH R Initial	12	0.1720

Continued

Table 4-2. Continued.

Variable	Sample Size	Dahlberg Statistic
Sagittal CHW L Final	12	0.1443
Sagittal CHW L Initial	12	0.1683
Sagittal CHW R Final	12	0.1323
Sagittal CHW R Initial	12	0.1528
Sagittal EAM-AE L Final	12	0.3007
Sagittal EAM-AE L Initial	12	0.3142
Sagittal EAM-AE R Final	12	0.2598
Sagittal EAM-AE R Initial	12	0.2806
Sagittal EAM-C L Final	12	0.1594
Sagittal EAM-C L Initial	12	0.1936
Sagittal EAM-C R Final	12	0.1990
Sagittal EAM-C R Initial	12	0.2776
Sagittal EAM-P L Final	12	0.1190
Sagittal EAM-P L Initial	12	0.1354
Sagittal EAM-P R Final	12	0.1339
Sagittal EAM-P R Initial	12	0.1458
Sagittal FD L Final	12	0.1173
Sagittal FD L Initial	12	0.1080
Sagittal FD R Final	12	0.1620
Sagittal FD R Initial	12	0.1683
Sagittal FW L Final	12	3.1643
Sagittal FW L Initial	12	0.3937
Sagittal FW R Final	12	0.2951
Sagittal FW R Initial	12	0.2723
Sagittal MJS L Final	12	0.1307
Sagittal MJS L Initial	12	0.1099
Sagittal MJS R Final	12	0.1080
Sagittal MJS R Initial	12	0.1000
Sagittal PJS L Final	12	0.0890
Sagittal PJS L Initial	12	0.1061
Sagittal PJS R Final	12	0.1190
Sagittal PJS R Initial	12	0.1696
Sella-Vertical-M Final	12	0.7228
Sella-Vertical-M Initial	12	1.1583
SNA Final	12	0.5319
SNA Initial	12	0.3629
SNB Final	12	0.4619
SNB Initial	12	0.2739

related. Efficiency is defined as the likelihood of finding a statistically significant difference when one exists. **Appendix C** lists the relevant descriptive statistics and the paired t tests for the double determinations.

We created Bland-Altman plots for the statistically significant variables. Of the 112 variables, 8 ($8/112 = 7.1\%$) were statistically significant at an unadjusted alpha level of 0.05 (**Table 4-3**). This level is too liberal because of the multiple comparison problem. The common over-correction of Bonferroni level of significance would be $0.05/112$ or 0.000446, and none of the differences is significant at this level. Indeed, by paired t-test (two-tail) the difference with the smallest probability (0.0022) was Sagittal EAM-P R at the initial examination. Importantly, even this “large” difference only differed between measurement sessions by an average of 0.16 mm, which we consider safely unimportant clinically. These significant differences were assessed from paired t tests. In a complementary but different manner, **Figures 4-2** through **4-9** are provided. These Bland-Altman plots tested for a significant dependency between size of the difference between paired measurements (X axis) and the mean size of the variable (Y axis). None of these plots was significant statistically.

Least Squares Means

You probably have heard the term “least squares means.” Least squares means (LS Means) are actually a sort of statistical jargon. Least square means is actually referred to as marginal means (or sometimes EMM, estimated marginal means). In an analysis of covariance model, they are the group means after having controlled for a covariate (*i.e.*, holding it constant at some typical value of the covariate, such as its mean value).

For example, consider some of the CBCT variables discussed here, like condyle size. This size (linear or area) can be used as a covariate because the condyle grows

Table 4-3. Statistics of the eight statistically significant (alpha = 0.05) variables when testing for systematic differences between intraobserver repeatability sessions.

Variable	Mean Difference	Paired t Test	P Value
ANB Initial	-0.1750	-3.17	0.0089
Axial MLCP R Final	-0.6750	2.67	0.0218
Condylar LJS L Final	0.1167	3.19	0.0086
Mesial Molar Relation Initial	0.3500	2.78	0.0179
Overbite Final	0.2833	2.25	0.0460
Sa AJS L Final	0.0750	2.69	0.0210
Sagittal EAM-P R Initial	0.1583	3.98	0.0022
Sagittal FW L Initial	0.3167	2.29	0.0425

Figure 4-2. Bland-Altman plot for the angle ANB at the initial examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

Figure 4-3. Bland-Altman plot for MLCP Right at the final examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

Figure 4-4. Bland-Altman plot for Condyle LJS Left at the final examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

Figure 4-5. Bland-Altman plot for Mesial Molar Relationship at the initial examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

Figure 4-6. Bland-Altman plot for Overbite at the final examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

Figure 4-7. Bland-Altman plot for AJS Left at the final examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

Figure 4-8. Bland-Altman plot for Sagittal EAM-P Right at the initial examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

Figure 4-9. Bland-Altman plot for Sagittal FW Left at the initial examination.

Dotted lines are the 95% confidence limits of the least-squares regression line, which did not differ significantly from zero.

(enlarges) with the age of the patient. The same thing occurs with using patient age since children and adolescents typically enlarge with age (*e.g.*, stature and body weight). The shortcoming of using ordinary means, then, is that there is the presumption that everyone in the samples is the same age (and the same size). Eliminating inter-individual variation plus changes that occur as a function of age is difficult. Suppose, in theory, that condylar size doubles from 5 to 15 years of age. Then, if the ages at treatment were different between samples, the investigator would be hard pressed to distinguish between pharyngeal sizes due to age compared to differences due to different malocclusions.

This problem can be solved statistically by using least squares means in place of the ordinary means. LS means picks a convenient age (commonly the sample mean) and transforms all of the cases to that same age (or whatever the covariate is in the model). Thus, if skull size or condylar dimensions change with the age of the patient, LS means corrects for this, expressing the variables as if the covariate were constant and the same between samples. This permits direct (unbiased) comparisons of the sizes of the dependent variable across the samples.

From the ANCOVA model used here (**Appendix B**), the LS means have been listed for all of the variables. The LS means are reported separately for the two sexes (boys, girls) and between the four treatment-by-sex combinations (**Appendix C**). In unbalanced designs with more than one effect, the arithmetic mean for a group may not accurately reflect the “typical” response for that group, since it does not take other effects into account.

Means and LS means will be the same if the design is balanced (equal number of cases per sample) and there are no missing data. In the present study there are no missing data, but the sample sizes are unequal (boys *versus* girls and the unequal sample sizes of the two treatments). LS means from different ANOVA models will be different because they have been adjusted for different effects.

Treatment-Clinic Differences

The research design used here selected the cases treated with Edgewise-Alone mechanics from one clinic (in Tennessee) and cases treated with Edgewise mechanics in combination with a MARA from another clinic (in Kansas). There was no overlap of orthodontists between clinics. As such, treatment mechanics and orthodontic office (“clinic”) were confounded. It was not possible to attribute differences solely to mechanics or clinic. One exception was the significant “treatment” differences found at the initial examination. Since no treatment had been delivered, initial differences were due to geographical and/or sampling differences from the two patient populations (TN *versus* KS).

A brute-force method of detecting statistically significant differences in the samples was used. Each variable was tested—at the start of treatment, at the end of treatment, and the in-treatment difference (calculated as the starting condition minus the

final condition, so a positive change signifies an increase during treatment). The variables ($k = 112$ dimensions) assessed in this study (see Methods) were a combination of midline and paired dimensions. That is, some conventional midline cephalometric landmarks were used (Sella, A Point, B Point) where there was no pairing. For the dimensions that depended on these midline landmarks, each CBCT variable was subjected to a two-way factorial analysis of variance (ANOVA), where one factor was method of treatment (Edgewise mechanics with or without MARA) and the second factor was sex of the patient (boy, girl). Both factors are fixed effects, and the full ANOVA model involved three simultaneous F-ratios, namely (1) treatment, (2) sex, and (3) the treatment-by-sex interaction effect.

The other dimensions were paired in that both the left and right temporomandibular joints in each subject were measured. Analysis of these paired (left, right) dimensions called for a more complex, mixed ANOVA model. There was the repeated measure of “side” in addition to treatment and sex tests. There were also between-subjects and within-subject factors that made this a mixed ANOVA model with separate error terms. The between-subject factors were (1) treatment (same as clinic), (2) sex of the patient, and (3) the treatment-by-sex interaction effect. The four within-subject factors were (1) side (left and right temporomandibular joints), (2) side-by-treatment interaction (3) side-by-sex interaction, and (4) the second-order interaction effect, side-by-treatment-by-sex. In all, then, there were 7 simultaneous F-ratios tested for each paired dimension (**Appendix B**).

The conventional alpha (0.05) was used throughout to gauge statistical significance. This raises the problem of multiple comparisons—elevated chance of finding a significant difference, but that seemed preferable to missing noteworthy differences. The first step in interpreting this plethora of statistical results was to scan the 112 ANOVA models and collect the significant treatment effects ($\alpha = 0.05$). The resulting 25 significant F-ratios are listed in **Table 4-4**. It seemed safe to assume that any “Treatment” differences that occurred when the initial examinations were performed were more correctly interpreted as geographical (TN versus KS) differences in these samples of the populations. Among the 25 significant tests, there were 6 such instances. These are Sagittal MJS Initial, Sagittal FD Initial, Sagittal CH Initial, Sagittal ATA Initial, Sagittal ACP Initial, and Sagittal AGF Initial. It is interesting that several of these dimensions involve sagittal measurements, but we are unsure at this juncture what this signifies, if anything. The “most significant” of the 25 variables are graphed and described here (those with probability values less than 0.0001). The treatment change in the angle SNA are graphed in **Figure 4-10**.

These Class II cases had Class II division 1 malocclusions, so the typical reduction seen in SNA was anticipated. Of interest significantly greater reduction was achieved in the Edgewise-Alone series. This may be a problem of having to treat the wrong jaw, however. Class II division 1 malocclusions most commonly present with mandibular retrognathia, which optimally would be treated by enhancing mandibular growth (if that were an option), not restricting maxillary growth.

Table 4-4. List of the statistically significant treatment differences abstracted from the Appendix of ANOVA results (alpha = 0.05).

Variable	Significant Factor	P Value
1. Change in SNA	Treatment	<0.0001
2. Change in SNB	Treatment	0.0031
3. Mesial Molar Relation Final	Treatment	0.0009
4. Sella-Vertical-to-M Final	Treatment	0.0008
5. Change in Sella-Vertical-to-M	Treatment	<0.0001
6. Change in Axial AP	Treatment	0.0437
7. Axial LACP Final	Treatment	0.0437
8. Change in Axial LACP	Treatment	0.0437
9. Sagittal MJS Initial	Treatment	0.0001
10. Change in Sagittal MJS	Treatment	0.0137
11. Sagittal FW Initial	Side-by-Treatment	0.0288
12. Sagittal FW Final	Side-by-Treatment	0.0006
13. Sagittal FD Initial	Treatment	0.0126
14. Change in Sagittal CHW	Treatment-by-Sex	0.0009
15. Sagittal CH Initial	Treatment	0.0018
16. Change in Sagittal CH	Treatment	0.0020
17. Sagittal EAM-AE Final	Side-by-Treatment	<0.0001
18. Sagittal ATA Initial	Treatment	<0.0001
19. Sagittal ATA Final	Treatment	0.0056
20. Change in Sagittal ATA	Treatment	0.0005
21. Sagittal CHA Final	Treatment-by-Sex	0.0382
22. Sagittal ACP Initial	Treatment	0.0042
23. Sagittal ACP Final	Treatment	0.0004
24. Sagittal AGF Initial	Side-by-Treatment	0.0071
25. Change in Sagittal AGF	Treatment	0.0035

Figure 4-10. Box plots of the in-treatment changes in the angle SNA.

Examining the interesting changes in the angle SNB (**Figure 4-11**), there is a significant difference by treatment. In the Edgewise-Alone sample, the angle got smaller, though the median was less than a degree. In the MARA+Edgewise group, the median came forward a bit (roughly ½ mm in the graph). Statistically, the difference between treatments achieved significance ($P = 0.0031$). Inspection of just this dimension suggests that the MARA does aid in repositioning the mandible forward.

In looking at the differences in the axial anteroposterior measurement of the condyle (**Figure 4-12**), there is a significant difference by treatment. In both the Edgewise-Alone and MARA+Edgewise group, the linear measurement decreased, but the difference between treatments achieved significance ($P = 0.0437$). This shows more decreasing change of the condylar head in the MARA group versus the Edgewise-Alone group.

The next significant dimension, Axial LACP, is interesting in that this dimension was significant between treatments both at final examinations and the in-treatment changes while being similar at the initiation of treatment. These results are graphed in **Figures 4-13** and **4-14**. With the AP dimension decreasing more in the MARA+Edgewise group, the assumption that the Edgewise alone sample would have a greater increase was validated with these data.

The Sagittal MJS dimension was significantly larger in the MARA+Edgewise (Kansas) sample at the start of treatment (**Figure 4-15**). Since no orthodontic work had been done at these initial records, this site difference would seem to be attributable solely to geographical (population) differences of the patient pools and/or to case selection.

In addition to the start of treatment, Sagittal MJS also differed significantly in the amounts of in-treatment change (**Figure 4-16**). There was little change in this dimension in the MARA+Edgewise (Kansas) sample, but the mode increased significantly in the Edgewise-Alone (Tennessee) sample. The graph also shows that a few (four) samples in the Edgewise-Alone group changed a lot (about 2 mm).

The next pair of significant treatment differences was Sagittal FD Initial and Sagittal CH Initial. Since both dimensions differed at the start of treatment, they are dealt with together. **Figure 4-17** lists the results, by treatment, for Sagittal FD Initial and **Figure 4-18** is for Sagittal CH Initial.

The Sagittal CH dimension was larger in the MARA+Edgewise group at the start of treatment (**Figure 4-18**) and it also increased significantly more during treatment, also in the MARA+Edgewise group (**Figure 4-19**). It cannot be determined whether the greater change was due to treatment instead of a population (Kansas *versus* Tennessee) difference in intrinsic growth patterns.

At both the start and end of treatment the dimension EAM-AE was larger in the Edgewise-Alone (Tennessee) sample. This is graphed for the start of treatment in **Figure 4-20**, and at the end of treatment in **Figure 4-21**. The amounts of in-treatment were

Figure 4-11. Box plots of the changes in SNB, by treatment.

The horizontal blue line is positioned at zero.

Figure 4-12. Box plots of the in-treatment changes in Axial AP, by treatment.

The blue horizontal line was placed at zero.

Figure 4-13. Box plots of Axial LACP Final, by treatment.

Figure 4-14. Box plots of the in-treatment change in Axial LACP, by treatment.

The treatment change was larger in the Edgewise-Alone sample.

Figure 4-15. Box plots of the Sagittal MJS dimension at the start of treatment.

This dimension was significantly longer in the MARA+Edgewise sample at the start of treatment.

Figure 4-16. Box plots of the in-treatment changes in the Sagittal MJS dimension, by treatment.

Using these raw statistics, there was almost no average change in the MARA+Edgewise group, but a small but significant increase, averaging about $\frac{1}{4}$ mm in the Edgewise-Alone sample.

Figure 4-17. Box plots of the Sagittal FD dimension, by treatment.

Sagittal FD was significantly larger in the MARA+Edgewise sample at the start of treatment.

Figure 4-18. Box plots of the Sagittal CH dimension, by treatment.

Sagittal CH was significantly larger in the Edgewise-Alone sample at the start of treatment.

Figure 4-19. Box plots of the Sagittal in-treatment change in the CH dimension, by treatment.

Treatment increased this dimension significantly more in the MARA+Edgewise sample. The blue horizontal line is set at zero (no change).

Figure 4-20. Box plots of the Sagittal EAM-AE dimension at the start of treatment.

This dimension was significantly larger in the Edgewise-Alone (Tennessee) sample at the start of treatment.

Figure 4-21. Box plots of the Sagittal EAM-AE dimension at the end of treatment.

This dimension was significantly larger in the Edgewise-Alone (Tennessee) sample at the end of treatment.

statistically equivalent (not significantly different), however. This suggests that the MARA did not affect this dimension appreciably.

The next significant dimension, Sagittal ATA, is intriguing in that this dimension was significant between treatments both at the initial and final examinations, as well as the in-treatment changes. These results are graphed in **Figures 4-22** through **4-25**. This trait seemed to exhibit an intrinsic growth difference since it was larger at the start of treatment in the MARA+Edgewise group.

The next variable, sagittal area of the condylar head (ACP), was remarkable in that significant differences were found in the initial and final, but the in-treatment changes did not achieve significance (**Figures 4-25** and **4-26**). As was observed in evaluating the other measurements of the condylar head, the condylar head increased in the Edgewise alone sample and decreased slightly in the MARA+ Edgewise sample. This change almost achieved significance ($P=0.055$).

The last variable of note in regards to treatment differences was sagittal area of the glenoid fossa (AGF). In the initial data, the dimensions MARA + Edgewise group was significantly greater than the Edgewise alone group, which shows an inherent geographical difference in the sample groups (**Figure 4-27**). However, the Edgewise alone group changed more significantly in the area than the MARA + Edgewise group (**Figure 4-28**), which made the final comparisons insignificant.

Figure 4-22. Box plots of the Sagittal ATA at the start of treatment.

This dimension was significantly larger in the MARA+Edgewise (Kansas) sample at the start of treatment.

Figure 4-23. Box plots of the Sagittal ATA at the end of treatment.

This dimension was significantly larger in the MARA+Edgewise (Kansas) sample at both the start and end of orthodontic treatment.

Figure 4-24. Box plots of the in-treatment changes in Sagittal ATA.

This dimension also was significantly larger in the MARA+Edgewise (Kansas) sample at the start and end of treatment. The blue horizontal line was set at zero (no change).

Figure 4-25. Box plots in Sagittal ACP at the start of treatment.

This dimension was significantly larger in the Edgewise-Alone (Tennessee) sample at the start and end of treatment.

Figure 4-26. Box plots in Sagittal ACP at the end of treatment.

This dimension was significantly larger in the Edgewise-Alone (Tennessee) sample at the start and the end of treatment.

Figure 4-27. Box plots in Sagittal AGF at the start of treatment.

Figure 4-28. Box plots of the in-treatment changes in Sagittal AGF.

The change was significantly larger in the Edgewise-Alone group.

CHAPTER 5. DISCUSSION

An ongoing argument is presently apparent in orthodontics about the amount of condyle-fossa remodeling and condylar growth seen in patients using functional appliance therapy in Class II skeletal patients. Some clinicians and researchers believe that functional appliances such as the MARA increase the amount of condylar growth and subsequent Class II skeletal correction, others believe that the mandible has a preset amount of growth and that conventional orthodontics will result in a similar amount of condylar growth to functional appliance therapy. This study reintroduced this dispute by comparing condylar remodeling in functional appliance therapy to conventional fixed orthodontic therapy Class II elastics. CBCT analysis was used in order to incorporate more accurate imaging than conventional radiography used in the past. We evaluated many changes induced by the MARA and conventional treatment, and compared the two groups to find any significant differences. This groundbreaking study showed significant results that will give clinicians an understanding of the changes in the TMJ during orthodontic treatment.

Operator Reliability (Bias)

In a “hot-topic” study such as this, the accuracy of the study is paramount in order to substantiate the claims. The use of functional appliances has spanned over 3 decades, and their perceived efficacy to correct skeletal and dental Class II malocclusions has differed between clinicians (Wahl 2006). During the study, many precautions were taken in order to validate the data accrued from the samples.

First, we derived the subjects in the study by evaluating consecutively treated patients from the patient archives of both practices (TN and KS). Certain parameters had to be met in order to qualify for inclusion in the study: Caucasian children aged 9 to 14, ANB of greater than 3.5, overjet greater than 5, no significant transverse dental issues, and no dental developmental issues. Once the samples were collected, a two-way factorial ANOVA model was used on the seven cephalometric variables to calculate the similarity of the groups based on treatment and sex (**Table 4-1**). It is of note that none of the tests was significant, so it was assumed that the treatment groups were very similar before any orthodontic treatment intervention.

After finding the total sample, the subjects were randomized by an independent evaluator. A separate evaluator (author) then collected all of the 3D data. This randomization of the subjects before data collection removed any evaluation bias. Once the data was collected, intraoperator reliability was performed on the entire sample two months later. The 3D measurements were not saved on the images as to remove any previous methods of retrieving the data. Bland-Altman plots for the statistically significant variables were derived from the repeats, and only 8 of the 112 variables ($8/112 = 7.1\%$) were statistically significant at an unadjusted alpha level of 0.05 (**Table 4-3**).

Significant Differences

The purpose of this study was to determine whether the MARA, a newer functional appliance, would cause statistically and clinically significant differences in the temporomandibular joint as compared to conventional orthodontic treatment. By evaluating the subjects with CBCT, we were able to evaluate many novel dimensions that were unavailable for previous studies. The variables ($k = 112$ dimensions) assessed in this study were a combination of midline and paired dimensions. Analysis of paired (left, right) dimensions called for a more complex, mixed ANOVA model. With this, the repeated measure of “side” was evaluated, which measured the intra-subject changes, in addition to treatment and sex tests. The first step in interpreting this plethora of statistical results was scanning the 112 ANOVA models and collect the significant treatment effects ($\alpha = 0.05$). The 25 significant F-ratios were listed in **Table 4-4**. These significant factors are discussed below.

Significance by Treatment (Clinic)

Although not one factor is weighed more than the rest, the significant differences in treatment by clinic was a potent factor in determining whether there is a difference between the functional and conventional groups. 19 of the 25 significant differences were due to geographics differences and treatment.

All of the subjects had Class II division 1 malocclusions, so the typical reduction seen in SNA was anticipated. Of interest significantly greater reduction was achieved in the Edgewise-Alone series (-2.25 degrees, $sd = 1.19$). This may be a problem of having to treat the wrong jaw, however. Class II division 1 malocclusions most commonly present with mandibular retrognathia, which optimally would be treated by enhancing mandibular growth (if that were an option), not restricting maxillary growth. The MARA+Edgewise group did have a slight reduction in SNA (-0.81 degrees, $sd = 1.31$), but was not as great as the Edgewise alone group. These findings are similar to the amount of SNA change seen by Pangrazio-Kulbersh *et al.* 2003 in their MARA sample group (-0.4°).

The changes in the angle SNB (**Figure 4-11**) showed significant difference by treatment. In the Edgewise-Alone sample, the angle got smaller (-0.46 degrees, $sd = 1.1$), though the median was less than a degree. One would suspect that, with the increased correction of the Class II and growth, this dimension would increase as well. However, in using Class II elastics, there is a vertical component as well as a horizontal component. This could cause a clockwise rotation in the mandible, giving the perceived decrease in the horizontal component. In the MARA+Edgewise group, the median came forward a bit (0.52 degrees, $sd = 1.24$). Pangrazio-Kulbersh *et al.* also found a forward relocation of B point in their MARA sample (1.1°), and they also found that the FMA decreased on average in their sample (-0.1°) (2003). Statistically, the difference between treatments in our study achieved significance ($P = 0.0031$). Inspection of just this measure suggests

that the MARA does aid in repositioning the mandible forward with possibly less of a vertical vector of force than conventional interarch elastics.

A significant difference in the posttreatment result of the maxillary-mandibular mesial molar relation was seen between the groups. The Edgewise (TN) group ended up at -1.15 mm (sd = 1.11), which meant that the maxillary molar mesiobuccal cusp was distal to the mandibular mesiobuccal cusp indicating a Class I relationship. The MARA (KS) group posttreatment was -0.31 mm (sd = 0.97), showing that the maxillary cusp was distal to the mandibular cusp; however, this difference was significant. The changes from pre- to posttreatment were not significant, indicating that there may have been a nonsignificant greater initial correction needed in the MARA group than the Edgewise-Alone group.

A variable that did not complement the rest of the data was cephalometric Sella-Vertical-to-M. This novel measurement was used to find the amount of horizontal advancement of the mandibular corpus as related to a relatively fixed structure, Sella. The Edgewise group surprisingly had more advancement in this measurement than the MARA (6.08 mm, sd = 3.41 Edgewise *versus* 2.58 mm, sd = 2.69 MARA). This does not correspond to the changes seen in SNB and CH, which would support more propulsion of the mandible in the MARA group.

In looking at the differences in the axial anteroposterior measurement of the condyle (**Figure 4-12**), there is a significant difference by treatment. In both the Edgewise-Alone and MARA+Edgewise group, the linear measurement decreased, but the difference between treatments achieved significance ($P = 0.0437$). The Edgewise-Alone and MARA+Edgewise groups' mean changes were less than a millimeter (-0.02 mm for Edge vs. -0.36 mm for MARA). This shows more decreasing change of the condylar head in the MARA group versus the Edgewise-Alone group. Bell (1982) stated that moderate loading facilitates normal remodeling of the condyle, but if the demands for change are too rapid, degenerative remodeling may take place instead. Since the MARA repositions the condyles forward against the articular eminence and more resorption was seen in those subjects, the anterior resorption of the condylar head may have been due to higher compressive forces of the condyle against the eminence in the MARA+Edgewise group.

The next significant dimension, Axial LACP, is interesting in that this dimension was significant between treatments both at final examinations and the in-treatment changes while being similar at the initiation of treatment. The Edgewise-Alone group had an average change of 5 mm^2 (sd = 13.75), while the MARA+Edgewise group had an average change of 4.25 mm^2 (sd = 13.92). The average areas of the condyles posttreatment for the Edgewise-Alone and MARA groups were 107.7 mm^2 (sd = 16.46) and 105.8 mm^2 (sd = 24.69), respectively. These results are graphed in **Figures 4-12** and **4-13**. With the AP dimension decreasing more in the MARA+Edgewise group and similar increases in length seen in the axial ML dimension of the condyles, the assumption that the Edgewise alone sample would have a greater increase was validated with the data.

The Sagittal MJS dimension was significantly larger in the MARA+Edgewise (Kansas) sample at the start of treatment (**Figure 4-15**). The Tennessee group had an initial measurement average of 2.1 mm (sd = 0.53), while the Kansas group had an initial average of 2.68 mm (sd = 0.71). Since no orthodontic work had been done at these initial records, this site difference would seem to be attributable solely to geographical (population) differences of the patient pools and/or to case selection. In addition to the start of treatment, Sagittal MJS also differed significantly in the amounts of in-treatment change (**Figure 4-16**). On average, the Edgewise (TN) group joint space increased (0.27 mm, sd = 0.66), while the MARA group slightly decreased (-0.08 mm, sd = 0.76). This differs from the Vanlaecken *et al.* study, where they found no significant differences in joint space pre-and posttreatment (2006). Ruf and Pancherz (1998) also noted in their Herbst study that the condylar position in the fossa is relatively unaffected by functional appliance therapy. While the changes were significant, the posttreatment joint spaces were similar and nonsignificant between the 2 groups (2.28 mm *versus* 2.6 mm). This shows that, by initial case selection, more MARA subjects may have had an initial malocclusion may have “unseated” the condyle, and with treatment, the condyle changed to a more natural position in the fossa.

One of the most important variables in noting any clinical treatment differences between the groups was sagittal condyle height (CH). The Sagittal CH dimension was larger in the Edgewise versus the MARA group at the start of treatment (16.38 mm, sd = 2.46 and 14.32 mm, sd = 2.41, respectively), but the MARA group increased significantly more during treatment as compared to the Edgewise group, also in the MARA+Edgewise group (**Figure 4-19**). It cannot be determined whether the greater change was due to treatment instead of a population (Kansas *versus* Tennessee) difference in intrinsic growth patterns, since the initial average age of the MARA group was slightly younger than the Edgewise Alone group (11.93 *versus* 12.37). Nevertheless, it could be ascertained that there were geographical differences at the initiation of treatment, and that the MARA group had significantly greater growth of the condylar process (1.45 mm, sd = 1.77 for MARA; 0.13 mm, sd = 1.5 for Edgewise). These findings would associate with those studies that were considered proponents of the advantages of functional appliance therapy; however, the difference on average is less than 1.5 mm, so the clinical significance may be minimal.

At both the start and end of treatment the dimension EAM-AE was larger in the Edgewise-Alone (Tennessee) sample. This is graphed for the start of treatment in **Figure 4-20**, and at the end of treatment in **Figure 4-21**. The amounts of in-treatment change were statistically equivalent (not significantly different), however. This suggests a geographical difference in the sample groups.

The next significant dimension, Sagittal ATA, is intriguing in that this dimension was significant between treatments both at the initial and final examinations, as well as the in-treatment changes. These results were graphed in **Figures 4-22, 4-23, and 4-24**. On average, the articular eminence of the MARA group (44.37 degrees, sd = 6.28) initially had a more obtuse angle than the Edgewise-Alone group (36.74 degrees, sd = 5.74), but the slope in the MARA group became more acute during treatment (-2.07

degrees, sd = 4.23) and the eminence in the Edgewise-Alone group became more obtuse (1.34 degrees, sd = 4.17). No explanation can be reasoned for the changes in this variable other than the possible treatment differences causing different effects on the articular eminence.

The next considerable difference between the treatment groups was sagittal area of the condyle (ACP). Pretreatment, the MARA group was significantly smaller than the Edgewise-Alone group (42.36 mm², sd = 9.29 and 48.97 mm², sd = 10.77, respectively), while the posttreatment results showed a decrease in condylar size of the MARA group (42.17 mm², sd = 9.43) and increase in the Edgewise-Alone group (50.13 mm², sd = 11.97). While initial and final variables were significant, the average changes were not quite significant (1.16 mm² *versus* -0.35 mm², P value = 0.055). These findings coincide with the significant changes seen in axial AP length of the condyle and axial LACP – the condylar head, on average, was smaller in the MARA group possibly due to more resorption of the anterior part of the condyle.

The final significant variable between the groups was sagittal area of the glenoid fossa (AGF). Initially, the groups were significantly different (74.11 mm², sd = 14.81 for Edgewise-Alone; 82.45 mm², sd = 15.76 for MARA), but the final treatment numbers were nonsignificant due to the significant changes in the dimension (7.32 mm², sd = 12.75 for Edgewise-Alone; 0.5 mm², sd = 7.7 for MARA). The final posttreatment numbers became more similar due to the significantly higher increase in glenoid fossa space in the Edgewise-Alone group. Ruf and Panherz (1998) looked at MRIs and also found that more bone apposition was seen on the inferior part of the glenoid spine, causing a relative anteclination of the posterior border of the glenoid fossa. This, along with relative resorption of the anterior border of the glenoid fossa, could contribute to the relatively constant area of the glenoid fossa.

Side-by-Treatment Significant Differences

Another interesting type of difference found was the intra-individual differences between the left and right “sides” of the individual by treatment. Of the results, 4 variables were seen to be significant for side:

1. Initial sagittal fossa width,
2. Final sagittal fossa width,
3. Final sagittal EAM-AE, and
4. Initial sagittal AGF.

Fossa width was an interesting variable. Initially, the right fossa width was significantly bigger on average than the left in the Tennessee group (18.07 mm and 17.48 mm), while the left FW was bigger on average than the right in the Kansas group (17.2 mm and 16.73

mm). In the final measurements, the same circumstance held true for both groups, showing an intrinsic difference in fossa width size for the two treatment groups. The final measurements for Sagittal EAM-AE were also significant for side and treatment. The average measurement for the right side of the Tennessee sample (24.92 mm) was significantly longer than the left side for Tennessee (23.96 mm), and both the left and right sides of the MARA group (23.78 mm and 23.23 mm, respectively). The initial measurement of sagittal area of glenoid fossa (AGF) was noteworthy in that the left area of the Tennessee sample on average (69.95 mm²) was significantly smaller than the right side (78.26 mm²) and both the left and right sides of the MARA sample (82.42 mm² and 82.48 mm², respectively). This initial measurement, as stated before, can be attributed to the intrinsic geographical differences of the sample.

Treatment-by-Sex Differences

Another remarkable factor was treatment-by-sex, or the differences seen in treatment categorized by gender. Two variables were significant for treatment by gender type: change in sagittal condyle head width (CHW) and final sagittal condylar head angle (CHA). For the final measurements in sagittal CHA, Tennessee boys had a more obtuse condylar head angle on average than girls (139.35 degrees vs. 132.06 degrees, respectively), while Kansas boys had a more acute angle on average than girls (131.48 degrees vs. 136.17 degrees, respectively). This may be due to treatment, geographical differences, or both; more studies may need to be done in order to confirm these changes and their degree of significance.

Treatment Differences Seen in Both Groups

Although only 25 significant variables were seen between both treatments, we prudently evaluated the posttreatment changes for all variables. Conveniently, we took descriptive statistics for the entire sample (**Appendix A**), so those variables that did not achieve inter-group statistical significance could be pooled together to see the average treatment changes for the entire sample of subjects. The following shows the average treatment changes for all of these variables and their significance level ($\alpha = 0.05$).

Cephalometric Variables

Although the main focus of this study was to determine the temporomandibular changes during orthodontic treatment, an overview of treatment changes in the dental and skeletal relationships is important to evaluate in conjunction with the changes in the TMJs. These variables show overall treatment results.

Even though the changes in SNA and SNB were different by treatment, overall skeletal change in ANB was very similar between the groups. Average ANB decreased by -1.56 degrees for both groups (-1.79 degrees for Edgewise; -1.35 degrees for MARA).

In terms of incisor position, overbite decreased (-2.34 mm Edgewise, -2.03 mm MARA; average = -2.18 mm) in both groups and overjet decreased (-3.54 mm Edgewise, -2.68 mm MARA; average = -3.11 mm), with both of these measurements showing significant improvement. While the posttreatment numbers for mesial molar relationship were significantly different between both groups, significant improvement in molar relationship was similar for both groups (-2.47 mm Edgewise, -1.78 mm MARA; average = -2.1 mm). Similar changes were seen in the Pangrazio-Kulbersh *et al.* study for the MARA treatment group (-1.4° ANB) (2003).

In evaluating these variables, an overall correction in the Class II malocclusion was seen for both groups. Dentally, overbite, overjet, and the molar relationship improved on average in all patients. Skeletally, the ANB decreased in both groups, although the underlying jaw correction was different for both groups.

Axial Variables

The diagnosis of the axial dimension of the TMJs is remarkable in that this plane could not be measured before with conventional radiography. Some interesting changes were seen in this dimension. In regards to the mediolateral length of each condyle, both groups had an average increase of 0.815 mm (0.81 mm L condyle, 0.82 R condyle). This change could be attributed to the innate growth seen in children this age. In terms of the distance of each condyle to the midsagittal plane (MSP), the L and R condyles in each group significantly widened further from the midline by increasing 1.4 mm on each side; this may be part of an innate lateral growth of the jaws and face. Condylar asymmetry, as evaluated with change in anteroposterior condylar distance (APCD), improved in the Edgewise group (from 0.31 mm to 0.01 mm), while the MARA group's asymmetry grew slightly worse (from 0.09 mm to 0.14 mm). These results, however, did not achieve statistical significance. The next variable evaluated was condylar angulation change as related to the MSP. The condyles on average became more obtuse in both groups (1.15 degrees L, 0.42 degrees R, average = 0.79 degrees), but this difference did not achieve statistical significance.

Sagittal Variables

The variables included in the sagittal dimension are of note because some other studies have shown findings in this dimension using axially corrected tomographs.

In terms of joint space, the amount of change was insignificant for both groups. Anterior joint space decreased slightly (-0.1 mm L, 0.03 mm R; average = -0.04 mm), and posterior joint space decreased slightly as well (-0.12 mm L and R). The decrease in joint space coincides with a Herbst study done by Croft *et al.* (1999), in which he looked at horizontally corrected tomographs. They found a relative decrease in posterior joint space after treatment (-0.4 mm). Change in middle joint space was significant between both groups, but as a whole, the change was not significant (0.05 mm L, 0.13 mm R;

average 0.09 mm). These results would follow the conventional thought that the temporomandibular joint space stays relatively constant throughout treatment (Ruf and Pancherz 1998, Vanlaecken *et al.* 2006).

Glenoid fossa width increased (0.25 mm L, 0.32 mm R; average 0.29 mm); glenoid fossa depth increased as well (0.29 mm L, 0.24 mm R; average 0.27 mm). Fossa depth and width would be assumed to increase with the increasing size of the condylar apparatus with growth and treatment.

In measuring the condylar head, the width showed no appreciable change though it decreased (-0.03 mm L, -0.09 mm R; average -0.06 mm); this change is in line with the assumption that the head resorbed on average in the AP dimension. Condylar head height increased for both groups (0.11 mm L, 0.31 mm R; average 0.21 mm), which is coincident to the condyle process increasing linearly in treatment for both groups.

In terms of the relative positioning of the TMJ as related to the external auditory meatus (EAM), all variables increased linearly; with the EAM being a relatively stable marker (Ricketts 1950), this showed a relative “forward positioning” of each of the landmarks involved. The distance to the articular eminence increased significantly (0.92 mm L, 0.52 mm R; average = 0.72 mm). The center of the condyle (0.56 mm L, 0.2 mm R; average 0.38 mm) and the posterior wall of the glenoid fossa (0.41 mm L, 0.1 mm R; average 0.26 mm) also came forward. In a study by Wigal *et al.* (2011), 22 subjects treated with the Herbst were evaluated during pre-treatment, after Herbst therapy, and after phase II treatment. They evaluated the TMJ using lateral cephalograms. The authors found, similarly to our study, significant anterior movement of the condyle and the anterior portion of the glenoid fossa through treatment. Another study by Wadhawan *et al.* (2008) measured the location of the condyle in the fossa as related to the EAM. They used MRI to evaluate 12 children, and, like our study, they found a forward positioning of the post-glenoid spine as related to the EAM.

Another interesting variable of note is the change in the condylar head angle as related to the condylar process. This angle became more acute in both groups (-7.11 degrees L, -5.71 degrees R; average -6.41 degrees), showing significant remodeling of the condylar head forward in both groups. The MARA group on average had about a degree more acute repositioning than the Edgewise alone group, but this change was not significant between treatment groups.

As mentioned before in the statistically significant consortium, change in area of the condylar head (ACP) closely neared significance between groups, but when the groups were pooled together, the size of the condyle increased nonsignificantly (0.45 mm² L, 0.49 mm² R; average = 0.47 mm²). Finally, when evaluating the change in area of the articular eminence, both groups had a significantly average increase in size (10.45 mm² L, 8.23 mm² R; average = 9.34 mm²). Even with possible changes of the posterior border of the articular eminence, the structure increased in size with growth.

Coronal Variables

The coronal dimension, not unlike the axial dimension, is incredible in that evaluating this aspect has been unavailable with conventional radiographic techniques. Coronal joint spaces (medial, superior, and lateral), similarly to the sagittal dimension, all showed nonsignificant changes pre- and post-treatment. Anterior joint space increased slightly in the L joint (0.12 mm) and decreased slightly in the R joint (-0.02 mm), superior joint space increased slightly in the L joint (0.03 mm) and decreased slightly in the R joint (-0.1 mm), and the posterior joint space decreased slightly in the L joint (-0.03 mm) and increased slightly in the R joint (0.06 mm). These findings would be consistent with the belief that the joint space seems to be relatively stable post-treatment.

CHAPTER 6. SUMMARY AND CONCLUSION

Much concentration has been seen in the orthodontic literature regarding functional appliances, and the debate is ongoing as to their treatment efficacy for the growing Class II patient as compared to conventional mechanics. The purpose of the present study was to add information through the analysis of cone beam computed tomographs (CBCT) comparing the temporomandibular effects of the MARA+Edgewise treatment compared to edgewise treatment alone with intermaxillary elastics. The goal was to identify any differing changes in the TMJ obtained from the use of the MARA that would benefit Class II correction compared to conventional treatment alone. The author selected MARA-treated cases and Edgewise-only conventional cases based on the following criteria: 1) 9-14 years of age, 2) ANB greater than 4 degrees, 3) positive overjet of greater than 3.5 mm, 4) non-extraction therapy, and 5) no posterior transverse problems or craniofacial anomalies.

The MARA plus Edgewise group consisted of 33 subjects, and the Edgewise-Alone group consisted of 31 subjects. The cephalometric and CBCT analysis was performed with Dolphin Imaging 11® to measure 98 separate variables. Major findings were:

- In terms of cephalometric changes, both types of mechanics resulted in improving the overall Class II division 1 skeletal and dental relationships. Yet, there was on average less retrusion of the maxilla and more advancement of the mandible to correct the Class II in the MARA versus the conventional treatment group.
- More resorption of the condylar head was seen anteroposteriorly in the MARA group versus conventional treatment, causing the condyles of the MARA subjects to decrease in size on average compared to the increase seen in the conventional edgewise group.
- Lengthening of the condyle was statistically greater in the MARA group than the conventional treatment group, although both increased on average.
- The slope of the posterior border of the articular eminence became more acute in the MARA group and more obtuse in the conventional edgewise group. Further studies may need to be developed to explain this phenomenon.
- On average, the condylar head angle decreased for both treatment groups, showing a forward remodeling of the condylar head.
- Temporomandibular joint spaces, as a whole, stayed relatively stable throughout both treatment groups.
- Overall, there was a relative increase and forward advancement of the temporomandibular apparatus in both treatment groups, with the consequence of this being due to treatment and growth of the subjects.

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**APPENDIX A. DESCRIPTIVE STATISTICAL RESULTS FOR EACH
VARIABLE, PARTITIONED BY TREATMENT PLUS ONE-SAMPLE T-
TESTS ASSESSING THE IN-TREATMENT CHANGES**

Table A-1. Sample statistics for SNA Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	82.73	82.71	82.72
Standard deviation	3.29	3.23	3.23
Standard error of mean	0.59	0.56	0.40
Upper 95% Mean	83.94	83.85	83.53
Lower 95% Mean	81.52	81.56	81.91
Sample size	31	33	64
Sample variance	10.83	10.45	10.46
Skewness (g1)	-0.21	-0.81	-0.50
Kurtosis (g2)	-0.36	0.53	-0.01
Coef Variation	3.98	3.91	3.91
Number missing	0	0	0
Median	82.6	82.9	82.9
Mode	80.8	81.7	81.9

Table A-2. Sample statistics for SNA Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	80.48	81.90	81.21
Standard deviation	2.94	3.29	3.18
Standard error of mean	0.53	0.57	0.40
Upper 95% Mean	81.56	83.07	82.01
Lower 95% Mean	79.40	80.73	80.42
Sample size	31	33	64
Sample variance	8.65	10.80	10.12
Skewness (g1)	0.02	-0.21	-0.03
Kurtosis (g2)	-0.42	0.59	0.02
Coef Variation	3.65	4.01	3.92
Number missing	0	0	0
Median	80.3	81.9	81.3
Mode	80.2	80.8	83.3

Table A-3. Sample statistics for Change in SNA, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-2.25	-0.81	-1.51
Standard deviation	1.19	1.31	1.44
Standard error of mean	0.21	0.23	0.18
Upper 95% Mean	-1.82	-0.34	-1.15
Lower 95% Mean	-2.69	-1.27	-1.87
Sample size	31	33	64
Sample variance	1.41	1.72	2.08
Skewness (g1)	0.14	0.29	0.25
Kurtosis (g2)	-0.77	-0.11	-0.19
Coef Variation	-52.81	-162.79	-95.70
Number missing	0	0	0
Median	-2.2	-0.9	-1.4
Mode	-3.5	-0.1	-0.1
		t-test	-8.36
		P-value (two tail)	<0.0001

Table A-4. Sample statistics for SNB Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	76.97	76.88	76.92
Standard deviation	2.77	3.07	2.91
Standard error of mean	0.50	0.53	0.36
Upper 95% Mean	77.98	77.97	77.65
Lower 95% Mean	75.95	75.79	76.20
Sample size	31	33	64
Sample variance	7.68	9.44	8.45
Skewness (g1)	0.27	-0.12	0.03
Kurtosis (g2)	0.21	-0.76	-0.42
Coef Variation	3.60	4.00	3.78
Number missing	0	0	0
Median	76.6	77.3	77.0
Mode	77.3	78.8	78.8

Table A-5. Sample statistics for SNB Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	76.51	77.40	76.97
Standard deviation	2.78	3.06	2.94
Standard error of mean	0.50	0.53	0.37
Upper 95% Mean	77.53	78.49	77.70
Lower 95% Mean	75.49	76.32	76.24
Sample size	31	33	64
Sample variance	7.74	9.33	8.63
Skewness (g1)	0.28	-0.07	0.11
Kurtosis (g2)	0.03	-0.83	-0.60
Coef Variation	3.64	3.95	3.82
Number missing	0	0	0
Median	76.2	77.6	77.1
Mode	76.1	73.7	76.1

Table A-6. Sample statistics for Change in SNB, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.46	0.52	0.05
Standard deviation	1.10	1.24	1.26
Standard error of mean	0.20	0.22	0.16
Upper 95% Mean	-0.06	0.96	0.36
Lower 95% Mean	-0.86	0.09	-0.27
Sample size	31	33	64
Sample variance	1.20	1.53	1.59
Skewness (g1)	0.03	-0.39	-0.05
Kurtosis (g2)	-1.09	-0.42	-0.81
Coef Variation	-239.33	235.66	2,605.20
Number missing	0	0	0
Median	-0.4	0.6	0.2
Mode	-1.4	1.9	-1.4
		t-test	0.31
		P-value (two tail)	0.7598

Table A-7. Sample statistics for ANB Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	5.76	5.84	5.80
Standard deviation	1.62	1.43	1.52
Standard error of mean	0.29	0.25	0.19
Upper 95% Mean	6.36	6.34	6.18
Lower 95% Mean	5.17	5.33	5.42
Sample size	31	33	64
Sample variance	2.64	2.05	2.30
Skewness (g1)	1.55	0.31	0.99
Kurtosis (g2)	2.08	-0.66	0.79
Coef Variation	28.18	24.55	26.14
Number missing	0	0	0
Median	5.3	5.5	5.5
Mode	4.5	5.5	5.3

Table A-8. Sample statistics for ANB Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	3.97	4.49	4.24
Standard deviation	1.64	1.63	1.64
Standard error of mean	0.29	0.28	0.21
Upper 95% Mean	4.57	5.07	4.65
Lower 95% Mean	3.37	3.91	3.83
Sample size	31	33	64
Sample variance	2.68	2.65	2.69
Skewness (g1)	1.38	0.22	0.73
Kurtosis (g2)	2.41	-1.02	0.11
Coef Variation	41.24	36.25	38.71
Number missing	0	0	0
Median	4.0	4.3	4.2
Mode	4.5	4.2	4.2

Table A-9. Sample statistics for Change in ANB, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-1.79	-1.35	-1.56
Standard deviation	0.92	1.28	1.14
Standard error of mean	0.17	0.22	0.14
Upper 95% Mean	-1.45	-0.89	-1.28
Lower 95% Mean	-2.13	-1.80	-1.85
Sample size	31	33	64
Sample variance	0.85	1.65	1.29
Skewness (g1)	-0.60	-0.11	-0.04
Kurtosis (g2)	0.41	-0.46	-0.01
Coef Variation	-51.46	-95.47	-72.82
Number missing	0	0	0
Median	-1.9	-1.3	-1.5
Mode	-2.1	-1.5	-1.5
		t-test	-10.99
		P-value (two tail)	<0.0001

Table A-10. Sample statistics for Overbite Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	3.72	3.49	3.60
Standard deviation	1.44	2.24	1.88
Standard error of mean	0.26	0.39	0.24
Upper 95% Mean	4.25	4.28	4.07
Lower 95% Mean	3.19	2.70	3.13
Sample size	31	33	64
Sample variance	2.09	5.00	3.55
Skewness (g1)	-0.05	-0.75	-0.71
Kurtosis (g2)	0.12	-0.31	0.30
Coef Variation	38.82	64.05	52.27
Number missing	0	0	0
Median	3.6	4.0	3.7
Mode	2.6	4.8	2.6

Table A-11. Sample statistics for Overbite Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.38	1.46	1.42
Standard deviation	0.76	1.24	1.03
Standard error of mean	0.14	0.22	0.13
Upper 95% Mean	1.66	1.90	1.68
Lower 95% Mean	1.10	1.02	1.16
Sample size	31	33	64
Sample variance	0.58	1.54	1.06
Skewness (g1)	0.08	-0.18	-0.09
Kurtosis (g2)	-0.13	-0.01	0.47
Coef Variation	55.05	85.05	72.39
Number missing	0	0	0
Median	1.1	1.3	1.3
Mode	1.0	0.3	1.0

Table A-12. Sample statistics for Change in Overbite, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-2.34	-2.03	-2.18
Standard deviation	1.54	1.97	1.77
Standard error of mean	0.28	0.34	0.22
Upper 95% Mean	-1.78	-1.34	-1.74
Lower 95% Mean	-2.91	-2.73	-2.62
Sample size	31	33	64
Sample variance	2.38	3.87	3.12
Skewness (g1)	-0.48	0.30	0.12
Kurtosis (g2)	0.58	0.11	0.43
Coef Variation	-65.93	-96.70	-80.96
Number missing	0	0	0
Median	-2.3	-2.3	-2.3
Mode	-2.4	-0.4	-2.0
		t-test	-9.88
		P-value (two tail)	<0.0001

Table A-13. Sample statistics for Overjet Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.17	5.85	6.00
Standard deviation	1.86	1.95	1.90
Standard error of mean	0.33	0.34	0.24
Upper 95% Mean	6.85	6.54	6.48
Lower 95% Mean	5.48	5.15	5.53
Sample size	31	33	64
Sample variance	3.47	3.81	3.61
Skewness (g1)	0.59	0.98	0.76
Kurtosis (g2)	-0.75	1.37	0.23
Coef Variation	30.21	33.37	31.67
Number missing	0	0	0
Median	5.8	5.7	5.8
Mode	4.2	3.8	4.2

Table A-14. Sample statistics for Overjet Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.63	3.17	2.91
Standard deviation	0.81	0.99	0.94
Standard error of mean	0.15	0.17	0.12
Upper 95% Mean	2.93	3.52	3.14
Lower 95% Mean	2.33	2.82	2.67
Sample size	31	33	64
Sample variance	0.66	0.98	0.89
Skewness (g1)	-0.08	0.68	0.52
Kurtosis (g2)	-0.34	0.39	0.64
Coef Variation	30.98	31.18	32.37
Number missing	0	0	0
Median	2.6	3.0	2.9
Mode	2.9	2.4	2.9

Table A-15. Sample statistics for Change in Overjet showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-3.54	-2.68	-3.09
Standard deviation	1.75	2.08	1.96
Standard error of mean	0.31	0.36	0.24
Upper 95% Mean	-2.90	-1.94	-2.60
Lower 95% Mean	-4.18	-3.41	-3.58
Sample size	31	33	64
Sample variance	3.06	4.31	3.84
Skewness (g1)	-0.41	-0.69	-0.43
Kurtosis (g2)	-0.95	0.99	0.08
Coef Variation	-49.40	-77.63	-63.30
Number missing	0	0	0
Median	-3.1	-2.5	-2.9
Mode	-2.8	-3.2	-4.9
		t-test	-12.64
		P-value (two tail)	<0.0001

Table A-16. Sample statistics for Mesial Molar Relation Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.32	1.47	1.40
Standard deviation	1.30	1.22	1.26
Standard error of mean	0.23	0.21	0.16
Upper 95% Mean	1.80	1.90	1.71
Lower 95% Mean	0.84	1.04	1.08
Sample size	31	33	64
Sample variance	1.70	1.50	1.58
Skewness (g1)	0.06	-0.73	-0.32
Kurtosis (g2)	-0.85	1.92	0.20
Coef Variation	98.87	83.22	89.87
Number missing	0	0	0
Median	1.4	1.3	1.4
Mode	0.1	0.6	0.6

Table A-17. Sample statistics for Mesial Molar Relation Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-1.15	-0.31	-0.72
Standard deviation	1.11	0.97	1.12
Standard error of mean	0.20	0.17	0.14
Upper 95% Mean	-0.75	0.04	-0.44
Lower 95% Mean	-1.56	-0.65	-1.00
Sample size	31	33	64
Sample variance	1.23	0.95	1.25
Skewness (g1)	0.38	-0.37	-0.08
Kurtosis (g2)	-0.03	1.09	-0.24
Coef Variation	-96.03	-318.56	-155.97
Number missing	0	0	0
Median	-1.2	-0.3	-0.7
Mode	-1.8	0.3	-0.6

Table A-18. Sample statistics for Change in Molar Relationship, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-2.47	-1.78	-2.11
Standard deviation	1.53	1.39	1.49
Standard error of mean	0.27	0.24	0.19
Upper 95% Mean	-1.91	-1.28	-1.74
Lower 95% Mean	-3.04	-2.27	-2.49
Sample size	31	33	64
Sample variance	2.34	1.92	2.21
Skewness (g1)	-0.59	-0.29	-0.48
Kurtosis (g2)	0.47	0.94	0.69
Coef Variation	-61.83	-78.03	-70.37
Number missing	0	0	0
Median	-2.2	-1.6	-2.0
Mode	-2.2	-3.1	-2.0
		t-test	-11.37
		P-value (two tail)	<0.0001

Table A-19. Sample statistics for Sella-Vertical-M Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	45.82	44.93	45.36
Standard deviation	3.84	4.89	4.40
Standard error of mean	0.69	0.85	0.55
Upper 95% Mean	47.23	46.66	46.46
Lower 95% Mean	44.41	43.19	44.26
Sample size	31	33	64
Sample variance	14.74	23.90	19.36
Skewness (g1)	0.00	-0.52	-0.42
Kurtosis (g2)	-1.10	0.91	0.59
Coef Variation	8.38	10.88	9.70
Number missing	0	0	0
Median	45.9	45.4	45.5
Mode	47.2	36.6	45.4

Table A-20. Sample statistics for Sella-Vertical-M Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	51.90	47.51	49.64
Standard deviation	5.06	5.65	5.77
Standard error of mean	0.91	0.98	0.72
Upper 95% Mean	53.76	49.51	51.08
Lower 95% Mean	50.05	45.51	48.20
Sample size	31	33	64
Sample variance	25.59	31.93	33.30
Skewness (g1)	0.07	-0.34	-0.25
Kurtosis (g2)	-1.31	0.35	0.04
Coef Variation	9.75	11.89	11.63
Number missing	0	0	0
Median	51.4	47.8	49.2
Mode	56.4	41.2	49.6

Table A-21. Sample statistics for Change in Sella-Vertical-M, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.08	2.58	4.28
Standard deviation	3.41	2.69	3.51
Standard error of mean	0.61	0.47	0.44
Upper 95% Mean	7.33	3.54	5.15
Lower 95% Mean	4.83	1.63	3.40
Sample size	31	33	64
Sample variance	11.64	7.24	12.33
Skewness (g1)	-0.59	-0.44	-0.07
Kurtosis (g2)	1.17	0.34	0.12
Coef Variation	56.11	104.22	82.10
Number missing	0	0	0
Median	6.3	2.7	4.6
Mode	6.2	0.5	4.6
		t-test	9.74
		P-value (two tail)	<0.0001

Table A-22. Sample statistics for Axial ML Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	17.43	17.06	17.24
Standard deviation	1.80	2.29	2.06
Standard error of mean	0.32	0.40	0.26
Upper 95% Mean	18.09	17.88	17.76
Lower 95% Mean	16.77	16.25	16.73
Sample size	31	33	64
Sample variance	3.25	5.25	4.25
Skewness (g1)	0.05	-0.18	-0.17
Kurtosis (g2)	-0.55	-0.20	-0.16
Coef Variation	10.34	13.43	11.96
Number missing	0	0	0
Median	17.2	16.8	17.0
Mode	16.4	16.5	16.4

Table A-23. Sample statistics for Axial ML Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	18.39	17.73	18.05
Standard deviation	2.03	2.63	2.36
Standard error of mean	0.36	0.46	0.30
Upper 95% Mean	19.13	18.66	18.64
Lower 95% Mean	17.64	16.80	17.46
Sample size	31	33	64
Sample variance	4.10	6.94	5.59
Skewness (g1)	-0.07	-0.17	-0.24
Kurtosis (g2)	-0.64	0.14	0.11
Coef Variation	11.02	14.85	13.10
Number missing	0	0	0
Median	18.0	17.9	18.0
Mode	17.5	16.0	17.5

Table A-24. Sample statistics for Change in Axial ML Left, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.95	0.67	0.81
Standard deviation	0.87	0.89	0.89
Standard error of mean	0.16	0.15	0.11
Upper 95% Mean	1.28	0.98	1.03
Lower 95% Mean	0.63	0.35	0.58
Sample size	31	33	64
Sample variance	0.76	0.79	0.79
Skewness (g1)	0.77	0.55	0.61
Kurtosis (g2)	0.15	-0.64	-0.27
Coef Variation	91.57	133.36	110.01
Number missing	0	0	0
Median	0.9	0.4	0.7
Mode	0.2	-0.2	0.2
		t-test	7.27
		P-value (two tail)	<0.0001

Table A-25. Sample statistics for Axial ML Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	17.65	17.09	17.36
Standard deviation	1.78	2.32	2.08
Standard error of mean	0.32	0.40	0.26
Upper 95% Mean	18.30	17.92	17.88
Lower 95% Mean	17.00	16.27	16.84
Sample size	31	33	64
Sample variance	3.17	5.38	4.32
Skewness (g1)	0.75	0.08	0.16
Kurtosis (g2)	0.09	0.08	0.28
Coef Variation	10.08	13.57	11.97
Number missing	0	0	0
Median	17.3	16.9	17.2
Mode	17.3	15.1	18.8

Table A-26. Sample statistics for Axial ML Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	18.44	17.95	18.19
Standard deviation	1.64	2.48	2.12
Standard error of mean	0.29	0.43	0.26
Upper 95% Mean	19.04	18.83	18.72
Lower 95% Mean	17.84	17.07	17.66
Sample size	31	33	64
Sample variance	2.70	6.16	4.47
Skewness (g1)	0.17	0.14	0.01
Kurtosis (g2)	-0.29	0.10	0.36
Coef Variation	8.91	13.83	11.63
Number missing	0	0	0
Median	18.3	17.9	18.2
Mode	17.6	16.4	16.5

Table A-27. Sample statistics for Change in Axial ML R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.79	0.85	0.82
Standard deviation	1.16	0.79	0.98
Standard error of mean	0.21	0.14	0.12
Upper 95% Mean	1.22	1.13	1.07
Lower 95% Mean	0.36	0.58	0.58
Sample size	31	33	64
Sample variance	1.35	0.62	0.96
Skewness (g1)	0.02	0.34	0.07
Kurtosis (g2)	0.80	0.11	1.03
Coef Variation	146.77	92.01	118.73
Number missing	0	0	0
Median	0.5	0.9	0.7
Mode	0.4	0.3	0.3
		t-test	6.74
		P-value (two tail)	<0.0001

The t test assessed whether the average in-treatment change differed systematically from zero (two tail).

Table A-28. Sample statistics for Axial AP Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.67	7.03	6.86
Standard deviation	1.22	1.18	1.20
Standard error of mean	0.22	0.21	0.15
Upper 95% Mean	7.12	7.45	7.16
Lower 95% Mean	6.23	6.61	6.56
Sample size	31	33	64
Sample variance	1.49	1.39	1.45
Skewness (g1)	-0.07	0.19	0.04
Kurtosis (g2)	-0.27	0.20	-0.04
Coef Variation	18.30	16.77	17.55
Number missing	0	0	0
Median	6.7	6.8	6.8
Mode	6.1	5.9	6.1

Table A-29. Sample statistics for Axial AP Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.67	6.75	6.71
Standard deviation	1.30	1.07	1.18
Standard error of mean	0.23	0.19	0.15
Upper 95% Mean	7.15	7.13	7.01
Lower 95% Mean	6.20	6.37	6.42
Sample size	31	33	64
Sample variance	1.69	1.15	1.39
Skewness (g1)	0.33	0.05	0.20
Kurtosis (g2)	-0.08	0.15	-0.02
Coef Variation	19.48	15.92	17.58
Number missing	0	0	0
Median	6.6	6.7	6.7
Mode	5.0	6.7	6.7

Table A-30. Sample statistics for Change in Axial AP L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.00	-0.28	-0.15
Standard deviation	0.59	0.92	0.78
Standard error of mean	0.11	0.16	0.10
Upper 95% Mean	0.22	0.04	0.05
Lower 95% Mean	-0.22	-0.61	-0.34
Sample size	31	33	64
Sample variance	0.35	0.84	0.62
Skewness (g1)	0.35	-0.88	-0.84
Kurtosis (g2)	-0.99	1.23	1.87
Coef Variation	.	-325.27	-539.77
Number missing	0	0	0
Median	-0.2	-0.2	-0.2
Mode	-0.5	-0.2	-0.5
		One-sample t-test	1.48
		P-value (two tail)	0.1433

Table A-31. Sample statistics for Axial AP Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.77	7.13	6.95
Standard deviation	1.19	1.06	1.13
Standard error of mean	0.21	0.18	0.14
Upper 95% Mean	7.20	7.51	7.24
Lower 95% Mean	6.33	6.76	6.67
Sample size	31	33	64
Sample variance	1.41	1.12	1.27
Skewness (g1)	0.04	1.03	0.38
Kurtosis (g2)	-0.43	1.41	0.49
Coef Variation	17.53	14.83	16.21
Number missing	0	0	0
Median	6.9	6.9	6.9
Mode	6.9	6.5	6.9

Table A-32. Sample statistics for Axial AP Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.73	6.72	6.72
Standard deviation	1.11	1.19	1.14
Standard error of mean	0.20	0.21	0.14
Upper 95% Mean	7.14	7.14	7.01
Lower 95% Mean	6.32	6.29	6.44
Sample size	31	33	64
Sample variance	1.24	1.41	1.31
Skewness (g1)	-0.17	-0.19	-0.18
Kurtosis (g2)	-0.92	0.17	-0.35
Coef Variation	16.56	17.69	17.01
Number missing	0		0
Median	6.8	6.8	6.8
Mode	6.8	6.8	6.8

Table A-33. Sample statistics for Change in Axial AP R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.04	-0.42	-0.23
Standard deviation	0.80	0.89	0.86
Standard error of mean	0.14	0.16	0.11
Upper 95% Mean	0.26	-0.10	-0.02
Lower 95% Mean	-0.33	-0.73	-0.45
Sample size	31	33	64
Sample variance	0.64	0.80	0.75
Skewness (g1)	-0.69	-0.98	-0.85
Kurtosis (g2)	0.76	1.01	0.95
Coef Variation	-2,071.70	-214.87	-371.08
Number missing	0	0	0
Median	0.0	-0.2	-0.1
Mode	-0.1	-0.2	-0.1
		One-sample t-test	2.16
		P-value (two tail)	0.0349

Table A-34. Sample statistics for Axial MLCP Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	46.16	46.15	46.16
Standard deviation	2.90	2.29	2.58
Standard error of mean	0.52	0.40	0.32
Upper 95% Mean	47.23	46.96	46.80
Lower 95% Mean	45.10	45.34	45.51
Sample size	31	33	64
Sample variance	8.39	5.24	6.66
Skewness (g1)	-0.13	0.26	0.01
Kurtosis (g2)	-0.07	0.12	0.05
Coef Variation	6.27	4.96	5.59
Number missing	0	0	0
Median	46.8	45.6	46.4
Mode	46.7	45.3	45.3

Table A-35. Sample statistics for Axial MLCP Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	47.46	47.64	47.55
Standard deviation	3.12	2.51	2.80
Standard error of mean	0.56	0.44	0.35
Upper 95% Mean	48.61	48.53	48.25
Lower 95% Mean	46.32	46.75	46.85
Sample size	31	33	64
Sample variance	9.76	6.29	7.85
Skewness (g1)	-0.22	0.38	-0.03
Kurtosis (g2)	0.05	0.91	0.38
Coef Variation	6.58	5.27	5.89
Number missing	0	0	0
Median	47.6	47.3	47.5
Mode	47.1	45.3	47.1

Table A-36. Sample statistics for Ch Axial MLCP L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.30	1.49	1.40
Standard deviation	1.13	1.16	1.14
Standard error of mean	0.20	0.20	0.14
Upper 95% Mean	1.71	1.90	1.68
Lower 95% Mean	0.88	1.08	1.11
Sample size	31	33	64
Sample variance	1.28	1.34	1.30
Skewness (g1)	0.50	0.48	0.48
Kurtosis (g2)	0.39	-0.75	-0.30
Coef Variation	87.23	77.65	81.61
Number missing	0	0	0
Median	1.1	1.3	1.2
Mode	0.9	2.3	0.7
		One-sample t-test	9.80
		P-value (two tail)	<0.0001

Table A-37. Sample statistics for Axial MLCP Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	46.62	46.15	46.38
Standard deviation	2.99	2.61	2.79
Standard error of mean	0.54	0.45	0.35
Upper 95% Mean	47.72	47.08	47.08
Lower 95% Mean	45.53	45.23	45.68
Sample size	31	33	64
Sample variance	8.95	6.80	7.77
Skewness (g1)	-0.01	0.47	0.22
Kurtosis (g2)	-0.19	0.20	-0.15
Coef Variation	6.42	5.65	6.01
Number missing	0		0
Median	47.0	46.0	46.3
Mode	47.0	45.4	47.0

Table A-38. Sample statistics for Axial MLCP Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	47.94	47.62	47.78
Standard deviation	2.95	2.80	2.86
Standard error of mean	0.53	0.49	0.36
Upper 95% Mean	49.02	48.62	48.49
Lower 95% Mean	46.86	46.63	47.06
Sample size	31	33	64
Sample variance	8.73	7.85	8.17
Skewness (g1)	0.04	1.28	0.62
Kurtosis (g2)	-0.05	2.18	0.69
Coef Variation	6.16	5.88	5.98
Number missing	0	0	0
Median	48.1	47.3	47.4
Mode	48.9	45.6	45.9

Table A-39. Sample statistics for Change in Axial MLCP R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.32	1.47	1.40
Standard deviation	1.18	1.11	1.14
Standard error of mean	0.21	0.19	0.14
Upper 95% Mean	1.75	1.86	1.68
Lower 95% Mean	0.88	1.08	1.11
Sample size	31	33	64
Sample variance	1.40	1.22	1.29
Skewness (g1)	0.94	0.17	0.55
Kurtosis (g2)	0.33	-0.36	-0.19
Coef Variation	89.90	75.10	81.44
Number missing	0	0	0
Median	1.0	1.6	1.3
Mode	1.3	1.0	1.3
		One-sample t-test	9.82
		P-value (two tail)	<0.0001

Table A-40. Sample statistics for Axial APCD Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.31	0.09	0.20
Standard deviation	1.62	0.84	1.27
Standard error of mean	0.29	0.15	0.16
Upper 95% Mean	0.90	0.39	0.51
Lower 95% Mean	-0.29	-0.21	-0.12
Sample size	31	33	64
Sample variance	2.61	0.71	1.62
Skewness (g1)	0.15	-0.03	0.28
Kurtosis (g2)	-0.96	0.21	-0.09
Coef Variation	527.38	899.32	646.05
Number missing	0	0	0
Median	0.0	0.0	0.0
Mode	0.0	0.0	0.0

Table A-41. Sample statistics for Axial APCD Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.01	-0.14	-0.06
Standard deviation	1.29	1.01	1.14
Standard error of mean	0.23	0.18	0.14
Upper 95% Mean	0.48	0.22	0.22
Lower 95% Mean	-0.46	-0.49	-0.35
Sample size	31	33	64
Sample variance	1.65	1.02	1.31
Skewness (g1)	-0.47	-0.57	-0.45
Kurtosis (g2)	0.16	0.70	0.35
Coef Variation	9,966.60	-739.45	-1,786.37
Number missing	0	0	0
Median	0.0	0.0	0.0
Mode	0.0	0.0	0.0

Table A-42. Sample statistics for Change in Axial APCD, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.29	-0.23	-0.26
Standard deviation	1.28	0.99	1.13
Standard error of mean	0.23	0.17	0.14
Upper 95% Mean	0.18	0.12	0.02
Lower 95% Mean	-0.76	-0.58	-0.54
Sample size	31	33	64
Sample variance	1.64	0.98	1.28
Skewness (g1)	-0.78	-0.33	-0.65
Kurtosis (g2)	0.24	0.10	0.34
Coef Variation	-436.61	-430.32	-433.93
Number missing	0	0	0
Median	0.0	0.0	0.0
Mode	0.0	0.0	0.0
		One-sample t-test	1.84
		P-value (two tail)	0.0699

Table A-43. Sample statistics for Axial CA Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	63.41	61.65	62.50
Standard deviation	8.32	5.69	7.08
Standard error of mean	1.49	0.99	0.89
Upper 95% Mean	66.46	63.67	64.27
Lower 95% Mean	60.36	59.64	60.74
Sample size	31	33	64
Sample variance	69.15	32.33	50.13
Skewness (g1)	0.78	-0.62	0.56
Kurtosis (g2)	2.45	0.42	2.78
Coef Variation	13.11	9.22	11.33
Number missing	0	0	0
Median	62.4	62.7	62.6
Mode	61.6	65.9	61.6

Table A-44. Sample statistics for Axial CA Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	64.45	62.91	63.65
Standard deviation	8.02	5.55	6.85
Standard error of mean	1.44	0.97	0.86
Upper 95% Mean	67.39	64.87	65.36
Lower 95% Mean	61.51	60.94	61.94
Sample size	31	33	64
Sample variance	64.35	30.75	46.87
Skewness (g1)	0.75	-0.86	0.45
Kurtosis (g2)	2.36	0.04	2.57
Coef Variation	12.45	8.82	10.76
Number missing	0	0	0
Median	65.3	63.9	65.0
Mode	59.5	63.4	63.4

Table A-45. Sample statistics for Change in Axial CA L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.04	1.25	1.15
Standard deviation	4.52	4.20	4.32
Standard error of mean	0.81	0.73	0.54
Upper 95% Mean	2.69	2.74	2.23
Lower 95% Mean	-0.62	-0.24	0.07
Sample size	31	33	64
Sample variance	20.39	17.61	18.66
Skewness (g1)	-0.33	-0.84	-0.56
Kurtosis (g2)	-0.23	2.56	0.83
Coef Variation	434.72	335.27	376.17
Number missing	0	0	0
Median	1.6	1.9	1.7
Mode	.	1.2	3.6
		One-sample t-test	2.13
		P-value (two tail)	0.0374

Table A-46. Sample statistics for Axial CA Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	63.18	62.03	62.59
Standard deviation	6.77	6.75	6.73
Standard error of mean	1.22	1.18	0.84
Upper 95% Mean	65.66	64.43	64.27
Lower 95% Mean	60.70	59.64	60.91
Sample size	31	33	64
Sample variance	45.81	45.61	45.32
Skewness (g1)	0.25	-0.78	-0.27
Kurtosis (g2)	0.08	1.70	0.92
Coef Variation	10.71	10.89	10.76
Number missing	0	0	0
Median	63.1	62.3	62.7
Mode	54.3	55.1	55.1

Table A-47. Sample statistics for Axial CA Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	63.40	62.63	63.00
Standard deviation	5.43	6.70	6.08
Standard error of mean	0.98	1.17	0.76
Upper 95% Mean	65.39	65.01	64.52
Lower 95% Mean	61.41	60.26	61.49
Sample size	31	33	64
Sample variance	29.49	44.92	37.01
Skewness (g1)	-0.20	-0.02	-0.12
Kurtosis (g2)	1.14	0.08	0.39
Coef Variation	8.57	10.70	9.66
Number missing	0		0
Median	63.3	61.7	62.9
Mode	62.7	59.9	62.7

Table A-48. Sample statistics for Change in Axial CA R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.22	0.60	0.42
Standard deviation	4.23	4.93	4.57
Standard error of mean	0.76	0.86	0.57
Upper 95% Mean	1.77	2.35	1.56
Lower 95% Mean	-1.33	-1.15	-0.73
Sample size	31	33	64
Sample variance	17.85	24.31	20.88
Skewness (g1)	-0.31	-1.31	-0.90
Kurtosis (g2)	-0.53	2.45	1.23
Coef Variation	1,926.12	821.70	1,099.51
Number missing	0	0	0
Median	0.7	1.9	1.3
Mode	2.2	-1.4	2.2
		One-sample t-test	0.73
		P-value (two tail)	0.4696

Table A-49. Sample statistics for Axial LACP Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	100.63	101.49	101.07
Standard deviation	17.53	21.53	19.54
Standard error of mean	3.15	3.75	2.44
Upper 95% Mean	107.06	109.12	105.95
Lower 95% Mean	94.20	93.85	96.19
Sample size	31	33	64
Sample variance	307.27	463.39	381.88
Skewness (g1)	-0.29	0.21	0.06
Kurtosis (g2)	-0.14	-0.99	-0.66
Coef Variation	17.42	21.21	19.33
Number missing	0	0	0
Median	101.0	99.5	100.1
Mode	.	99.5	99.5

Table A-50. Sample statistics for Axial LACP Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	107.17	105.42	106.27
Standard deviation	16.25	23.35	20.08
Standard error of mean	2.92	4.06	2.51
Upper 95% Mean	113.13	113.70	111.29
Lower 95% Mean	101.21	97.15	101.25
Sample size	31	33	64
Sample variance	264.04	545.01	403.33
Skewness (g1)	-0.03	-0.22	-0.22
Kurtosis (g2)	-0.45	-0.92	-0.57
Coef Variation	15.16	22.14	18.90
Number missing	0	0	0
Median	105.3	107.5	106.8
Mode	100.3	75.5	100.3

Table A-51. Sample statistics for Change in Axial LACP L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.54	3.94	5.20
Standard deviation	13.46	11.65	12.53
Standard error of mean	2.42	2.03	1.57
Upper 95% Mean	11.47	8.07	8.32
Lower 95% Mean	1.60	-0.19	2.07
Sample size	31.00	33.00	64.00
Sample variance	181.30	135.63	156.94
Skewness (g1)	0.02	0.17	0.12
Kurtosis (g2)	-0.52	-0.08	-0.38
Coef Variation	206.03	295.85	241.13
Number missing	0.00	0.00	0.00
Median	7.20	4.70	5.50
Mode	.	.	-0.50
		One-sample t-test	3.32
		P-value (two tail)	0.0015

Table A-52. Sample statistics for Axial LACP Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	103.63	104.49	104.08
Standard deviation	16.76	24.65	21.04
Standard error of mean	3.01	4.29	2.63
Upper 95% Mean	109.78	113.23	109.33
Lower 95% Mean	97.48	95.76	98.82
Sample size	31	33	64
Sample variance	280.98	607.40	442.51
Skewness (g1)	0.30	1.04	0.92
Kurtosis (g2)	0.40	1.37	1.64
Coef Variation	16.18	23.59	20.21
Number missing	0	0	0
Median	105.7	100.8	102.7
Mode	.	100.8	95.1

Table A-53. Sample statistics for Axial LACP Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	106.80	109.88	108.39
Standard deviation	16.67	26.03	21.89
Standard error of mean	2.99	4.53	2.74
Upper 95% Mean	112.91	119.11	113.85
Lower 95% Mean	100.69	100.64	102.92
Sample size	31	33	64
Sample variance	277.91	677.72	478.98
Skewness (g1)	-0.21	-0.47	-0.34
Kurtosis (g2)	-0.52	-0.64	-0.34
Coef Variation	15.61	23.69	20.19
Number missing	0	0	0
Median	107.6	112.9	110.1
Mode	.	.	.

Table A-54. Sample statistics for Change in Axial LACP R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	3.17	5.38	4.31
Standard deviation	14.03	16.18	15.10
Standard error of mean	2.52	2.82	1.89
Upper 95% Mean	8.32	11.12	8.08
Lower 95% Mean	-1.98	-0.35	0.54
Sample size	31	33	64
Sample variance	196.96	261.76	227.99
Skewness (g1)	-0.20	-0.63	-0.42
Kurtosis (g2)	0.21	0.29	0.12
Coef Variation	443.04	300.62	350.38
Number missing	0	0	0
Median	2.2	5.8	3.4
Mode	.	.	-32.7
		One-sample t-test	2.28
		P-value (two tail)	0.0258

Table A-55. Sample statistics for Sagittal AJS Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.26	1.42	1.35
Standard deviation	0.51	0.71	0.62
Standard error of mean	0.09	0.12	0.08
Upper 95% Mean	1.45	1.68	1.50
Lower 95% Mean	1.07	1.17	1.19
Sample size	31	33	64
Sample variance	0.26	0.50	0.39
Skewness (g1)	0.77	1.22	1.21
Kurtosis (g2)	0.23	1.73	1.94
Coef Variation	40.77	49.74	46.28
Number missing	0	0	0
Median	1.2	1.3	1.3
Mode	1.0	1.3	1.0

Table A-56. Sample statistics for Sagittal AJS Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.19	1.29	1.24
Standard deviation	0.44	0.56	0.50
Standard error of mean	0.08	0.10	0.06
Upper 95% Mean	1.35	1.49	1.37
Lower 95% Mean	1.03	1.09	1.12
Sample size	31	33	64
Sample variance	0.19	0.32	0.25
Skewness (g1)	1.09	0.56	0.78
Kurtosis (g2)	2.35	-0.52	0.30
Coef Variation	36.58	43.66	40.59
Number missing	0	0	0
Median	1.2	1.1	1.2
Mode	1.2	1.1	0.8

Table A-57. Sample statistics for Change in Sagittal AJS L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.07	-0.13	-0.10
Standard deviation	0.56	0.59	0.57
Standard error of mean	0.10	0.10	0.07
Upper 95% Mean	0.14	0.08	0.04
Lower 95% Mean	-0.28	-0.34	-0.25
Sample size	31	33	64
Sample variance	0.32	0.35	0.33
Skewness (g1)	-0.44	0.23	-0.08
Kurtosis (g2)	-0.08	-0.38	-0.39
Coef Variation	-795.60	-442.38	-556.64
Number missing	0	0	0
Median	-0.1	-0.2	-0.1
Mode	-0.1	-0.5	-0.2
		One-sample t-test	1.44
		P-value (two tail)	0.1556

Table A-58. Sample statistics for Sagittal MJS Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.00	2.63	2.33
Standard deviation	0.64	0.74	0.76
Standard error of mean	0.11	0.13	0.09
Upper 95% Mean	2.23	2.89	2.51
Lower 95% Mean	1.77	2.37	2.14
Sample size	31	33	64
Sample variance	0.40	0.55	0.57
Skewness (g1)	0.25	0.53	0.47
Kurtosis (g2)	0.33	0.05	0.33
Coef Variation	31.75	28.24	32.56
Number missing	0	0	0
Median	2.0	2.6	2.2
Mode	2.0	3.1	2.0

Table A-59. Sample statistics for Sagittal MJS Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.24	2.50	2.37
Standard deviation	0.75	0.86	0.81
Standard error of mean	0.13	0.15	0.10
Upper 95% Mean	2.51	2.81	2.58
Lower 95% Mean	1.96	2.20	2.17
Sample size	31	33	64
Sample variance	0.56	0.74	0.66
Skewness (g1)	0.39	-0.08	0.16
Kurtosis (g2)	0.36	0.36	0.16
Coef Variation	33.35	34.37	34.20
Number missing	0	0	0
Median	2.1	2.7	2.5
Mode	2.0	2.7	2.0

Table A-60. Sample statistics for Change in Sagittal MJS L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.24	-0.13	0.05
Standard deviation	0.71	0.72	0.73
Standard error of mean	0.13	0.12	0.09
Upper 95% Mean	0.50	0.13	0.23
Lower 95% Mean	-0.02	-0.38	-0.13
Sample size	31	33	64
Sample variance	0.50	0.51	0.53
Skewness (g1)	0.32	0.20	0.22
Kurtosis (g2)	1.14	0.12	0.45
Coef Variation	300.99	-563.26	1,508.15
Number missing	0	0	0
Median	0.2	0.0	0.0
Mode	-0.2	0.0	-0.2
		One-sample t-test	0.53
		P-value (two tail)	0.5977

Table A-61. Sample statistics for Sagittal PJS Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.77	2.85	2.81
Standard deviation	1.23	0.87	1.05
Standard error of mean	0.22	0.15	0.13
Upper 95% Mean	3.22	3.16	3.07
Lower 95% Mean	2.32	2.54	2.55
Sample size	31	33	64
Sample variance	1.50	0.75	1.10
Skewness (g1)	0.82	0.33	0.66
Kurtosis (g2)	0.79	-0.15	0.75
Coef Variation	44.21	30.38	37.25
Number missing	0	0	0
Median	2.7	2.8	2.8
Mode	2.4	2.5	3.0

Table A-62. Sample statistics for Sagittal PJS Left Final 2, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.72	2.67	2.69
Standard deviation	1.36	0.98	1.17
Standard error of mean	0.24	0.17	0.15
Upper 95% Mean	3.21	3.02	2.99
Lower 95% Mean	2.22	2.32	2.40
Sample size	31	33	64
Sample variance	1.84	0.96	1.37
Skewness (g1)	0.47	0.42	0.48
Kurtosis (g2)	-0.90	-0.80	-0.66
Coef Variation	49.99	36.73	43.42
Number missing	0	0	0
Median	2.4	2.5	2.5
Mode	1.1	1.4	1.4

Table A-63. Sample statistics for Change in Sagittal PJS L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.05	-0.18	-0.12
Standard deviation	0.78	0.81	0.79
Standard error of mean	0.14	0.14	0.10
Upper 95% Mean	0.23	0.11	0.08
Lower 95% Mean	-0.34	-0.47	-0.32
Sample size	31	33	64
Sample variance	0.61	0.66	0.63
Skewness (g1)	-0.23	0.47	0.14
Kurtosis (g2)	-0.80	2.89	0.95
Coef Variation	-1,427.21	-455.20	-669.47
Number missing	0	0	0
Median	0.0	-0.3	-0.2
Mode	-0.5	-0.3	-0.3
		One-sample t-test	1.20
		P-value (two tail)	0.2366

Table A-64. Sample statistics for Sagittal AJS Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.35	1.46	1.41
Standard deviation	0.36	0.61	0.50
Standard error of mean	0.07	0.11	0.06
Upper 95% Mean	1.49	1.68	1.53
Lower 95% Mean	1.22	1.24	1.28
Sample size	31	33	64
Sample variance	0.13	0.37	0.25
Skewness (g1)	-0.28	0.07	0.16
Kurtosis (g2)	0.30	-1.07	-0.41
Coef Variation	26.94	41.64	35.80
Number missing	0	0	0
Median	1.3	1.5	1.4
Mode	1.1	0.6	1.5

Table A-65. Sample statistics for Sagittal AJS Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.35	1.51	1.43
Standard deviation	0.44	0.66	0.57
Standard error of mean	0.08	0.12	0.07
Upper 95% Mean	1.52	1.74	1.58
Lower 95% Mean	1.19	1.27	1.29
Sample size	31	33	64
Sample variance	0.19	0.44	0.32
Skewness (g1)	1.00	0.35	0.65
Kurtosis (g2)	2.48	0.01	0.76
Coef Variation	32.39	43.81	39.42
Number missing	0	0	0
Median	1.3	1.7	1.5
Mode	1.5	0.8	0.8

Table A-66. Sample statistics for Change in Sagittal AJS R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.00	0.05	0.03
Standard deviation	0.49	0.55	0.51
Standard error of mean	0.09	0.10	0.06
Upper 95% Mean	0.18	0.24	0.16
Lower 95% Mean	-0.18	-0.15	-0.10
Sample size	31	33	64
Sample variance	0.24	0.30	0.26
Skewness (g1)	0.33	-0.23	0.01
Kurtosis (g2)	0.98	0.03	0.25
Coef Variation	15,070.04	1,127.46	1,937.41
Number missing	0	0	0
Median	-0.10	0.10	0.10
Mode	-0.20	0.20	0.20
		One-sample t-test	0.41
		P-value (two tail)	0.6811

Table A-67. Sample statistics for Sagittal MJS Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.19	2.73	2.47
Standard deviation	0.43	0.67	0.62
Standard error of mean	0.08	0.12	0.08
Upper 95% Mean	2.35	2.97	2.62
Lower 95% Mean	2.03	2.49	2.31
Sample size	31	33	64
Sample variance	0.19	0.44	0.39
Skewness (g1)	0.49	-0.04	0.48
Kurtosis (g2)	0.99	-1.19	-0.61
Coef Variation	19.89	24.37	25.31
Number missing	0	0	0
Median	2.1	2.7	2.4
Mode	2.4	2.6	1.8

Table A-68. Sample statistics for Sagittal MJS Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.48	2.70	2.60
Standard deviation	0.65	0.86	0.77
Standard error of mean	0.12	0.15	0.10
Upper 95% Mean	2.72	3.00	2.79
Lower 95% Mean	2.25	2.40	2.40
Sample size	31	33	64
Sample variance	0.42	0.74	0.59
Skewness (g1)	0.89	-0.20	0.23
Kurtosis (g2)	1.33	0.30	0.40
Coef Variation	26.20	31.79	29.54
Number missing	0	0	0
Median	2.4	2.8	2.5
Mode	2.1	2.4	2.4

Table A-69. Sample statistics for Change in Sagittal MJS R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.30	-0.03	0.13
Standard deviation	0.60	0.80	0.72
Standard error of mean	0.11	0.14	0.09
Upper 95% Mean	0.52	0.25	0.31
Lower 95% Mean	0.08	-0.31	-0.05
Sample size	31	33	64
Sample variance	0.36	0.64	0.52
Skewness (g1)	0.55	1.05	0.66
Kurtosis (g2)	0.92	2.25	1.35
Coef Variation	203.20	-2,638.05	565.47
Number missing	0	0	0
Median	0.30	-0.10	0.10
Mode	0.10	-0.80	0.10
		One-sample t-test	1.41
		P-value (two tail)	0.1621

Table A-70. Sample statistics for Sagittal PJS Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.84	2.74	2.79
Standard deviation	1.30	1.06	1.17
Standard error of mean	0.23	0.18	0.15
Upper 95% Mean	3.32	3.11	3.08
Lower 95% Mean	2.36	2.36	2.49
Sample size	31	33	64
Sample variance	1.70	1.12	1.38
Skewness (g1)	1.33	1.15	1.28
Kurtosis (g2)	0.82	1.93	1.23
Coef Variation	45.90	38.59	42.12
Number missing	0	0	0
Median	2.4	2.5	2.5
Mode	1.9	2.1	2.7

Table A-71. Sample statistics for Sagittal PJS Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.93	2.42	2.67
Standard deviation	1.41	0.75	1.14
Standard error of mean	0.25	0.13	0.14
Upper 95% Mean	3.45	2.69	2.95
Lower 95% Mean	2.41	2.15	2.38
Sample size	31	33	64
Sample variance	2.00	0.57	1.31
Skewness (g1)	1.22	0.73	1.54
Kurtosis (g2)	0.85	-0.03	2.61
Coef Variation	48.29	31.08	42.84
Number missing	0	0	0
Median	2.5	2.3	2.3
Mode	2.0	2.1	2.0

Table A-72. Sample statistics for Change in Sagittal PJS R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.09	-0.32	-0.12
Standard deviation	0.80	1.11	0.99
Standard error of mean	0.14	0.19	0.12
Upper 95% Mean	0.39	0.08	0.13
Lower 95% Mean	-0.20	-0.71	-0.37
Sample size	31	33	64
Sample variance	0.65	1.23	0.98
Skewness (g1)	0.85	-1.31	-0.89
Kurtosis (g2)	0.68	6.85	6.34
Coef Variation	890.94	-349.22	-821.91
Number missing	0	0	0
Median	-0.1	-0.4	-0.2
Mode	-0.5	-0.4	-0.4
		One-sample t-test	0.97
		P-value (two tail)	0.3341

Table A-73. Sample statistics for Sagittal FW Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	17.48	17.20	17.33
Standard deviation	1.78	2.03	1.91
Standard error of mean	0.32	0.35	0.24
Upper 95% Mean	18.13	17.92	17.81
Lower 95% Mean	16.82	16.48	16.86
Sample size	31	33	64
Sample variance	3.17	4.14	3.63
Skewness (g1)	0.43	1.46	1.01
Kurtosis (g2)	-0.62	3.55	1.68
Coef Variation	10.19	11.82	10.99
Number missing	0	0	0
Median	17.1	16.7	16.8
Mode	15.7	16.6	15.7

Table A-74. Sample statistics for Sagittal FW Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	17.61	17.55	17.58
Standard deviation	1.66	1.77	1.70
Standard error of mean	0.30	0.31	0.21
Upper 95% Mean	18.22	18.18	18.01
Lower 95% Mean	17.00	16.93	17.16
Sample size	31	33	64
Sample variance	2.75	3.14	2.90
Skewness (g1)	0.15	0.33	0.25
Kurtosis (g2)	-0.39	0.11	-0.18
Coef Variation	9.41	10.10	9.69
Number missing	0	0	0
Median	17.5	17.3	17.4
Mode	17.5	17.7	17.7

Table A-75. Sample statistics for Change in Sagittal FW L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.13	0.35	0.25
Standard deviation	1.28	1.45	1.36
Standard error of mean	0.23	0.25	0.17
Upper 95% Mean	0.60	0.87	0.59
Lower 95% Mean	-0.34	-0.16	-0.09
Sample size	31	33	64
Sample variance	1.63	2.09	1.85
Skewness (g1)	0.70	-2.51	-1.18
Kurtosis (g2)	3.47	10.46	6.69
Coef Variation	965.20	407.70	550.92
Number missing	0	0	0
Median	0.2	0.5	0.4
Mode	-0.2	1.1	-0.2
		One-sample t-test	1.45
		P-value (two tail)	0.1514

Table A-76. Sample statistics for Sagittal FD Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	7.06	7.87	7.48
Standard deviation	1.01	1.15	1.15
Standard error of mean	0.18	0.20	0.14
Upper 95% Mean	7.43	8.28	7.77
Lower 95% Mean	6.69	7.46	7.19
Sample size	31	33	64
Sample variance	1.02	1.33	1.32
Skewness (g1)	-0.88	-0.24	-0.27
Kurtosis (g2)	1.24	-0.73	0.17
Coef Variation	14.27	14.63	15.38
Number missing	0	0	0
Median	7.2	7.9	7.5
Mode	7.2	8.3	7.2

Table A-77. Sample statistics for Sagittal FD Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	7.50	8.02	7.77
Standard deviation	1.11	1.12	1.13
Standard error of mean	0.20	0.19	0.14
Upper 95% Mean	7.91	8.41	8.05
Lower 95% Mean	7.09	7.62	7.48
Sample size	31	33	64
Sample variance	1.23	1.25	1.29
Skewness (g1)	-0.98	0.25	-0.30
Kurtosis (g2)	2.15	-0.35	1.14
Coef Variation	14.80	13.93	14.61
Number missing	0	0	0
Median	7.3	7.9	7.8
Mode	8.5	6.8	8.5

Table A-78. Sample statistics for Change in Sagittal FD L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.44	0.15	0.29
Standard deviation	1.01	0.56	0.82
Standard error of mean	0.18	0.10	0.10
Upper 95% Mean	0.81	0.35	0.49
Lower 95% Mean	0.07	-0.05	0.09
Sample size	31	33	64
Sample variance	1.02	0.32	0.67
Skewness (g1)	1.96	-0.35	1.92
Kurtosis (g2)	7.27	1.48	9.51
Coef Variation	229.81	378.78	282.34
Number missing	0	0	0
Median	0.2	0.2	0.2
Mode	0.2	0.2	0.2
		One-sample t-test	2.83
		P-value (two tail)	0.0062

Table A-79. Sample statistics for Sagittal FW Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	18.07	16.73	17.38
Standard deviation	2.06	1.86	2.05
Standard error of mean	0.37	0.32	0.26
Upper 95% Mean	18.82	17.39	17.89
Lower 95% Mean	17.31	16.07	16.87
Sample size	31	33	64
Sample variance	4.24	3.45	4.22
Skewness (g1)	0.52	0.37	0.46
Kurtosis (g2)	0.21	-0.47	0.05
Coef Variation	11.39	11.10	11.82
Number missing	0	0	0
Median	18.0	16.6	17.5
Mode	18.5	18.0	18.0

Table A-80. Sample statistics for Sagittal FW Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	18.44	17.02	17.70
Standard deviation	1.91	1.68	1.92
Standard error of mean	0.34	0.29	0.24
Upper 95% Mean	19.14	17.61	18.18
Lower 95% Mean	17.73	16.42	17.22
Sample size	31	33	64
Sample variance	3.65	2.82	3.68
Skewness (g1)	0.08	0.13	0.21
Kurtosis (g2)	-0.36	-0.62	-0.37
Coef Variation	10.36	9.88	10.84
Number missing	0	0	0
Median	18.5	16.6	17.7
Mode	19.1	16.0	16.5

Table A-81. Sample statistics for Change in Sagittal FW R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.37	0.28	0.32
Standard deviation	1.31	1.39	1.34
Standard error of mean	0.24	0.24	0.17
Upper 95% Mean	0.85	0.78	0.66
Lower 95% Mean	-0.11	-0.21	-0.01
Sample size	31	33	64
Sample variance	1.71	1.93	1.80
Skewness (g1)	-0.10	-1.27	-0.74
Kurtosis (g2)	0.54	3.93	2.32
Coef Variation	355.83	493.55	414.80
Number missing	0	0	0
Median	0.5	0.3	0.4
Mode	-1.0	0.6	0.2
		One-sample t-test	1.93
		P-value (two tail)	0.0583

Table A-82. Sample statistics for Sagittal FD Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	7.37	7.85	7.62
Standard deviation	1.12	0.84	1.01
Standard error of mean	0.20	0.15	0.13
Upper 95% Mean	7.78	8.14	7.87
Lower 95% Mean	6.96	7.55	7.36
Sample size	31	33	64
Sample variance	1.26	0.71	1.02
Skewness (g1)	0.00	0.57	-0.03
Kurtosis (g2)	-0.67	0.29	-0.08
Coef Variation	15.24	10.74	13.25
Number missing	0	0	0
Median	7.4	7.8	7.6
Mode	6.1	7.6	7.6

Table A-83. Sample statistics for Sagittal FD Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	7.71	7.98	7.85
Standard deviation	1.02	1.07	1.05
Standard error of mean	0.18	0.19	0.13
Upper 95% Mean	8.09	8.36	8.11
Lower 95% Mean	7.33	7.61	7.59
Sample size	31	33	64
Sample variance	1.05	1.14	1.10
Skewness (g1)	-0.01	0.03	0.03
Kurtosis (g2)	-0.94	0.10	-0.39
Coef Variation	13.28	13.37	13.34
Number missing	0	0	0
Median	7.8	8.0	7.9
Mode	6.2	7.3	7.8

Table A-84. Sample statistics for Change in Sagittal FD R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.34	0.14	0.24
Standard deviation	0.66	0.68	0.67
Standard error of mean	0.12	0.12	0.08
Upper 95% Mean	0.58	0.38	0.40
Lower 95% Mean	0.10	-0.10	0.07
Sample size	31	33	64
Sample variance	0.44	0.46	0.45
Skewness (g1)	-0.41	-0.32	-0.35
Kurtosis (g2)	-0.76	-0.16	-0.49
Coef Variation	195.20	486.54	284.91
Number missing	0	0	0
Median	0.5	0.1	0.3
Mode	0.3	0.1	0.3
		One-sample t-test	2.81
		P-value (two tail)	0.0066

Table A-85. Sample statistics for Sagittal CHW Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	8.82	8.90	8.86
Standard deviation	1.25	1.26	1.24
Standard error of mean	0.22	0.22	0.16
Upper 95% Mean	9.28	9.34	9.17
Lower 95% Mean	8.36	8.45	8.55
Sample size	31	33	64
Sample variance	1.56	1.58	1.55
Skewness (g1)	-0.66	-0.23	-0.42
Kurtosis (g2)	0.39	-0.56	-0.17
Coef Variation	14.15	14.12	14.03
Number missing	0	0	0
Median	8.9	8.9	8.9
Mode	8.9	8.9	8.9

Table A-86. Sample statistics for Sagittal CHW Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	8.77	8.89	8.83
Standard deviation	1.50	1.14	1.32
Standard error of mean	0.27	0.20	0.17
Upper 95% Mean	9.32	9.30	9.16
Lower 95% Mean	8.22	8.49	8.50
Sample size	31	33	64
Sample variance	2.26	1.31	1.75
Skewness (g1)	-0.59	0.18	-0.38
Kurtosis (g2)	-0.37	1.34	0.29
Coef Variation	17.14	12.87	14.95
Number missing	0	0	0
Median	8.9	8.9	8.9
Mode	8.6	9.3	9.3

Table A-87. Sample statistics for Change in Sagittal CHW L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.05	0.00	-0.03
Standard deviation	0.85	0.86	0.85
Standard error of mean	0.15	0.15	0.11
Upper 95% Mean	0.26	0.30	0.19
Lower 95% Mean	-0.36	-0.31	-0.24
Sample size	31	33	64
Sample variance	0.72	0.75	0.72
Skewness (g1)	-0.68	0.65	0.03
Kurtosis (g2)	0.95	1.55	1.15
Coef Variation	-1,751.90	-28,536.95	-3,400.09
Number missing	0	0	0
Median	0.0	-0.1	0.0
Mode	0.0	0.1	0.1
		One-sample t-test	-0.24
		P-value (two tail)	0.8147

Table A-88. Sample statistics for Sagittal CHH Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.56	6.43	6.49
Standard deviation	1.02	0.99	1.00
Standard error of mean	0.18	0.17	0.12
Upper 95% Mean	6.94	6.78	6.74
Lower 95% Mean	6.19	6.07	6.24
Sample size	31	33	64
Sample variance	1.04	0.99	1.00
Skewness (g1)	0.99	0.68	0.81
Kurtosis (g2)	0.46	0.53	0.41
Coef Variation	15.50	15.46	15.39
Number missing	0	0	0
Median	6.2	6.3	6.3
Mode	6.2	6.1	6.2

Table A-89. Sample statistics for Sagittal CHH Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.61	6.59	6.60
Standard deviation	0.92	1.02	0.97
Standard error of mean	0.17	0.18	0.12
Upper 95% Mean	6.95	6.95	6.84
Lower 95% Mean	6.28	6.23	6.36
Sample size	31	33	64
Sample variance	0.85	1.04	0.93
Skewness (g1)	0.00	0.43	0.25
Kurtosis (g2)	-1.28	0.39	-0.31
Coef Variation	13.92	15.47	14.62
Number missing	0	0	0
Median	6.5	6.5	6.5
Mode	7.5	6.0	6.0

Table A-90. Sample statistics for Change in Sagittal CHH L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.05	0.16	0.11
Standard deviation	0.90	0.72	0.81
Standard error of mean	0.16	0.13	0.10
Upper 95% Mean	0.38	0.42	0.31
Lower 95% Mean	-0.28	-0.09	-0.10
Sample size	31	33	64
Sample variance	0.81	0.52	0.65
Skewness (g1)	-0.54	0.36	-0.26
Kurtosis (g2)	1.08	-0.58	0.74
Coef Variation	1,864.49	447.35	760.54
Number missing	0	0	0
Median	0.2	0.1	0.1
Mode	-0.4	-0.5	0.4
		One-sample t-test	1.05
		P-value (two tail)	0.2969

Table A-91. Sample statistics for Sagittal CH Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	16.40	14.42	15.38
Standard deviation	2.47	2.24	2.54
Standard error of mean	0.44	0.39	0.32
Upper 95% Mean	17.31	15.21	16.01
Lower 95% Mean	15.49	13.62	14.74
Sample size	31	33	64
Sample variance	6.12	5.04	6.47
Skewness (g1)	0.04	0.64	0.34
Kurtosis (g2)	0.17	-0.44	-0.44
Coef Variation	15.09	15.57	16.54
Number missing	0	0	0
Median	16.4	13.7	15.3
Mode	16.5	13.0	13.1

Table A-92. Sample statistics for Sagittal CH Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	16.44	15.81	16.11
Standard deviation	3.05	2.49	2.77
Standard error of mean	0.55	0.43	0.35
Upper 95% Mean	17.55	16.69	16.81
Lower 95% Mean	15.32	14.93	15.42
Sample size	31	33	64
Sample variance	9.29	6.18	7.66
Skewness (g1)	0.68	0.65	0.71
Kurtosis (g2)	0.09	0.11	0.21
Coef Variation	18.54	15.72	17.18
Number missing	0	0	0
Median	15.9	15.3	15.5
Mode	14.8	17.9	15.4

Table A-93. Sample statistics for Change in Sagittal CH L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.04	1.39	0.74
Standard deviation	1.98	1.48	1.85
Standard error of mean	0.36	0.26	0.23
Upper 95% Mean	0.76	1.92	1.20
Lower 95% Mean	-0.69	0.87	0.27
Sample size	31	33	64
Sample variance	3.91	2.18	3.44
Skewness (g1)	-0.61	0.08	-0.60
Kurtosis (g2)	-0.22	-0.94	0.40
Coef Variation	5,573.80	105.86	251.91
Number missing	0	0	0
Median	0.2	1.4	0.8
Mode	0.2	0.0	0.0
		One-sample t-test	3.18
		P-value (two tail)	0.0023

Table A-94. Sample statistics for Sagittal CHW Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	9.36	8.87	9.11
Standard deviation	0.99	1.35	1.21
Standard error of mean	0.18	0.24	0.15
Upper 95% Mean	9.73	9.35	9.41
Lower 95% Mean	9.00	8.39	8.81
Sample size	31	33	64
Sample variance	0.99	1.84	1.46
Skewness (g1)	-0.50	0.17	-0.19
Kurtosis (g2)	-0.03	-0.59	-0.48
Coef Variation	10.61	15.27	13.28
Number missing	0	0	0
Median	9.4	8.7	9.3
Mode	10.6	8.0	8.0

Table A-95. Sample statistics for Sagittal CHW Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	9.35	8.72	9.02
Standard deviation	1.11	1.37	1.28
Standard error of mean	0.20	0.24	0.16
Upper 95% Mean	9.76	9.20	9.34
Lower 95% Mean	8.94	8.23	8.70
Sample size	31	33	64
Sample variance	1.24	1.88	1.65
Skewness (g1)	-0.22	0.67	0.19
Kurtosis (g2)	-0.60	0.25	-0.45
Coef Variation	11.92	15.74	14.24
Number missing	0		0
Median	9.5	8.8	8.9
Mode	8.9	7.2	8.9

Table A-96. Sample statistics for Change in Sagittal CHW R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.01	-0.16	-0.09
Standard deviation	0.80	0.87	0.83
Standard error of mean	0.14	0.15	0.10
Upper 95% Mean	0.28	0.15	0.12
Lower 95% Mean	-0.31	-0.47	-0.30
Sample size	31	33	64
Sample variance	0.65	0.75	0.70
Skewness (g1)	-0.47	-0.25	-0.35
Kurtosis (g2)	0.34	0.39	0.24
Coef Variation	-6,234.59	-551.20	-953.90
Number missing	0	0	0
Median	0.1	-0.2	-0.1
Mode	-0.1	-0.7	-0.4
		One-sample t-test	-0.84
		P-value (two tail)	0.4048

Table A-97. Sample statistics for Sagittal CHH Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.69	6.33	6.51
Standard deviation	1.00	0.79	0.91
Standard error of mean	0.18	0.14	0.11
Upper 95% Mean	7.06	6.61	6.74
Lower 95% Mean	6.33	6.05	6.28
Sample size	31	33	64
Sample variance	1.01	0.63	0.83
Skewness (g1)	-0.18	-0.21	-0.04
Kurtosis (g2)	-0.51	0.87	-0.07
Coef Variation	15.00	12.51	14.01
Number missing	0	0	0
Median	6.5	6.3	6.4
Mode	6.4	5.8	6.4

Table A-98. Sample statistics for Sagittal CHH Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	7.15	6.52	6.82
Standard deviation	1.22	0.95	1.12
Standard error of mean	0.22	0.16	0.14
Upper 95% Mean	7.59	6.85	7.10
Lower 95% Mean	6.70	6.18	6.54
Sample size	31	33	64
Sample variance	1.49	0.89	1.26
Skewness (g1)	0.87	0.31	0.80
Kurtosis (g2)	-0.09	-0.27	0.49
Coef Variation	17.06	14.51	16.46
Number missing	0	0	0
Median	6.5	6.4	6.5
Mode	6.2	6.1	6.2

Table A-99. Sample statistics for Change in Sagittal CHH R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.45	0.18	0.31
Standard deviation	1.06	0.91	0.99
Standard error of mean	0.19	0.16	0.12
Upper 95% Mean	0.84	0.51	0.56
Lower 95% Mean	0.06	-0.14	0.07
Sample size	31	33	64
Sample variance	1.13	0.82	0.97
Skewness (g1)	0.58	-0.18	0.33
Kurtosis (g2)	1.06	-0.30	0.74
Coef Variation	235.65	489.72	314.18
Number missing	0	0	0
Median	0.4	0.2	0.3
Mode	0.0	0.6	0.6
		One-sample t-test	2.55
		P-value (two tail)	0.0133

Table A-100. Sample statistics for Sagittal CH Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	16.35	14.22	15.25
Standard deviation	2.42	2.57	2.70
Standard error of mean	0.43	0.45	0.34
Upper 95% Mean	17.23	15.14	15.93
Lower 95% Mean	15.46	13.31	14.58
Sample size	31	33	64
Sample variance	5.84	6.60	7.28
Skewness (g1)	-0.24	0.88	0.23
Kurtosis (g2)	0.19	0.10	-0.74
Coef Variation	14.79	18.06	17.69
Number missing	0	0	0
Median	16.3	13.3	15.1
Mode	15.9	12.1	16.8

Table A-101. Sample statistics for Sagittal CH Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	16.56	15.73	16.13
Standard deviation	2.84	2.54	2.70
Standard error of mean	0.51	0.44	0.34
Upper 95% Mean	17.61	16.63	16.81
Lower 95% Mean	15.52	14.83	15.46
Sample size	31	33	64
Sample variance	8.09	6.46	7.31
Skewness (g1)	0.14	0.37	0.28
Kurtosis (g2)	-0.25	-0.24	-0.32
Coef Variation	17.17	16.16	16.76
Number missing	0	0	0
Median	16.5	15.5	15.8
Mode	14.3	14.1	15.5

Table A-102. Sample statistics for Change in Sagittal CH Right, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.22	1.50	0.88
Standard deviation	1.55	1.51	1.65
Standard error of mean	0.28	0.26	0.21
Upper 95% Mean	0.79	2.04	1.29
Lower 95% Mean	-0.35	0.97	0.47
Sample size	31	33	64
Sample variance	2.39	2.28	2.71
Skewness (g1)	-0.76	-0.84	-0.63
Kurtosis (g2)	0.69	0.46	0.27
Coef Variation	704.52	100.43	186.90
Number missing	0	0	0
Median	0.60	1.80	1.05
Mode	0.90	1.40	0.90
		One-sample t-test	4.28
		P-value (two tail)	<0.0001

Table A-103. Sample statistics for Sagittal EAM-AE Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	23.06	22.85	22.95
Standard deviation	1.99	1.97	1.97
Standard error of mean	0.36	0.34	0.25
Upper 95% Mean	23.79	23.55	23.44
Lower 95% Mean	22.33	22.15	22.46
Sample size	31	33	64
Sample variance	3.96	3.89	3.88
Skewness (g1)	-0.34	-0.15	-0.24
Kurtosis (g2)	-1.10	-0.32	-0.76
Coef Variation	8.63	8.63	8.58
Number missing	0	0	0
Median	23.5	23.0	23.1
Mode	19.8	19.5	23.0

Table A-104. Sample statistics for Sagittal EAM-AE Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	23.96	23.78	23.87
Standard deviation	1.88	2.25	2.06
Standard error of mean	0.34	0.39	0.26
Upper 95% Mean	24.66	24.58	24.39
Lower 95% Mean	23.27	22.99	23.36
Sample size	31	33	64
Sample variance	3.55	5.05	4.26
Skewness (g1)	-0.67	0.03	-0.24
Kurtosis (g2)	0.01	-0.18	-0.17
Coef Variation	7.86	9.45	8.65
Number missing	0	0	0
Median	24.1	24.2	24.2
Mode	24.1	22.6	24.5

Table A-105. Sample statistics for Change in Sagittal EAM-AE L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.90	0.94	0.92
Standard deviation	1.18	0.99	1.08
Standard error of mean	0.21	0.17	0.13
Upper 95% Mean	1.33	1.29	1.19
Lower 95% Mean	0.47	0.58	0.65
Sample size	31	33	64
Sample variance	1.39	0.99	1.17
Skewness (g1)	1.40	0.67	1.09
Kurtosis (g2)	5.10	0.60	3.27
Coef Variation	131.16	106.12	117.50
Number missing	0	0	0
Median	0.7	0.8	0.7
Mode	0.5	1.3	1.3
		One-sample t-test	6.81
		P-value (two tail)	<0.0001

Table A-106. Sample statistics for Sagittal EAM-C Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	12.74	13.22	12.99
Standard deviation	1.45	1.48	1.47
Standard error of mean	0.26	0.26	0.18
Upper 95% Mean	13.27	13.75	13.36
Lower 95% Mean	12.21	12.70	12.62
Sample size	31	33	64
Sample variance	2.11	2.19	2.18
Skewness (g1)	0.07	0.31	0.20
Kurtosis (g2)	-0.39	-0.33	-0.32
Coef Variation	11.40	11.19	11.35
Number missing	0	0	0
Median	12.7	13.2	13.1
Mode	11.6	11.3	12.0

Table A-107. Sample statistics for Sagittal EAM-C Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	13.73	13.38	13.55
Standard deviation	2.08	1.50	1.80
Standard error of mean	0.37	0.26	0.22
Upper 95% Mean	14.49	13.92	14.00
Lower 95% Mean	12.96	12.85	13.10
Sample size	31	33	64
Sample variance	4.31	2.26	3.23
Skewness (g1)	1.23	-0.09	0.94
Kurtosis (g2)	4.42	-0.61	3.82
Coef Variation	15.12	11.22	13.26
Number missing	0	0	0
Median	13.5	13.5	13.5
Mode	13.3	11.9	13.5

Table A-108. Sample statistics for Change in Sagittal EAM-C L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.98	0.16	0.56
Standard deviation	1.84	1.02	1.52
Standard error of mean	0.33	0.18	0.19
Upper 95% Mean	1.66	0.53	0.94
Lower 95% Mean	0.31	-0.20	0.18
Sample size	31	33	64
Sample variance	3.37	1.05	2.31
Skewness (g1)	4.13	0.42	3.83
Kurtosis (g2)	20.50	0.97	23.43
Coef Variation	186.59	625.05	270.77
Number missing	0	0	0
Median	0.7	0.1	0.4
Mode	0.6	-0.6	0.6
		One-sample t-test	2.95
		P-value (two tail)	0.0044

Table A-109. Sample statistics for Sagittal EAM-P Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	5.45	5.82	5.64
Standard deviation	1.13	0.97	1.06
Standard error of mean	0.20	0.17	0.13
Upper 95% Mean	5.86	6.17	5.91
Lower 95% Mean	5.03	5.48	5.38
Sample size	31	33	64
Sample variance	1.27	0.95	1.12
Skewness (g1)	0.14	-0.07	-0.03
Kurtosis (g2)	-0.67	-0.48	-0.63
Coef Variation	20.69	16.73	18.78
Number missing	0	0	0
Median	5.4	5.8	5.7
Mode	4.0	5.5	5.5

Table A-110. Sample statistics for Sagittal EAM-P Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	5.94	6.16	6.05
Standard deviation	1.16	1.27	1.22
Standard error of mean	0.21	0.22	0.15
Upper 95% Mean	6.36	6.61	6.36
Lower 95% Mean	5.51	5.71	5.75
Sample size	31	33	64
Sample variance	1.35	1.62	1.48
Skewness (g1)	0.00	0.71	0.43
Kurtosis (g2)	-0.34	1.08	0.57
Coef Variation	19.54	20.66	20.08
Number missing	0	0	0
Median	6.0	6.0	6.0
Mode	6.0	7.2	5.1

Table A-111. Sample statistics for Change in Sagittal EAM-P L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.49	0.34	0.41
Standard deviation	0.72	0.83	0.78
Standard error of mean	0.13	0.14	0.10
Upper 95% Mean	0.75	0.63	0.61
Lower 95% Mean	0.22	0.05	0.22
Sample size	31	33	64
Sample variance	0.53	0.69	0.60
Skewness (g1)	0.84	1.03	0.89
Kurtosis (g2)	0.30	4.48	2.63
Coef Variation	148.78	244.19	189.20
Number missing	0	0	0
Median	0.2	0.3	0.3
Mode	0.1	-0.1	0.1
		One-sample t-test	4.23
		P-value (two tail)	<0.0001

Table A-112. Sample statistics for Sagittal EAM-AE Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	24.50	22.62	23.53
Standard deviation	2.02	2.16	2.28
Standard error of mean	0.36	0.38	0.29
Upper 95% Mean	25.24	23.39	24.10
Lower 95% Mean	23.76	21.86	22.96
Sample size	31	33	64
Sample variance	4.08	4.65	5.20
Skewness (g1)	0.45	-0.04	0.06
Kurtosis (g2)	0.24	-0.48	0.08
Coef Variation	8.25	9.54	9.69
Number missing	0	0	0
Median	24.2	23.2	23.7
Mode	23.1	24.1	24.1

Table A-113. Sample statistics for Sagittal EAM-AE Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	24.92	23.23	24.05
Standard deviation	2.17	1.97	2.22
Standard error of mean	0.39	0.34	0.28
Upper 95% Mean	25.71	23.93	24.60
Lower 95% Mean	24.12	22.53	23.49
Sample size	31	33	64
Sample variance	4.72	3.89	4.94
Skewness (g1)	0.00	-0.47	-0.06
Kurtosis (g2)	-0.30	-0.33	-0.02
Coef Variation	8.72	8.49	9.24
Number missing	0	0	0
Median	24.8	23.5	24.3
Mode	24.4	22.6	22.6

Table A-114. Sample statistics for Change in Sagittal EAM-AE R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.42	0.61	0.52
Standard deviation	1.19	1.34	1.26
Standard error of mean	0.21	0.23	0.16
Upper 95% Mean	0.85	1.09	0.83
Lower 95% Mean	-0.02	0.14	0.20
Sample size	31	33	64
Sample variance	1.41	1.80	1.60
Skewness (g1)	0.37	-0.14	0.09
Kurtosis (g2)	2.36	-0.36	0.45
Coef Variation	285.43	219.40	244.39
Number missing	0	0	0
Median	0.2	0.5	0.4
Mode	0.2	-0.5	0.0
		One-sample t-test	3.27
		P-value (two tail)	0.0017

Table A-115. Sample statistics for Sagittal EAM-C Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	13.72	12.98	13.34
Standard deviation	1.34	1.49	1.46
Standard error of mean	0.24	0.26	0.18
Upper 95% Mean	14.21	13.51	13.70
Lower 95% Mean	13.23	12.45	12.98
Sample size	31	33	64
Sample variance	1.79	2.23	2.12
Skewness (g1)	0.98	-0.07	0.23
Kurtosis (g2)	0.94	-0.51	0.40
Coef Variation	9.75	11.50	10.92
Number missing	0	0	0
Median	13.4	13.0	13.2
Mode	12.7	11.6	13.0

Table A-116. Sample statistics for Sagittal EAM-C Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	14.00	13.11	13.54
Standard deviation	1.51	1.43	1.52
Standard error of mean	0.27	0.25	0.19
Upper 95% Mean	14.56	13.62	13.92
Lower 95% Mean	13.45	12.60	13.16
Sample size	31	33	64
Sample variance	2.27	2.05	2.32
Skewness (g1)	0.24	-0.52	-0.06
Kurtosis (g2)	0.93	0.46	0.87
Coef Variation	10.76	10.92	11.25
Number missing	0	0	0
Median	13.7	13.2	13.6
Mode	13.0	13.6	13.0

Table A-117. Sample statistics for Change in Sagittal EAM-C R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.28	0.13	0.20
Standard deviation	0.87	1.08	0.98
Standard error of mean	0.16	0.19	0.12
Upper 95% Mean	0.60	0.51	0.45
Lower 95% Mean	-0.04	-0.25	-0.04
Sample size	31	33	64
Sample variance	0.76	1.17	0.96
Skewness (g1)	0.71	0.94	0.80
Kurtosis (g2)	2.98	2.58	2.49
Coef Variation	306.31	829.78	478.63
Number missing	0	0	0
Median	0.3	-0.1	0.3
Mode	0.3	-0.2	0.3
		One-sample t-test	1.67
		P-value (two tail)	0.0996

Table A-118. Sample statistics for Sagittal EAM-P Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.10	5.85	5.97
Standard deviation	1.28	0.94	1.11
Standard error of mean	0.23	0.16	0.14
Upper 95% Mean	6.57	6.18	6.25
Lower 95% Mean	5.63	5.52	5.69
Sample size	31	33	64
Sample variance	1.64	0.88	1.24
Skewness (g1)	1.03	0.56	0.99
Kurtosis (g2)	1.42	1.11	1.78
Coef Variation	20.98	16.00	18.65
Number missing	0	0	0
Median	6.1	5.9	6.0
Mode	5.3	6.0	5.5

Table A-119. Sample statistics for Sagittal EAM-P Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.11	6.04	6.08
Standard deviation	1.27	0.85	1.07
Standard error of mean	0.23	0.15	0.13
Upper 95% Mean	6.58	6.34	6.34
Lower 95% Mean	5.64	5.74	5.81
Sample size	31	33	64
Sample variance	1.62	0.73	1.14
Skewness (g1)	0.53	-0.15	0.41
Kurtosis (g2)	0.24	0.09	0.63
Coef Variation	20.82	14.10	17.58
Number missing	0	0	0
Median	6.0	6.1	6.1
Mode	4.3	5.6	6.2

Table A-120. Sample statistics for Change in EAM P-R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.01	0.19	0.10
Standard deviation	0.64	0.62	0.63
Standard error of mean	0.11	0.11	0.08
Upper 95% Mean	0.24	0.41	0.26
Lower 95% Mean	-0.22	-0.03	-0.05
Sample size	31	33	64
Sample variance	0.40	0.38	0.39
Skewness (g1)	-1.98	-0.01	-0.96
Kurtosis (g2)	7.21	0.43	3.95
Coef Variation	6,564.47	322.99	608.40
Number missing	0	0	0
Median	0.0	0.2	0.2
Mode	-0.1	0.2	0.0
		One-sample t-test	1.31
		P-value (two tail)	0.1933

Table A-121. Sample statistics for Sagittal ATA Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	36.76	43.95	40.47
Standard deviation	5.64	7.71	7.64
Standard error of mean	1.01	1.34	0.96
Upper 95% Mean	38.83	46.68	42.38
Lower 95% Mean	34.69	41.22	38.56
Sample size	31	33	64
Sample variance	31.81	59.38	58.43
Skewness (g1)	-0.62	0.20	0.32
Kurtosis (g2)	0.03	-0.02	0.45
Coef Variation	15.34	17.53	18.89
Number missing	0	0	0
Median	38.3	44.3	40.3
Mode	26.6	44.3	39.7

Table A-122. Sample statistics for Sagittal ATA Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	37.92	41.83	39.94
Standard deviation	6.51	7.84	7.43
Standard error of mean	1.17	1.36	0.93
Upper 95% Mean	40.30	44.61	41.79
Lower 95% Mean	35.53	39.05	38.08
Sample size	31	33	64
Sample variance	42.35	61.40	55.25
Skewness (g1)	0.05	0.88	0.66
Kurtosis (g2)	0.38	2.18	1.88
Coef Variation	17.16	18.73	18.61
Number missing	0	0	0
Median	37.5	41.5	39.7
Mode	37.1	37.9	37.1

Table A-123. Sample statistics for Change in Sagittal ATA L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.15	-2.12	-0.53
Standard deviation	4.34	4.32	4.60
Standard error of mean	0.78	0.75	0.57
Upper 95% Mean	2.75	-0.59	0.62
Lower 95% Mean	-0.44	-3.65	-1.68
Sample size	31	33	64
Sample variance	18.82	18.66	21.16
Skewness (g1)	-0.75	-0.02	-0.29
Kurtosis (g2)	0.55	-0.47	-0.51
Coef Variation	375.63	-203.94	-863.29
Number missing	0	0	0
Median	1.4	-1.4	-0.1
Mode	3.7	-6.8	-5.9
		One-sample t-test	-0.93
		P-value (two tail)	0.3576

Table A-124. Sample statistics for Sagittal CHA Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	141.59	141.18	141.38
Standard deviation	8.76	8.43	8.52
Standard error of mean	1.57	1.47	1.07
Upper 95% Mean	144.80	144.17	143.51
Lower 95% Mean	138.38	138.20	139.25
Sample size	31	33	64
Sample variance	76.69	71.03	72.64
Skewness (g1)	-0.48	0.17	-0.16
Kurtosis (g2)	1.31	0.06	0.52
Coef Variation	6.18	5.97	6.03
Number missing	0	0	0
Median	142.4	141.9	142.2
Mode	135.8	134.1	135.8

Table A-125. Sample statistics for Sagittal CHA Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	135.11	133.47	134.27
Standard deviation	9.86	13.19	11.64
Standard error of mean	1.77	2.30	1.45
Upper 95% Mean	138.73	138.15	137.17
Lower 95% Mean	131.50	128.80	131.36
Sample size	31	33	64
Sample variance	97.28	173.98	135.38
Skewness (g1)	0.08	-0.45	-0.36
Kurtosis (g2)	-0.44	-0.46	-0.20
Coef Variation	7.30	9.88	8.67
Number missing	0	0	0
Median	135.8	135.6	135.7
Mode	122.4	.	128.9

Table A-126. Sample statistics for Change in Sagittal CHA L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-6.48	-7.71	-7.11
Standard deviation	8.39	12.08	10.39
Standard error of mean	1.51	2.10	1.30
Upper 95% Mean	-3.40	-3.43	-4.52
Lower 95% Mean	-9.56	-12.00	-9.71
Sample size	31	33	64
Sample variance	70.42	145.94	108.04
Skewness (g1)	-0.86	-0.83	-0.92
Kurtosis (g2)	1.75	1.35	1.83
Coef Variation	-129.55	-156.64	-146.11
Number missing	0	0	0
Median	-6.4	-6.5	-6.5
Mode	-0.8	.	-8.1
		One-sample t-test	5.48
		P-value (two tail)	<0.0001

Table A-127. Sample statistics for Sagittal ATA Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	36.71	44.79	40.88
Standard deviation	5.83	6.85	7.52
Standard error of mean	1.05	1.19	0.94
Upper 95% Mean	38.85	47.22	42.76
Lower 95% Mean	34.57	42.36	39.00
Sample size	31	33	64
Sample variance	33.98	46.96	56.62
Skewness (g1)	-0.27	-0.16	0.06
Kurtosis (g2)	0.60	-0.79	-0.31
Coef Variation	15.88	15.30	18.4
Number missing	0	0	0
Median	36.7	45.5	40.4
Mode	37.8	45.5	36.6

Table A-128. Sample statistics for Sagittal ATA Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	38.24	42.79	40.59
Standard deviation	5.46	6.94	6.62
Standard error of mean	0.98	1.21	0.83
Upper 95% Mean	40.24	45.25	42.24
Lower 95% Mean	36.24	40.33	38.93
Sample size	31	33	64
Sample variance	29.80	48.12	43.88
Skewness (g1)	-0.32	0.01	0.14
Kurtosis (g2)	-0.30	-0.89	-0.39
Coef Variation	14.28	16.21	16.32
Number missing	0	0	0
Median	38.6	43.1	40.2
Mode	38.6	50.7	35.4

Table A-129. Sample statistics for Change in Sagittal ATA R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.53	-2.01	-0.29
Standard deviation	4.00	4.13	4.41
Standard error of mean	0.72	0.72	0.55
Upper 95% Mean	3.00	-0.54	0.81
Lower 95% Mean	0.06	-3.47	-1.39
Sample size	31	33	64
Sample variance	16.01	17.07	19.47
Skewness (g1)	-0.26	-0.53	-0.33
Kurtosis (g2)	0.34	2.17	0.97
Coef Variation	261.10	-205.97	-1,510.15
Number missing	0	0	0
Median	1.8	-1.9	-0.1
Mode	-2.4	-6.0	1.8
		One-sample t-test	0.53
		P-value (two tail)	0.5981

Table A-130. Sample statistics for Sagittal CHA Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	143.99	137.92	140.86
Standard deviation	6.68	9.03	8.49
Standard error of mean	1.20	1.57	1.06
Upper 95% Mean	146.44	141.12	142.98
Lower 95% Mean	141.54	134.71	138.74
Sample size	31	33	64
Sample variance	44.58	81.63	72.06
Skewness (g1)	-0.45	-0.42	-0.63
Kurtosis (g2)	0.08	-0.46	0.05
Coef Variation	4.64	6.55	6.03
Number missing	0	0	0
Median	143.6	139.5	142.2
Mode	143.6	134.6	139.5

Table A-131. Sample statistics for Sagittal CHA Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	138.69	131.83	135.15
Standard deviation	8.58	12.17	11.06
Standard error of mean	1.54	2.12	1.38
Upper 95% Mean	141.84	136.14	137.92
Lower 95% Mean	135.55	127.51	132.39
Sample size	31	33	64
Sample variance	73.60	148.20	122.29
Skewness (g1)	-0.26	-0.20	-0.47
Kurtosis (g2)	1.62	-0.98	-0.14
Coef Variation	6.19	9.23	8.18
Number missing	0	0	0
Median	140.5	134.5	138.1
Mode	143.8	120.2	134.5

Table A-132. Sample statistics for Change in Sagittal CHA R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-5.30	-6.09	-5.71
Standard deviation	6.12	10.65	8.69
Standard error of mean	1.10	1.85	1.09
Upper 95% Mean	-3.06	-2.32	-3.54
Lower 95% Mean	-7.54	-9.87	-7.88
Sample size	31	33	64
Sample variance	37.45	113.40	75.59
Skewness (g1)	-0.22	-0.33	-0.41
Kurtosis (g2)	-0.27	0.81	1.52
Coef Variation	-115.47	-174.83	-152.32
Number missing	0	0	0
Median	-4.2	-6.4	-5.3
Mode	-4.2	-7.5	-4.2
		One-sample t-test	5.25
		P-value (two tail)	<0.0001

Table A-133. Sample statistics for Sagittal ACP Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	48.65	42.69	45.58
Standard deviation	12.35	9.57	11.32
Standard error of mean	2.22	1.67	1.42
Upper 95% Mean	53.19	46.08	48.41
Lower 95% Mean	44.12	39.30	42.75
Sample size	31	33	64
Sample variance	152.59	91.57	128.20
Skewness (g1)	0.70	0.27	0.69
Kurtosis (g2)	0.00	-0.05	0.47
Coef Variation	25.39	22.42	24.84
Number missing	0		0
Median	45.8	43.1	43.6
Mode	36.9	35.6	46.7

Table A-134. Sample statistics for Sagittal ACP Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	50.20	42.11	46.03
Standard deviation	11.71	9.55	11.32
Standard error of mean	2.10	1.66	1.41
Upper 95% Mean	54.49	45.49	48.85
Lower 95% Mean	45.90	38.72	43.20
Sample size	31	33	64
Sample variance	137.01	91.12	128.13
Skewness (g1)	0.40	1.26	0.77
Kurtosis (g2)	-0.28	1.74	0.06
Coef Variation	23.32	22.67	24.59
Number missing	0	0	0
Median	49.5	39.8	44.7
Mode	.	33.8	33.8

Table A-135. Sample statistics for Change in ACP L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.54	-0.58	0.45
Standard deviation	8.98	6.00	7.60
Standard error of mean	1.61	1.04	0.95
Upper 95% Mean	4.83	1.54	2.34
Lower 95% Mean	-1.75	-2.71	-1.45
Sample size	31	33	64
Sample variance	80.57	36.03	57.82
Skewness (g1)	-1.18	0.01	-0.73
Kurtosis (g2)	2.63	-0.50	1.89
Coef Variation	582.13	-1,026.35	1,707.49
Number missing	0	0	0
Median	1.1	0.3	0.8
Mode	-0.9	-9.1	-0.9
		One-sample t-test	0.47
		P-value (two tail)	0.6410

Table A-136. Sample statistics for Sagittal AAE Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	86.10	89.88	88.05
Standard deviation	16.34	19.02	17.74
Standard error of mean	2.94	3.31	2.22
Upper 95% Mean	92.10	96.63	92.48
Lower 95% Mean	80.11	83.14	83.62
Sample size	31	33	64
Sample variance	267.11	361.77	314.58
Skewness (g1)	0.30	0.06	0.19
Kurtosis (g2)	-0.59	0.30	-0.06
Coef Variation	18.98	21.16	20.14
Number missing	0	0	0
Median	84.5	88.2	86.0
Mode	.	.	80.9

Table A-137. Sample statistics for Sagittal AAE Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	97.19	99.73	98.50
Standard deviation	19.30	27.06	23.47
Standard error of mean	3.47	4.71	2.93
Upper 95% Mean	104.27	109.33	104.37
Lower 95% Mean	90.12	90.13	92.64
Sample size	31	33	64
Sample variance	372.37	732.51	551.02
Skewness (g1)	0.35	0.92	0.84
Kurtosis (g2)	0.20	1.26	1.43
Coef Variation	19.85	27.14	23.83
Number missing	0	0	0
Median	97.1	95.3	96.2
Mode	112.9	.	81.2

Table A-138. Sample statistics for Change in Sagittal AAE L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	11.09	9.85	10.45
Standard deviation	11.93	16.14	14.16
Standard error of mean	2.14	2.81	1.77
Upper 95% Mean	15.46	15.57	13.98
Lower 95% Mean	6.72	4.12	6.91
Sample size	31	33	64
Sample variance	142.22	260.48	200.43
Skewness (g1)	-0.16	0.20	0.06
Kurtosis (g2)	-0.27	-0.59	-0.39
Coef Variation	107.53	163.93	135.50
Number missing	0	0	0
Median	11.8	8.4	9.2
Mode	2.8	.	2.8
		One-sample t-test	5.90
		P-value (two tail)	<0.0001

Table A-139. Sample statistics for Sagittal AGF Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	69.95	82.42	76.38
Standard deviation	14.31	15.78	16.23
Standard error of mean	2.57	2.75	2.03
Upper 95% Mean	75.19	88.02	80.43
Lower 95% Mean	64.70	76.83	72.32
Sample size	31	33	64
Sample variance	204.71	248.89	263.40
Skewness (g1)	-0.67	0.30	0.02
Kurtosis (g2)	0.47	-0.25	0.51
Coef Variation	20.46	19.14	21.25
Number missing	0	0	0
Median	72.9	82.1	76.2
Mode	69.2	70.4	69.2

Table A-140. Sample statistics for Sagittal AGF Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	77.87	81.86	79.93
Standard deviation	17.03	17.37	17.19
Standard error of mean	3.06	3.02	2.15
Upper 95% Mean	84.12	88.02	84.22
Lower 95% Mean	71.62	75.70	75.64
Sample size	31	33	64
Sample variance	290.12	301.88	295.53
Skewness (g1)	-0.90	0.65	-0.06
Kurtosis (g2)	0.56	0.37	0.68
Coef Variation	21.87	21.22	21.51
Number missing	0	0	0
Median	81.2	79.2	80.2
Mode	96.7	115.7	75.8

Table A-141. Sample statistics for Change in Sagittal AGF L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	7.93	-0.56	3.55
Standard deviation	12.49	7.42	10.98
Standard error of mean	2.24	1.29	1.37
Upper 95% Mean	12.51	2.07	6.29
Lower 95% Mean	3.34	-3.19	0.81
Sample size	31	33	64
Sample variance	156.00	55.02	120.49
Skewness (g1)	0.97	0.28	1.20
Kurtosis (g2)	2.70	0.23	3.46
Coef Variation	157.59	-1,330.28	309.07
Number missing	0	0	0
Median	7.8	-1.3	3.6
Mode	8.0	-2.3	0.4
		One-sample t-test	2.59
		P-value (two tail)	0.0120

Table A-142. Sample statistics for Sagittal ACP Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	49.29	42.02	45.54
Standard deviation	9.19	9.01	9.74
Standard error of mean	1.65	1.57	1.22
Upper 95% Mean	52.66	45.21	47.97
Lower 95% Mean	45.92	38.82	43.11
Sample size	31	33	64
Sample variance	84.38	81.24	94.85
Skewness (g1)	0.18	0.78	0.40
Kurtosis (g2)	0.62	-0.09	-0.26
Coef Variation	18.64	21.45	21.39
Number missing	0	0	0
Median	49.4	39.7	44.5
Mode	.	39.7	39.7

Table A-143. Sample statistics for Sagittal ACP Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	50.06	42.25	46.03
Standard deviation	12.23	9.31	11.43
Standard error of mean	2.20	1.62	1.43
Upper 95% Mean	54.54	45.55	48.89
Lower 95% Mean	45.57	38.95	43.17
Sample size	31	33	64
Sample variance	149.63	86.60	130.72
Skewness (g1)	0.55	0.46	0.69
Kurtosis (g2)	-0.31	-0.33	0.15
Coef Variation	24.44	22.03	24.84
Number missing	0	0	0
Median	48.1	40.5	44.1
Mode	.	35.6	35.6

Table A-144. Sample statistics for Change in Sagittal ACP R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.77	0.23	0.49
Standard deviation	8.33	7.04	7.63
Standard error of mean	1.50	1.22	0.95
Upper 95% Mean	3.83	2.72	2.40
Lower 95% Mean	-2.28	-2.27	-1.42
Sample size	31	33	64
Sample variance	69.37	49.52	58.26
Skewness (g1)	0.70	0.27	0.54
Kurtosis (g2)	1.10	0.54	0.89
Coef Variation	1,080.33	3,096.19	1,555.74
Number missing	0	0	0
Median	0.0	0.9	0.4
Mode	-8.8	.	-5.2
		One-sample t-test	0.51
		P-value (two tail)	0.6089

Table A-145. Sample statistics for Sagittal AAE Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	86.49	96.43	91.62
Standard deviation	21.03	23.52	22.73
Standard error of mean	3.78	4.09	2.84
Upper 95% Mean	94.20	104.77	97.29
Lower 95% Mean	78.77	88.09	85.94
Sample size	31	33	64
Sample variance	442.19	553.17	516.64
Skewness (g1)	0.14	0.04	0.15
Kurtosis (g2)	-0.88	0.40	-0.14
Coef Variation	24.31	24.39	24.81
Number missing	0	0	0
Median	84.6	97.1	92.8
Mode	49.7	68.8	94.2

Table A-146. Sample statistics for Sagittal AAE Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	97.32	102.21	99.84
Standard deviation	23.29	25.81	24.55
Standard error of mean	4.18	4.49	3.07
Upper 95% Mean	105.87	111.36	105.97
Lower 95% Mean	88.78	93.06	93.71
Sample size	31	33	64
Sample variance	542.53	666.01	602.69
Skewness (g1)	0.27	0.32	0.32
Kurtosis (g2)	-0.85	-0.11	-0.39
Coef Variation	23.93	25.25	24.59
Number missing	0	0	0
Median	103.1	98.8	99.2
Mode	103.1	120.6	70.9

Table A-147. Sample statistics for Change in Sagittal AAE R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	10.84	5.77	8.23
Standard deviation	16.63	14.37	15.59
Standard error of mean	2.99	2.50	1.95
Upper 95% Mean	16.94	10.87	12.12
Lower 95% Mean	4.74	0.68	4.33
Sample size	31	33	64
Sample variance	276.58	206.45	243.07
Skewness (g1)	0.53	0.67	0.62
Kurtosis (g2)	0.59	0.69	0.57
Coef Variation	153.48	248.90	189.55
Number missing	0	0	0
Median	9.5	3.1	6.3
Mode	6.1	.	9.5
		One-sample t-test	4.22
		P-value (two tail)	<0.0001

Table A-148. Sample statistics for Sagittal AGF Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	78.26	82.48	80.44
Standard deviation	15.31	15.74	15.56
Standard error of mean	2.75	2.74	1.94
Upper 95% Mean	83.88	88.06	84.32
Lower 95% Mean	72.65	76.90	76.55
Sample size	31	33	64
Sample variance	234.28	247.90	242.00
Skewness (g1)	-0.27	0.97	0.39
Kurtosis (g2)	0.44	1.84	1.33
Coef Variation	19.56	19.09	19.34
Number missing	0	0	0
Median	79.6	78.8	79.1
Mode	.	69.2	69.2

Table A-149. Sample statistics for Sagittal AGF Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	84.98	84.04	
Standard deviation	14.11	16.28	15.16
Standard error of mean	2.54	2.83	1.89
Upper 95% Mean	90.15	89.81	88.28
Lower 95% Mean	79.80	78.26	80.71
Sample size	31	33	64
Sample variance	199.22	265.11	229.75
Skewness (g1)	-0.22	0.47	0.19
Kurtosis (g2)	-0.57	1.84	0.87
Coef Variation	16.61	19.38	17.94
Number missing	0	0	0
Median	84.8	82.7	83.8
Mode	.	.	.

Table A-150. Sample statistics for Change in Sagittal AGF R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	6.71	1.55	4.05
Standard deviation	13.00	7.97	10.93
Standard error of mean	2.33	1.39	1.37
Upper 95% Mean	11.48	4.38	6.78
Lower 95% Mean	1.95	-1.27	1.32
Sample size	31	33	64
Sample variance	168.90	63.52	119.45
Skewness (g1)	0.40	0.34	0.69
Kurtosis (g2)	-0.03	-0.23	0.70
Coef Variation	193.60	512.69	269.65
Number missing	0	0	0
Median	6.0	0.7	3.1
Mode	.	-0.7	-0.7
		One-sample t-test	2.97
		P-value (two tail)	0.0042

Table A-151. Sample statistics for Coronal MJS Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.86	1.87	1.87
Standard deviation	0.64	0.74	0.68
Standard error of mean	0.11	0.13	0.09
Upper 95% Mean	2.09	2.13	2.04
Lower 95% Mean	1.62	1.61	1.69
Sample size	31	33	64
Sample variance	0.40	0.54	0.47
Skewness (g1)	0.40	0.71	0.59
Kurtosis (g2)	-0.25	0.41	0.15
Coef Variation	34.20	39.31	36.66
Number missing	0	0	0
Median	1.9	1.8	1.9
Mode	1.1	1.3	1.1

Table A-152. Sample statistics for Coronal MJS Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.80	2.16	1.99
Standard deviation	0.60	1.08	0.89
Standard error of mean	0.11	0.19	0.11
Upper 95% Mean	2.02	2.55	2.21
Lower 95% Mean	1.58	1.78	1.77
Sample size	31	33	64
Sample variance	0.36	1.17	0.80
Skewness (g1)	-0.49	1.06	1.16
Kurtosis (g2)	0.29	0.93	2.44
Coef Variation	33.38	49.95	44.93
Number missing	0	0	0
Median	1.8	2.0	1.9
Mode	1.6	1.7	1.6

Table A-153. Sample statistics for Change in Coronal MJS L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.05	0.29	0.12
Standard deviation	0.62	1.06	0.89
Standard error of mean	0.11	0.19	0.11
Upper 95% Mean	0.17	0.67	0.35
Lower 95% Mean	-0.28	-0.09	-0.10
Sample size	31	33	64
Sample variance	0.38	1.13	0.79
Skewness (g1)	-0.52	1.35	1.34
Kurtosis (g2)	4.16	2.83	4.69
Coef Variation	-1,129.84	365.45	719
Number missing	0	0	0
Median	-0.1	0.2	0.0
Mode	-0.3	-0.4	-0.4
		One-sample t-test	1.11
		P-value (two tail)	0.2699

Table A-154. Sample statistics for Coronal SJS Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.98	1.78	1.87
Standard deviation	0.83	0.61	0.72
Standard error of mean	0.15	0.11	0.09
Upper 95% Mean	2.28	1.99	2.05
Lower 95% Mean	1.67	1.56	1.69
Sample size	31	33	64
Sample variance	0.68	0.37	0.52
Skewness (g1)	0.97	-0.36	0.68
Kurtosis (g2)	0.68	0.23	1.18
Coef Variation	41.84	34.31	38.67
Number missing	0	0	0
Median	1.6	1.8	1.8
Mode	1.4	1.4	1.4

Table A-155. Sample statistics for Coronal SJS Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.97	1.83	1.90
Standard deviation	0.69	0.79	0.74
Standard error of mean	0.12	0.14	0.09
Upper 95% Mean	2.23	2.11	2.09
Lower 95% Mean	1.72	1.55	1.72
Sample size	31	33	64
Sample variance	0.47	0.63	0.55
Skewness (g1)	0.22	0.44	0.31
Kurtosis (g2)	-0.24	0.15	-0.08
Coef Variation	34.82	43.31	39.01
Number missing	0	0	0
Median	2.0	1.9	1.9
Mode	1.1	1.9	1.9

Table A-156. Sample statistics for Change in Coronal SJS L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.00	0.06	0.03
Standard deviation	0.72	0.89	0.81
Standard error of mean	0.13	0.16	0.10
Upper 95% Mean	0.26	0.37	0.23
Lower 95% Mean	-0.27	-0.26	-0.17
Sample size	31	33	64
Sample variance	0.52	0.80	0.65
Skewness (g1)	-0.68	0.45	0.10
Kurtosis (g2)	0.56	1.80	1.52
Coef Variation	-22,303.98	1,549.85	2,870.76
Number missing	0	0	0
Median	0.1	0.1	0.1
Mode	0.0	-0.2	0.0
		One-sample t-test	0.28
		P-value (two tail)	0.7814

Table A-157. Sample statistics for Coronal LJS Left Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.65	2.30	2.47
Standard deviation	0.65	0.79	0.74
Standard error of mean	0.12	0.14	0.09
Upper 95% Mean	2.89	2.58	2.66
Lower 95% Mean	2.42	2.02	2.28
Sample size	31	33	64
Sample variance	0.43	0.63	0.55
Skewness (g1)	-0.44	0.72	0.16
Kurtosis (g2)	1.56	1.41	0.68
Coef Variation	24.56	34.48	30.12
Number missing	0	0	0
Median	2.7	2.4	2.5
Mode	3.0	2.4	2.5

Table A-158. Sample statistics for Coronal LJS Left Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.53	2.37	2.45
Standard deviation	0.70	0.72	0.71
Standard error of mean	0.13	0.13	0.09
Upper 95% Mean	2.79	2.62	2.62
Lower 95% Mean	2.27	2.11	2.27
Sample size	31	33	64
Sample variance	0.49	0.53	0.51
Skewness (g1)	0.51	-0.13	0.15
Kurtosis (g2)	-0.89	-0.56	-0.58
Coef Variation	27.81	30.63	29.18
Number missing	0	0	0
Median	2.4	2.5	2.5
Mode	1.9	1.4	2.5

Table A-159. Sample statistics for Change in Coronal LJS L, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	-0.13	0.07	-0.03
Standard deviation	0.69	0.65	0.67
Standard error of mean	0.12	0.11	0.08
Upper 95% Mean	0.13	0.30	0.14
Lower 95% Mean	-0.38	-0.16	-0.19
Sample size	31	33	64
Sample variance	0.48	0.43	0.45
Skewness (g1)	0.41	-0.03	0.16
Kurtosis (g2)	0.20	-0.47	-0.31
Coef Variation	-549.54	937.76	-2,696.03
Number missing	0	0	0
Median	-0.1	0.1	-0.1
Mode	-0.1	0.1	-0.1
		One-sample t-test	0.30
		P-value (two tail)	0.7676

Table A-160. Sample statistics for Coronal MJS Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.76	1.82	1.79
Standard deviation	0.80	0.83	0.81
Standard error of mean	0.14	0.14	0.10
Upper 95% Mean	2.06	2.11	2.00
Lower 95% Mean	1.47	1.53	1.59
Sample size	31	33	64
Sample variance	0.65	0.68	0.66
Skewness (g1)	0.56	0.69	0.62
Kurtosis (g2)	-0.50	-0.07	-0.33
Coef Variation	45.56	45.36	45.13
Number missing	0	0	0
Median	1.7	1.8	1.8
Mode	0.7	2.0	1.4

Table A-161. Sample statistics for Coronal MJS Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.93	1.63	1.78
Standard deviation	0.69	0.81	0.76
Standard error of mean	0.12	0.14	0.10
Upper 95% Mean	2.19	1.92	1.97
Lower 95% Mean	1.68	1.35	1.59
Sample size	31	33	64
Sample variance	0.48	0.65	0.58
Skewness (g1)	0.88	0.78	0.67
Kurtosis (g2)	0.40	0.19	0.09
Coef Variation	35.91	49.47	42.96
Number missing	0	0	0
Median	1.9	1.5	1.7
Mode	1.4	0.7	0.7

Table A-162. Sample statistics for Change in Coronal MJS R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.17	-0.19	-0.02
Standard deviation	0.61	0.79	0.73
Standard error of mean	0.11	0.14	0.09
Upper 95% Mean	0.39	0.09	0.17
Lower 95% Mean	-0.05	-0.47	-0.20
Sample size	31	33	64
Sample variance	0.37	0.63	0.53
Skewness (g1)	0.72	-0.39	-0.25
Kurtosis (g2)	0.72	2.05	2.07
Coef Variation	360.79	-422.21	-4,642.10
Number missing	0	0	0
Median	0.1	-0.1	0.0
Mode	0.3	0.0	0.0
		One-sample t-test	0.17
		P-value (two tail)	0.8637

Table A-163. Sample statistics for Coronal SJS Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.85	1.95	1.90
Standard deviation	0.57	0.58	0.57
Standard error of mean	0.10	0.10	0.07
Upper 95% Mean	2.06	2.15	2.04
Lower 95% Mean	1.65	1.74	1.76
Sample size	31	33	64
Sample variance	0.33	0.34	0.33
Skewness (g1)	0.20	-0.56	-0.19
Kurtosis (g2)	-0.92	-0.22	-0.71
Coef Variation	30.78	29.92	30.18
Number missing	0	0	0
Median	1.9	2.1	2.0
Mode	1.1	2.1	2.3

Table A-164. Sample statistics for Coronal SJS Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	1.92	1.68	1.80
Standard deviation	0.61	0.79	0.71
Standard error of mean	0.11	0.14	0.09
Upper 95% Mean	2.14	1.97	1.98
Lower 95% Mean	1.70	1.40	1.62
Sample size	31	33	64
Sample variance	0.37	0.63	0.51
Skewness (g1)	0.05	1.99	1.24
Kurtosis (g2)	-0.82	6.33	3.49
Coef Variation	31.52	47.07	39.62
Number missing	0	0	0
Median	2.1	1.5	1.7
Mode	2.3	1.5	1.4

Table A-165. Sample statistics for Change in Coronal SJS R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.07	-0.26	-0.10
Standard deviation	0.65	0.93	0.82
Standard error of mean	0.12	0.16	0.10
Upper 95% Mean	0.31	0.07	0.10
Lower 95% Mean	-0.17	-0.59	-0.31
Sample size	31	33	64
Sample variance	0.43	0.86	0.67
Skewness (g1)	0.89	1.89	1.37
Kurtosis (g2)	0.91	6.45	4.40
Coef Variation	964.54	-355.71	-804.22
Number missing	0	0	0
Median	-0.1	-0.4	-0.2
Mode	-0.4	-0.9	-0.4
		One-sample t-test	-0.99
		P-value (two tail)	0.3237

Table A-166. Sample statistics for Coronal LJS Right Initial, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.47	2.26	2.36
Standard deviation	0.61	0.60	0.61
Standard error of mean	0.11	0.10	0.08
Upper 95% Mean	2.69	2.48	2.52
Lower 95% Mean	2.25	2.05	2.21
Sample size	31	33	64
Sample variance	0.37	0.36	0.37
Skewness (g1)	0.07	0.26	0.16
Kurtosis (g2)	-0.24	-0.17	-0.32
Coef Variation	24.53	26.41	25.64
Number missing	0	0	0
Median	2.4	2.1	2.3
Mode	1.9	2.1	2.1

Table A-167. Sample statistics for Coronal LJS Right Final, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	2.55	2.32	2.43
Standard deviation	0.68	0.71	0.70
Standard error of mean	0.12	0.12	0.09
Upper 95% Mean	2.80	2.57	2.60
Lower 95% Mean	2.30	2.06	2.25
Sample size	31	33	64
Sample variance	0.47	0.50	0.49
Skewness (g1)	0.86	0.32	0.52
Kurtosis (g2)	0.33	-0.39	0.02
Coef Variation	26.84	30.54	28.85
Number missing	0	0	0
Median	2.4	2.4	2.4
Mode	2.0	2.5	2.5

Table A-168. Sample statistics for Change in Coronal LJS R, showing Edgewise sample alone (n = 31), MARA+Edgewise alone (n = 33) and the total sample (n = 64).

Statistic	Edgewise Alone	MARA+Edge Alone	Total Sample
Mean	0.08	0.05	0.06
Standard deviation	0.73	0.62	0.67
Standard error of mean	0.13	0.11	0.08
Upper 95% Mean	0.35	0.27	0.23
Lower 95% Mean	-0.19	-0.17	-0.10
Sample size	31	33	64
Sample variance	0.53	0.39	0.45
Skewness (g1)	0.52	0.41	0.48
Kurtosis (g2)	0.53	0.40	0.44
Coef Variation	942.54	1,211.41	1,048.93
Number missing	0	0	0
Median	0.00	0.00	0.00
Mode	0.50	-0.10	0.50
		One-sample t-test	0.76
		P-value (two tail)	0.4485

APPENDIX B. RESULTS OF ANALYSIS OF VARIANCE FOR TREATMENT OR SEX DIFFERENCES IN THE UNILATERAL (MIDLINE) DIMENSIONS AND TREATMENT, SEX, AND SIDE (LEFT, RIGHT) IN THE BILATERAL DIMENSIONS

Table B-1. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for SNA at the start of treatment.

Source	df	SSQ	F ratio	P value
Treatment	1	0.03	0.00	0.9618
Sex	1	2.27	0.21	0.6489
Treatment-by-Sex	1	7.68	0.71	0.4028

Table B-2. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for SNA at the end of treatment.

Source	df	SSQ	F ratio	P value
Treatment	1	31.83	3.18	0.0797
Sex	1	0.01	0.00	0.9763
Treatment-by-Sex	1	4.22	0.42	0.5188

Table B-3. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for the treatment change in SNA.

Source	df	SSQ	F ratio	P value
Treatment	1	30.07	18.98	<.0001
Sex	1	1.99	1.26	0.2666
Treatment-by-Sex	1	0.52	0.33	0.5704

Table B-4. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for SNB Initial.

Source	df	SSQ	F ratio	P value
Treatment	1	0.08	0.01	0.9249
Sex	1	0.16	0.02	0.8938
Treatment-by-Sex	1	2.33	0.26	0.6093

Table B-5. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for SNB Final.

Source	df	SSQ	F ratio	P value
Treatment	1	10.83	1.23	0.2715
Sex	1	2.38	0.27	0.6049
Treatment-by-Sex	1	0.86	0.10	0.7554

Table B-6. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Change in SNB.

Source	df	SSQ	F ratio	P value
Treatment	1	12.76	9.47	0.0031
Sex	1	3.77	2.80	0.0997
Treatment-by-Sex	1	0.36	0.27	0.6078

Table B-7. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for ANB Initial.

Source	df	SSQ	F ratio	P value
Treatment	1	0.23	0.10	0.7588
Sex	1	1.21	0.51	0.4772
Treatment-by-Sex	1	1.57	0.66	0.4191

Table B-8. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for ANB Final.

Source	df	SSQ	F ratio	P value
Treatment	1	5.36	1.99	0.1631
Sex	1	2.43	0.90	0.3455
Treatment-by-Sex	1	1.45	0.54	0.4661

Table B-9. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Change in ANB.

Source	df	SSQ	F ratio	P value
Treatment	1	3.39	2.60	0.1120
Sex	1	0.21	0.16	0.6891
Treatment-by-Sex	1	0.00	0.00	0.9660

Table B-10. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Overbite Initial.

Source	df	SSQ	F ratio	P value
Treatment	1	0.74	0.20	0.6559
Sex	1	0.12	0.03	0.8572
Treatment-by-Sex	1	0.12	0.03	0.8558

Table B-11. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Overbite Final.

Source	df	SSQ	F ratio	P value
Treatment	1	0.08	0.07	0.7887
Sex	1	0.03	0.03	0.8628
Treatment-by-Sex	1	1.20	1.10	0.2977

Table B-12. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Change in Overbite.

Source	df	SSQ	F ratio	P value
Treatment	1	1.31	0.41	0.5262
Sex	1	0.28	0.09	0.7690
Treatment-by-Sex	1	2.09	0.65	0.4228

Table B-13. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Overjet Initial.

Source	df	SSQ	F ratio	P value
Treatment	1	1.62	0.44	0.5114
Sex	1	0.00	0.00	0.9792
Treatment-by-Sex	1	3.90	1.06	0.3085

Table B-14. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Overjet Final.

Source	df	SSQ	F ratio	P value
Treatment	1	0.08	0.07	0.7887
Sex	1	0.03	0.03	0.8628
Treatment-by-Sex	1	1.20	1.10	0.2977

Table B-15. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Change in Overjet.

Source	df	SSQ	F ratio	P value
Treatment	1	1.31	0.41	0.5262
Sex	1	0.28	0.09	0.7690
Treatment-by-Sex	1	2.09	0.65	0.4228

Table B-16. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Mesial Molar Relation Initial.

Source	df	SSQ	F ratio	P value
Treatment	1	0.86	0.55	0.4619
Sex	1	4.59	2.92	0.0928
Treatment-by-Sex	1	0.01	0.00	0.9528

Table B-17. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Mesial Molar Relation Final.

Source	df	SSQ	F ratio	P value
Treatment	1	13.12	12.25	0.0009
Sex	1	3.01	2.81	0.0987
Treatment-by-Sex	1	0.00	0.00	0.9471

Table B-18. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Change in Molar Relation.

Source	df	SSQ	F ratio	P value
Treatment	1	7.26	3.31	0.0737
Sex	1	0.16	0.08	0.7850
Treatment-by-Sex	1	0.00	0.00	0.9970

Table B-19. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Sella-Vella-to-M Initial.

Source	df	SSQ	F ratio	P value
Treatment	1	14.67	0.75	0.3900
Sex	1	4.19	0.21	0.6450
Treatment-by-Sex	1	28.52	1.46	0.2320

Table B-20. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Sella-Vella-to-M Final.

Source	df	SSQ	F ratio	P value
Treatment	1	351.43	12.46	0.0008
Sex	1	81.64	2.89	0.0941
Treatment-by-Sex	1	13.08	0.46	0.4985

Table B-21. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Change in Sella-Vertical-to-M.

Source	df	SSQ	F ratio	P value
Treatment	1	222.52	25.20	<0.0001
Sex	1	48.82	5.53	0.0220
Treatment-by-Sex	1	2.97	0.34	0.5641

Table B-22. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Axial APCD Initial.

Source	df	SSQ	F ratio	P value
Treatment	0.3236	0.22	1, 60	0.6436
Sex	2.6703	1.79	1, 60	0.1866
Treatment-by-Sex	9.0793	6.07	1, 60	0.0166

Table B-23. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Axial APCD Final.

Source	df	SSQ	F ratio	P value
Treatment	0.0506	0.05	1, 60	0.8319
Sex	4.9615	4.46	1, 60	0.0389
Treatment-by-Sex	10.8948	9.79	1, 60	0.0027

Table B-24. Results of ANOVA testing for treatment (Edgewise with or without MARA) and sex (male, female) differences for Change in Axial APCD.

Source	df	SSQ	F ratio	P value
Treatment	0.1183	0.09	1, 60	0.7672
Sex	0.3520	0.26	1, 60	0.6099
Treatment-by-Sex	0.0827	0.06	1, 60	0.8045

Table B-25. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial ML L Initial and Axial ML R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1228	2.46	3, 60	0.0717
Treatment	0.0276	1.66	1, 60	0.2030
Sex	0.0781	4.69	1, 60	0.0343
Treatment-by-Sex	0.0260	1.56	1, 60	0.2164
Within Subjects				
All Within Interactions	0.0141	0.28	3, 60	0.8375
Side	0.0086	0.52	1, 60	0.4742
Side-by-Treatment	0.0074	0.44	1, 60	0.5082
Side-by-Sex	0.0023	0.14	1, 60	0.7134
Side-by-Treatment-by-Sex	0.0053	0.32	1, 60	0.5760

Table B-26. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial ML L Final and Axial ML R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1792	3.58	3, 60	0.0188
Treatment	0.0388	2.33	1, 60	0.1325
Sex	0.1121	6.72	1, 60	0.0119
Treatment-by-Sex	0.0408	2.45	1, 60	0.1229
Within Subjects				
All Within Interactions	0.0556	1.11	3, 60	0.3518
Side	0.0059	0.36	1, 60	0.5535
Side-by-Treatment	0.0079	0.47	1, 60	0.4947
Side-by-Sex	0.0301	1.80	1, 60	0.1842
Side-by-Treatment-by-Sex	0.0234	1.40	1, 60	0.2411

Table B-27. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Axial ML L and Change in Axial ML R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0605	1.21	3, 60	0.3138
Treatment	0.0112	0.67	1, 60	0.4159
Sex	0.0352	2.11	1, 60	0.1513
Treatment-by-Sex	0.0175	1.05	1, 60	0.3093
Within Subjects				
All Within Interactions	0.1108	2.22	3, 60	0.0955
Side	0.0001	0.00	1, 60	0.9529
Side-by-Treatment	0.0428	2.57	1, 60	0.1143
Side-by-Sex	0.0729	4.38	1, 60	0.0407
Side-by-Treatment-by-Sex	0.0121	0.73	1, 60	0.3974

Table B-28. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial AP L Initial and Axial AP R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1355	2.71	3, 60	0.0529
Treatment	0.0169	1.01	1, 60	0.3185
Sex	0.0944	5.66	1, 60	0.0205
Treatment-by-Sex	0.0105	0.63	1, 60	0.4307
Within Subjects				
All Within Interactions	0.0736	1.47	3, 60	0.2314
Side	0.0047	0.28	1, 60	0.5955
Side-by-Treatment	0.0002	0.01	1, 60	0.9222
Side-by-Sex	0.0124	0.74	1, 60	0.3923
Side-by-Treatment-by-Sex	0.0593	3.56	1, 60	0.0641

Table B-29. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial AP L F and Axial AP R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1053	2.11	3, 60	0.1090
Treatment	0.0013	0.08	1, 60	0.7850
Sex	0.1010	6.06	1, 60	0.0167
Treatment-by-Sex	0.0054	0.33	1, 60	0.5698
Within Subjects				
All Within Interactions	0.0286	0.57	3, 60	0.6357
Side	0.0001	0.01	1, 60	0.9352
Side-by-Treatment	0.0014	0.09	1, 60	0.7711
Side-by-Sex	0.0060	0.36	1, 60	0.5509
Side-by-Treatment-by-Sex	0.0207	1.24	1, 60	0.2697

Table B-30. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Axial AP L and Change in Axial AP R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0731	1.46	3, 60	0.2342
Treatment	0.0708	4.25	1, 60	0.0437
Sex	0.0008	0.05	1, 60	0.8304
Treatment-by-Sex	0.0019	0.11	1, 60	0.7378
Within Subjects				
All Within Interactions	0.0405	0.81	3, 60	0.4938
Side	0.0051	0.31	1, 60	0.5828
Side-by-Treatment	0.0005	0.03	1, 60	0.8699
Side-by-Sex	0.0280	1.68	1, 60	0.1997
Side-by-Treatment-by-Sex	0.0091	0.54	1, 60	0.4633

Table B-31. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial MLCP L Initial and Axial MLCP R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0584	1.17	3, 60	0.3293
Treatment	0.0065	0.39	1, 60	0.5346
Sex	0.0442	2.65	1, 60	0.1086
Treatment-by-Sex	0.0104	0.62	1, 60	0.4335
Within Subjects				
All Within Interactions	0.0818	1.64	3, 60	0.1905
Side	0.0267	1.60	1, 60	0.2103
Side-by-Treatment	0.0552	3.31	1, 60	0.0738
Side-by-Treatment-by-Sex	0.0000	0.00	1, 60	0.9782

Table B-32. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial MLCP L Final and Axial MLCP R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0714	1.43	3, 60	0.2437
Treatment	0.0027	0.16	1, 60	0.6897
Sex	0.0628	3.77	1, 60	0.0570
Treatment-by-Sex	0.0070	0.42	1, 60	0.5202
Within Subjects				
All Within Interactions	0.0932	1.86	3, 60	0.1452
Side	0.0241	1.44	1, 60	0.2342
Side-by-Treatment	0.0356	2.14	1, 60	0.1492
Side-by-Sex	0.0636	3.82	1, 60	0.0554
Side-by-Treatment-by-Sex	0.0084	0.50	1, 60	0.4809

Table B-33. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Axial MLCP L and Change in Axial MLCP R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0284	0.57	3, 60	0.6378
Treatment	0.0053	0.32	1, 60	0.5742
Sex	0.0180	1.08	1, 60	0.3029
Treatment-by-Sex	0.0017	0.10	1, 60	0.7506
Within Subjects				
All Within Interactions	0.0191	0.38	3, 60	0.7666
Side	0.0004	0.02	1, 60	0.8779
Side-by-Treatment	0.0007	0.04	1, 60	0.8432
Side-by-Sex	0.0044	0.26	1, 60	0.6089
Side-by-Treatment-by-Sex	0.0150	0.90	1, 60	0.3471

Table B-34. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial CA L Initial and Axial CA R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0212	0.43	3, 60	0.7358
Treatment	0.0157	0.94	1, 60	0.3357
Sex	0.0051	0.31	1, 60	0.5820
Treatment-by-Sex	0.0025	0.15	1, 60	0.7004
Within Subjects				
All Within Interactions	0.0738	1.48	3, 60	0.2299
Side	0.0000	0.00	1, 60	0.9784
Side-by-Treatment	0.0006	0.03	1, 60	0.8554
Side-by-Sex	0.0532	3.19	1, 60	0.0789
Side-by-Treatment-by-Sex	0.0151	0.90	1, 60	0.3453

Table B-35. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial CA L Final and Axial CA R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0586	1.17	3, 60	0.3278
Treatment	0.0160	0.96	1, 60	0.3317
Sex	0.0235	1.41	1, 60	0.2397
Treatment-by-Sex	0.0227	1.36	1, 60	0.2483
Within Subjects				
All Within Interactions	0.0342	0.68	3, 60	0.5649
Side	0.0177	1.06	1, 60	0.3063
Side-by-Treatment	0.0027	0.16	1, 60	0.6889
Side-by-Sex	0.0079	0.47	1, 60	0.4938
Side-by-Treatment-by-Sex	0.0211	1.27	1, 60	0.2649

Table B-36. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Axial CA L and Change in Axial CA R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0330	0.66	3, 60	0.5793
Treatment	0.0005	0.03	1, 60	0.8590
Sex	0.0113	0.68	1, 60	0.4126
Treatment-by-Sex	0.0191	1.15	1, 60	0.2882
Within Subjects				
All Within Interactions	0.0246	0.49	3, 60	0.6889
Side	0.0306	1.83	1, 60	0.1807
Side-by-Treatment	0.0018	0.11	1, 60	0.7440
Side-by-Sex	0.0220	1.32	1, 60	0.2556
Side-by-Treatment-by-Sex	0.0028	0.17	1, 60	0.6843

Table B-37. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial LACP L Initial and Axial LACP R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1637	3.27	3, 60	0.0271
Treatment	0.0010	0.06	1, 60	0.8054
Sex	0.1309	7.85	1, 60	0.0068
Treatment-by-Sex	0.0281	1.69	1, 60	0.1991
Within Subjects				
All Within Interactions	0.0265	0.53	3, 60	0.6640
Side	0.0493	2.96	1, 60	0.0906
Side-by-Treatment	0.0000	0.00	1, 60	0.9568
Side-by-Sex	0.0026	0.16	1, 60	0.6926
Side-by-Treatment-by-Sex	0.0233	1.40	1, 60	0.2418

Table B-38. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Axial LACP L Final and Axial LACP R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0731	1.46	3, 60	0.2342
Treatment	0.0708	4.25	1, 60	0.0437
Sex	0.0008	0.05	1, 60	0.8304
Treatment-by-Sex	0.0019	0.11	1, 60	0.7378
Within Subjects				
All Within Interactions	0.0405	0.81	3, 60	0.4938
Side	0.0051	0.31	1, 60	0.5828
Side-by-Treatment	0.0005	0.03	1, 60	0.8699
Side-by-Sex	0.0280	1.68	1, 60	0.1997
Side-by-Treatment-by-Sex	0.0091	0.54	1, 60	0.4633

Table B-39. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Axial LACP L and Change in Axial LACP R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0731	1.46	3, 60	0.2342
Treatment	0.0708	4.25	1, 60	0.0437
Sex	0.0008	0.05	1, 60	0.8304
Treatment-by-Sex	0.0019	0.11	1, 60	0.7378
Within Subjects				
All Within Interactions	0.0405	0.81	3, 60	0.4938
Side	0.0051	0.31	1, 60	0.5828
Side-by-Treatment	0.0005	0.03	1, 60	0.8699
Side-by-Sex	0.0280	1.68	1, 60	0.1997
Side-by-Treatment-by-Sex	0.0091	0.54	1, 60	0.4633

Table B-40. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal AJS L Initial and Sagittal AJS R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0228	0.4568	3, 60	0.7135
Treatment	0.0178	1.0679	1, 60	0.3056
Sex	0.0015	0.0905	1, 60	0.7646
Treatment-by-Sex	0.0013	0.0806	1, 60	0.7775
Within Subjects				
All Within Interactions	0.0102	0.2045	3, 60	0.8929
Side	0.0103	0.6163	1, 60	0.4355
Side-by-Treatment	0.0031	0.1841	1, 60	0.6694
Side-by-Sex	0.0026	0.1544	1, 60	0.6958
Side-by-Treatment-by-Sex	0.0051	0.3039	1, 60	0.5835

Table B-41. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal AJS L Final and Sagittal AJS R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0466	0.9311	3, 60	0.4313
Treatment	0.0166	0.9936	1, 60	0.3229
Sex	0.0121	0.7286	1, 60	0.3967
Treatment-by-Sex	0.0119	0.7157	1, 60	0.4009
Within Subjects				
All Within Interactions	0.0385	0.7705	3, 60	0.5150
Side	0.0893	5.3587	1, 60	0.0241
Side-by-Treatment	0.0034	0.2062	1, 60	0.6514
Side-by-Sex	0.0058	0.3475	1, 60	0.5577
Side-by-Treatment-by-Sex	0.0314	1.8855	1, 60	0.1748

Table B-42. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal AJS L and Change in Sagittal AJS R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0102	0.204	3, 60	0.8932
Treatment	0.0004	0.0253	1, 60	0.8741
Sex	0.0048	0.2866	1, 60	0.5944
Treatment-by-Sex	0.0050	0.2992	1, 60	0.5864
Within Subjects				
All Within Interactions	0.0262	0.5238	3, 60	0.6676
Side	0.0301	1.8038	1, 60	0.1843
Side-by-Treatment	0.0093	0.5597	1, 60	0.4573
Side-by-Sex	0.0116	0.6971	1, 60	0.4071
Side-by-Treatment-by-Sex	0.0088	0.5264	1, 60	0.4710

Table B-43. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal MJS L Initial and Sagittal MJS R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.3361	6.72	3, 60	0.0006
Treatment	0.2766	16.59	1, 60	0.0001
Sex	0.0219	1.31	1, 60	0.2562
Treatment-by-Sex	0.0048	0.29	1, 60	0.5926
Within Subjects				
All Within Interactions	0.0057	0.11	3, 60	0.9518
Side	0.0475	2.85	1, 60	0.0967
Side-by-Treatment	0.0045	0.27	1, 60	0.6055
Side-by-Sex	0.0000	0.00	1, 60	0.9838
Side-by-Treatment-by-Sex	0.0010	0.06	1, 60	0.8079

Table B-44. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal MJS L Final and Sagittal AJS R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1112	2.22	3, 60	0.0945
Treatment	0.0176	1.05	1, 60	0.3088
Sex	0.0689	4.13	1, 60	0.0464
Treatment-by-Sex	0.0098	0.59	1, 60	0.4461
Within Subjects				
All Within Interactions	0.0308	0.62	3, 60	0.6076
Side	0.1511	9.07	1, 60	0.0038
Side-by-Treatment	0.0004	0.02	1, 60	0.8833
Side-by-Sex	0.0263	1.58	1, 60	0.2143
Side-by-Treatment-by-Sex	0.0020	0.12	1, 60	0.7290

Table B-45. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal MJS L and Change in Sagittal MJS R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1289	2.58	3, 60	0.0620
Treatment	0.1076	6.45	1, 60	0.0137
Sex	0.0329	1.97	1, 60	0.1654
Treatment-by-Sex	0.0031	0.19	1, 60	0.6677
Within Subjects				
All Within Interactions	0.0179	0.36	3, 60	0.7832
Side	0.0117	0.70	1, 60	0.4064
Side-by-Treatment	0.0016	0.10	1, 60	0.7559
Side-by-Sex	0.0135	0.81	1, 60	0.3711
Side-by-Treatment-by-Sex	0.0034	0.20	1, 60	0.6528

Table B-46. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal PJS L Initial and Sagittal PJS R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0209	0.42	3, 60	0.7402
Treatment	0.0001	0.01	1, 60	0.9357
Sex	0.0099	0.59	1, 60	0.4445
Treatment-by-Sex	0.0104	0.62	1, 60	0.4336
Within Subjects				
All Within Interactions	0.0234	0.47	3, 60	0.7052
Side	0.0005	0.03	1, 60	0.8693
Side-by-Treatment	0.0081	0.49	1, 60	0.4882
Side-by-Sex	0.0105	0.63	1, 60	0.4296
Side-by-Treatment-by-Sex	0.0012	0.07	1, 60	0.7935

Table B-47. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal PJS L Final and Sagittal PJS R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0287	0.57	3, 60	0.6338
Treatment	0.0196	1.18	1, 60	0.2826
Sex	0.0032	0.19	1, 60	0.6627
Treatment-by-Sex	0.0084	0.50	1, 60	0.4816
Within Subjects				
All Within Interactions	0.0737	1.47	3, 60	0.2308
Side	0.0003	0.02	1, 60	0.8894
All Within Interactions	0.0676	4.06	1, 60	0.0485
Side	0.0010	0.06	1, 60	0.8074
Side-by-Treatment	0.0007	0.04	1, 60	0.8381

Table B-48. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal PJS L and Change in Sagittal PJS R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0330	0.66	3, 60	0.5793
Treatment	0.0005	0.03	1, 60	0.8590
Sex	0.0113	0.68	1, 60	0.4126
Treatment-by-Sex	0.0191	1.15	1, 60	0.2882
Within Subjects				
All Within Interactions	0.0246	0.49	3, 60	0.6889
Side	0.0306	1.83	1, 60	0.1807
Side-by-Treatment	0.0018	0.11	1, 60	0.7440
Side-by-Sex	0.0220	1.32	1, 60	0.2556
Side-by-Treatment-by-Sex	0.0028	0.17	1, 60	0.6843

Table B-49. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal FW L Initial and Sagittal FW R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0627	1.25	3, 60	0.2986
Treatment	0.0580	3.48	1, 60	0.0670
Sex	0.0004	0.02	1, 60	0.8834
Treatment-by-Sex	0.0045	0.27	1, 60	0.6048
Within Subjects				
All Within Interactions	0.0869	1.74	3, 60	0.1690
Side	0.0016	0.09	1, 60	0.7610
Side-by-Treatment	0.0837	5.02	1, 60	0.0288
Side-by-Sex	0.0000	0.00	1, 60	0.9935
Side-by-Treatment-by-Sex	0.0013	0.08	1, 60	0.7808

Table B-50. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal FW L Final and Sagittal FW R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1135	2.27	3, 60	0.0896
Treatment	0.0759	4.56	1, 60	0.0369
Sex	0.0515	3.09	1, 60	0.0839
Treatment-by-Sex	0.0021	0.12	1, 60	0.7265
Within Subjects				
All Within Interactions	0.2212	4.42	3, 60	0.0071
Side	0.0106	0.64	1, 60	0.4278
Side-by-Treatment	0.2179	13.07	1, 60	0.0006
Side-by-Sex	0.0116	0.69	1, 60	0.4083
Side-by-Treatment-by-Sex	0.0027	0.16	1, 60	0.6863

Table B-51. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal FW L and Change in Sagittal FW R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1406	2.81	3, 60	0.0469
Treatment	0.0002	0.01	1, 60	0.9107
Sex	0.1012	6.07	1, 60	0.0166
Treatment-by-Sex	0.0342	2.05	1, 60	0.1575
Within Subjects				
All Within Interactions	0.0179	0.36	3, 60	0.7839
Side	0.0025	0.15	1, 60	0.6989
Side-by-Treatment	0.0114	0.68	1, 60	0.4113
Side-by-Sex	0.0092	0.55	1, 60	0.4600
Side-by-Treatment-by-Sex	0.0001	0.00	1, 60	0.9505

Table B-52. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal FD L Initial and Sagittal FD R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1379	2.76	3, 60	0.0501
Treatment	0.1104	6.62	1, 60	0.0126
Sex	0.0093	0.56	1, 60	0.4582
Treatment-by-Sex	0.0047	0.28	1, 60	0.5980
Within Subjects				
All Within Interactions	0.0439	0.88	3, 60	0.4578
Side	0.0265	1.59	1, 60	0.2126
Side-by-Treatment	0.0298	1.79	1, 60	0.1866
Side-by-Sex	0.0076	0.46	1, 60	0.5025
Side-by-Treatment-by-Sex	0.0007	0.04	1, 60	0.8400

Table B-53. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal FD L Final and Sagittal FD R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0523	1.05	3, 60	0.3791
Treatment	0.0400	2.40	1, 60	0.1267
Sex	0.0020	0.12	1, 60	0.7324
Treatment-by-Sex	0.0064	0.38	1, 60	0.5392
Within Subjects				
All Within Interactions	0.0206	0.41	3, 60	0.7456
Side	0.0086	0.52	1, 60	0.4755
Side-by-Treatment	0.0137	0.82	1, 60	0.3682
Side-by-Sex	0.0040	0.24	1, 60	0.6267
Side-by-Treatment-by-Sex	0.0000	0.00	1, 60	0.9632

Table B-54. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal FD L and Change in Sagittal FD R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0596	1.19	3, 60	0.3207
Treatment	0.0447	2.68	1, 60	0.1069
Sex	0.0073	0.44	1, 60	0.5107
Treatment-by-Sex	0.0006	0.04	1, 60	0.8503
Within Subjects				
All Within Interactions	0.0028	0.06	1, 60	0.9827
Side	0.0033	0.20	1, 60	0.6590
Side-by-Treatment	0.0018	0.11	1, 60	0.7416
Side-by-Sex	0.0003	0.02	1, 60	0.8910
Side-by-Treatment-by-Sex	0.0003	0.02	1, 60	0.8910

Table B-55. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CHW L Initial and Sagittal CHW R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1111	2.22	3, 60	0.0947
Treatment	0.0196	1.18	1, 60	0.2822
Sex	0.0650	3.90	1, 60	0.0528
Treatment-by-Sex	0.0325	1.95	1, 60	0.1676
Within Subjects				
All Within Interactions	0.1758	3.52	3, 60	0.0204
Side	0.0396	2.38	1, 60	0.1283
Side-by-Treatment	0.0491	2.95	1, 60	0.0911
Side-by-Sex	0.0544	3.26	1, 60	0.0759
Side-by-Treatment-by-Sex	0.0560	3.36	1, 60	0.0718

Table B-56. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CHW L Final and Sagittal CHW R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0498	1.00	3, 60	0.4014
Treatment	0.0195	1.17	1, 60	0.2832
Sex	0.0318	1.91	1, 60	0.1723
Treatment-by-Sex	0.0061	0.36	1, 60	0.5484
Within Subjects				
All Within Interactions	0.1577	3.15	3, 60	0.0313
Side	0.0318	1.91	1, 60	0.1723
Side-by-Treatment	0.1127	6.76	1, 60	0.0117
Side-by-Sex	0.0214	1.28	1, 60	0.2621
Side-by-Treatment-by-Sex	0.0049	0.29	1, 60	0.5910

Table B-57. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal CHW L and Change in Sagittal CHW R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.2176	4.35	3, 60	0.0077
Treatment	0.0008	0.05	1, 60	0.8247
Sex	0.0085	0.51	1, 60	0.4783
Treatment-by-Sex	0.2044	12.27	1, 60	0.0009
Within Subjects				
All Within Interactions	0.0519	1.04	3, 60	0.3827
Side	0.0009	0.05	1, 60	0.8192
Side-by-Treatment	0.0122	0.73	1, 60	0.3949
Side-by-Sex	0.0101	0.60	1, 60	0.4400
Side-by-Treatment-by-Sex	0.0339	2.03	1, 60	0.1591

Table B-58. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CHH L Initial and Sagittal CHH R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1222	2.44	3, 60	0.0727
Treatment	0.0393	2.36	1, 60	0.1299
Sex	0.0958	5.75	1, 60	0.0197
Treatment-by-Sex	0.0023	0.14	1, 60	0.7120
Within Subjects				
All Within Interactions	0.0542	1.08	3, 60	0.3629
Side	0.0021	0.13	1, 60	0.7237
Side-by-Treatment	0.0173	1.04	1, 60	0.3118
Side-by-Sex	0.0091	0.55	1, 60	0.4629
Side-by-Treatment-by-Sex	0.0223	1.34	1, 60	0.2519

Table B-59. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CHH L Final and Sagittal CHH R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1426	2.85	3, 60	0.0447
Treatment	0.0634	3.81	1, 60	0.0558
Sex	0.1001	6.01	1, 60	0.0172
Treatment-by-Sex	0.0001	0.01	1, 60	0.9367
Within Subjects				
All Within Interactions	0.0794	1.59	3, 60	0.2015
Side	0.0399	2.40	1, 60	0.1269
Side-by-Treatment	0.0586	3.52	1, 60	0.0656
Side-by-Sex	0.0108	0.65	1, 60	0.4239
Side-by-Treatment-by-Sex	0.0001	0.01	1, 60	0.9270

Table B-60. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal CHH L and Change in Sagittal CHH R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0065	0.13	3, 60	0.9415
Treatment	0.0038	0.23	1, 60	0.6327
Sex	0.0000	+	1, 60	0.9843
Treatment-by-Sex	0.0026	0.15	1, 60	0.6970
Within Subjects				
All Within Interactions	0.0291	0.58	3, 60	0.6295
Side	0.0233	1.40	1, 60	0.2421
Side-by-Treatment	0.0196	1.17	1, 60	0.2828
Side-by-Sex	0.0014	0.08	1, 60	0.7743
Side-by-Treatment-by-Sex	0.0060	0.36	1, 60	0.5514

Table B-61. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CH L Initial and Sagittal CH R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.2124	4.25	3, 60	0.0087
Treatment	0.1780	10.68	1, 60	0.0018
Sex	0.1780	10.68	1, 60	0.0018
Treatment-by-Sex	0.0000	0.00	1, 60	0.9772
Within Subjects				
All Within Interactions	0.0044	0.09		0.9668
Side	0.0101	0.61	3, 60	0.4384
Side-by-Treatment	0.0029	0.18	1, 60	0.6755
Side-by-Sex	0.0005	0.03	1, 60	0.8565
Side-by-Treatment-by-Sex	0.0003	0.02	1, 60	0.8857

Table B-62. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CH L Final and Sagittal CH R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0257	0.51	3, 60	0.6743
Treatment	0.0171	1.03	1, 60	0.3149
Sex	0.0026	0.16	1, 60	0.6923
Treatment-by-Sex	0.0032	0.19	1, 60	0.6640
Within Subjects				
All Within Interactions	0.0182	0.36		0.7792
Side	0.0002	0.01	3, 60	0.9077
Side-by-Treatment	0.0042	0.25	1, 60	0.6182
Side-by-Sex	0.0114	0.68	1, 60	0.4117
Side-by-Treatment-by-Sex	0.0001	0.00	1, 60	0.9500

Table B-63. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal CH L and Change in Sagittal CH R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.2086	4.17	3, 60	0.0095
Treatment	0.1737	10.42	1, 60	0.0020
Sex	0.0080	0.48	1, 60	0.4904
Treatment-by-Sex	0.0105	0.63	1, 60	0.4299
Within Subjects				
All Within Interactions	0.0139	0.28	3, 60	0.8411
Side	0.0185	1.11	1, 60	0.2957
Side-by-Treatment	0.0004	0.02	1, 60	0.8831
Side-by-Sex	0.0117	0.70	1, 60	0.4045
Side-by-Treatment-by-Sex	0.0010	0.06	1, 60	0.8051

Table B-64. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal EAM-AE L Initial and Sagittal EAM-AE R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1104	2.21	3, 60	0.0965
Treatment	0.0901	5.40	1, 60	0.0235
Sex	0.0099	0.59	1, 60	0.4442
Treatment-by-Sex	0.0187	1.12	1, 60	0.2934
Within Subjects				
All Within Interactions	0.2882	5.76	3, 60	0.0016
Side	0.1493	8.96	1, 60	0.0040
Side-by-Treatment	0.2874	17.24	1, 60	0.0001
Side-by-Sex	0.0045	0.27	1, 60	0.6066
Side-by-Treatment-by-Sex	0.0007	0.04	1, 60	0.8356

Table B-65. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal EAM-AE L Final and Sagittal EAM-AE R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0809	1.62	3, 60	0.1945
Treatment	0.0693	4.16	1, 60	0.0459
Sex	0.0182	1.09	1, 60	0.2998
Treatment-by-Sex	0.0032	0.19	1, 60	0.6615
Within Subjects				
All Within Interactions	0.3346	6.69	3, 60	0.0006
Side	0.0266	1.59	1, 60	0.2116
Side-by-Treatment	0.3199	19.19	1, 60	<0.0001
Side-by-Sex	0.0210	1.26	1, 60	0.2660
Side-by-Treatment-by-Sex	0.0131	0.79	1, 60	0.3784

Table B-66. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal EAM AE L and Change in Sagittal EAM AE R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0386	0.77	3, 60	0.5147
Treatment	0.0028	0.17	1, 60	0.6850
Sex	0.0074	0.44	1, 60	0.5080
Treatment-by-Sex	0.0258	1.55	1, 60	0.2178
Within Subjects				
All Within Interactions	0.0125	0.25	3, 60	0.8606
Side	0.0656	3.94	1, 60	0.0519
Side-by-Treatment	0.0018	0.11	1, 60	0.7416
Side-by-Sex	0.0040	0.24	1, 60	0.6261
Side-by-Treatment-by-Sex	0.0060	0.36	1, 60	0.5521

Table B-67. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal EAM-C L Initial and Sagittal EAM-C R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0331	0.66	3, 60	0.5783
Treatment	0.0028	0.17	1, 60	0.6828
Sex	0.0006	0.04	1, 60	0.8515
Treatment-by-Sex	0.0304	1.82	1, 60	0.1820
Within Subjects				
All Within Interactions	0.4099	8.20	3, 60	0.0001
Side	0.1383	8.30	1, 60	0.0055
Side-by-Treatment	0.3929	23.57	1, 60	<0.0001
Side-by-Sex	0.0002	0.01	1, 60	0.9147
Side-by-Treatment-by-Sex	0.0038	0.23	1, 60	0.6333

Table B-68. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal EAM-C L Final and Sagittal EAM-C R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0603	1.21	3, 60	0.3150
Treatment	0.0446	2.68	1, 60	0.1070
Sex	0.0005	0.03	1, 60	0.8644
Treatment-by-Sex	0.0127	0.76	1, 60	0.3871
Within Subjects				
All Within Interactions	0.1012	2.02	3, 60	0.1202
Side	0.0004	0.02	1, 60	0.8766
Side-by-Treatment	0.0493	2.96	1, 60	0.0905
Side-by-Sex	0.0555	3.33	1, 60	0.0731
Side-by-Treatment-by-Sex	0.0124	0.74	1, 60	0.3922

Table B-69. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal EAM C L and Change in Sagittal EAM C R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0751	1.50	3, 60	0.2230
Treatment	0.0586	3.52	1, 60	0.0656
Sex	0.0045	0.27	1, 60	0.6071
Treatment-by-Sex	0.0054	0.33	1, 60	0.5704
Within Subjects				
All Within Interactions	0.1258	2.52	3, 60	0.0668
Side	0.0468	2.81	1, 60	0.0991
Side-by-Treatment	0.0326	1.96	1, 60	0.1669
Side-by-Sex	0.0571	3.42	1, 60	0.0692
Side-by-Treatment-by-Sex	0.0219	1.31	1, 60	0.2563

Table B-70. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal EAM-P L Initial and Sagittal EAM-P R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0115	0.23	3, 60	0.8748
Treatment	0.0011	0.06	1, 60	0.8020
Sex	0.0000	0.00	1, 60	0.9883
Treatment-by-Sex	0.0104	0.62	1, 60	0.4327
Within Subjects				
All Within Interactions	0.1421	2.84	3, 60	0.0452
Side	0.1328	7.97	1, 60	0.0064
Side-by-Treatment	0.1155	6.93	1, 60	0.0108
Side-by-Sex	0.0270	1.62	1, 60	0.2082
Side-by-Treatment-by-Sex	0.0157	0.94	1, 60	0.3362

Table B-71. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal EAM-P L Final and Sagittal EAM-P R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0124	0.25	3, 60	0.8626
Treatment	0.0022	0.13	1, 60	0.7153
Sex	0.0029	0.17	1, 60	0.6788
Treatment-by-Sex	0.0076	0.46	1, 60	0.5022
Within Subjects				
All Within Interactions	0.0739	1.48	3, 60	0.2294
Side	0.0010	0.06	1, 60	0.8080
Side-by-Treatment	0.0304	1.82	1, 60	0.1821
Side-by-Sex	0.0542	3.25	1, 60	0.0765
Side-by-Treatment-by-Sex	0.0006	0.04	1, 60	0.8444

Table B-72. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal EAM P L and Change in EAM P R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0121	0.24	3, 60	0.8672
Treatment	0.0012	0.07	1, 60	0.7924
Sex	0.0115	0.69	1, 60	0.4094
Treatment-by-Sex	0.0004	0.02	1, 60	0.8809
Within Subjects				
All Within Interactions	0.0441	0.88	3, 60	0.4560
Side	0.1057	6.34	1, 60	0.0145
Side-by-Treatment	0.0227	1.36	1, 60	0.2482
Side-by-Sex	0.0070	0.42	1, 60	0.5202
Side-by-Treatment-by-Sex	0.0093	0.56	1, 60	0.4590

Table B-73. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal ATA L Initial and Sagittal ATA R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.4216	8.43	3, 60	<0.0001
Treatment	0.4170	25.02	1, 60	<0.0001
Sex	0.0012	0.07	1, 60	0.7899
Treatment-by-Sex	0.0000	0.00	1, 60	0.9898
Within Subjects				
All Within Interactions	0.0244	0.49	3, 60	0.6917
Side	0.0043	0.26	1, 60	0.6117
Side-by-Treatment	0.0105	0.63	1, 60	0.4309
Side-by-Sex	0.0162	0.97	1, 60	0.3286
Side-by-Treatment-by-Sex	0.0016	0.10	1, 60	0.7561

Table B-74. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MA0052A) sex (male, female), and side (left, right TMJ) differences for Sagittal ATA L Final and Sagittal ATA R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1483	2.97	3, 60	0.0390
Treatment	0.1374	8.24	1, 60	0.0056
Sex	0.0252	1.51	1, 60	0.2233
Treatment-by-Sex	0.0002	0.01	1, 60	0.9074
Within Subjects				
All Within Interactions	0.0215	0.43	3, 60	0.7324
Side	0.0107	0.64	1, 60	0.4269
Side-by-Treatment	0.0051	0.31	1, 60	0.5804
Side-by-Sex	0.0055	0.33	1, 60	0.5685
Side-by-Treatment-by-Sex	0.0129	0.77	1, 60	0.3825

Table B-75. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal ATA L and Change in Sagittal ATA R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.3251	6.50	3, 60	0.0007
Treatment	0.2283	13.70	1, 60	0.0005
Sex	0.0534	3.20	1, 60	0.0786
Treatment-by-Sex	0.0006	0.04	1, 60	0.8481
Within Subjects				
All Within Interactions	0.0110	0.22	3, 60	0.8816
Side	0.0015	0.09	1, 60	0.7669
Side-by-Treatment	0.0013	0.08	1, 60	0.7778
Side-by-Sex	0.0038	0.23	1, 60	0.6339
Side-by-Treatment-by-Sex	0.0061	0.37	1, 60	0.5467

Table B-76. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CHA L Initial and Sagittal CHA R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0755	1.51	3, 60	0.2213
Treatment	0.0548	3.29	1, 60	0.0748
Sex	0.0000	0.00	1, 60	0.9665
Treatment-by-Sex	0.0200	1.20	1, 60	0.2775
Within Subjects				
All Within Interactions	0.1278	2.56	3, 60	0.0636
Side	0.0049	0.30	1, 60	0.5880
Side-by-Treatment	0.1068	6.41	1, 60	0.0140
Side-by-Sex	0.0002	0.01	1, 60	0.9221
Side-by-Treatment-by-Sex	0.0165	0.99	1, 60	0.3236

Table B-77. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal CHA L Final and Sagittal CHA R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1245	2.49	3, 60	0.0689
Treatment	0.0501	3.00	1, 60	0.0882
Sex	0.0003	0.02	1, 60	0.9010
Treatment-by-Sex	0.0749	4.49	1, 60	0.0382
Within Subjects				
All Within Interactions	0.0922	1.84	3, 60	0.1490
Side	0.0080	0.48	1, 60	0.4916
Side-by-Treatment	0.0660	3.96	1, 60	0.0512
Side-by-Sex	0.0107	0.64	1, 60	0.4257
Side-by-Treatment-by-Sex	0.0053	0.32	1, 60	0.5749

Table B-78. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal CHA L and Change in Sagittal CHA R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0512	1.02	3, 60	0.3887
Treatment	0.0048	0.29	1, 60	0.5933
Sex	0.0002	0.01	1, 60	0.9058
Treatment-by-Sex	0.0467	2.80	1, 60	0.0995
Within Subjects				
All Within Interactions	0.0084	0.17	3, 60	0.9177
Side	0.0175	1.05	1, 60	0.3091
Side-by-Treatment	0.0011	0.06	1, 60	0.8024
Side-by-Sex	0.0064	0.38	1, 60	0.5382
Side-by-Treatment-by-Sex	0.0014	0.08	1, 60	0.7743

Table B-79. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal ACP L Initial and Sagittal ACP R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1822	3.64	3, 60	0.0175
Treatment	0.1480	8.88	1, 60	0.0042
Sex	0.0171	1.03	1, 60	0.3148
Treatment-by-Sex	0.0270	1.62	1, 60	0.2081
Within Subjects				
All Within Interactions	0.0146	0.29	3, 60	0.8315
Side	0.0000	0.00	1, 60	0.9741
Side-by-Treatment	0.0049	0.29	1, 60	0.5911
Side-by-Sex	0.0074	0.45	1, 60	0.5067
Side-by-Treatment-by-Sex	0.0001	0.00	1, 60	0.9524

Table B-80. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal ACP L Final and Sagittal ACP R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.2929	5.86	3, 60	0.0014
Treatment	0.2346	14.08	1, 60	0.0004
Sex	0.0958	5.75	1, 60	0.0197
Treatment-by-Sex	0.0013	0.08	1, 60	0.7796
Within Subjects				
All Within Interactions	0.0217	0.43	3, 60	0.7290
Side	0.0005	0.03	1, 60	0.8611
Side-by-Treatment	0.0003	0.02	1, 60	0.9001
Side-by-Sex	0.0002	0.01	1, 60	0.9048
Side-by-Treatment-by-Sex	0.0211	1.27	1, 60	0.2650

Table B-81. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal ACP L and Change in Sagittal ACP R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1336	2.67	3, 60	0.0555
Treatment	0.0265	1.59	1, 60	0.2123
Sex	0.0821	4.92	1, 60	0.0303
Treatment-by-Sex	0.0411	2.47	1, 60	0.1214
Within Subjects				
All Within Interactions	0.0354	0.71	3, 60	0.5507
Side	0.0007	0.04	1, 60	0.8335
Side-by-Treatment	0.0059	0.35	1, 60	0.5548
Side-by-Sex	0.0033	0.20	1, 60	0.6568
Side-by-Treatment-by-Sex	0.0250	1.50	1, 60	0.2254

Table B-82. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal AAE L Initial and Sagittal AAE R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0962	1.92	3, 60	0.1352
Treatment	0.0248	1.49	1, 60	0.2270
Sex	0.0481	2.89	1, 60	0.0946
Treatment-by-Sex	0.0117	0.70	1, 60	0.4057
Within Subjects				
All Within Interactions	0.0718	1.44	3, 60	0.2413
Side	0.0583	3.50	1, 60	0.0664
Side-by-Treatment	0.0324	1.94	1, 60	0.1686
Side-by-Sex	0.0029	0.18	1, 60	0.6755
Side-by-Treatment-by-Sex	0.0327	1.96	1, 60	0.1664

Table B-83. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal AAE L Final and Sagittal AAE R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0320	0.64	3, 60	0.5927
Treatment	0.0040	0.24	1, 60	0.6263
Sex	0.0223	1.34	1, 60	0.2521
Treatment-by-Sex	0.0024	0.15	1, 60	0.7047
Within Subjects				
All Within Interactions	0.0436	0.87	3, 60	0.4605
Side	0.0088	0.53	1, 60	0.4704
Side-by-Treatment	0.0037	0.22	1, 60	0.6386
Side-by-Sex	0.0010	0.06	1, 60	0.8038
Side-by-Treatment-by-Sex	0.0388	2.33	1, 60	0.1323

Table B-84. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal AAE L and Change in Sagittal AAE R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0255	0.51	3, 60	0.6762
Treatment	0.0143	0.86	1, 60	0.3573
Sex	0.0035	0.21	1, 60	0.6488
Treatment-by-Sex	0.0052	0.31	1, 60	0.5794
Within Subjects				
All Within Interactions	0.0269	0.54	3, 60	0.6577
Side	0.0143	0.86	1, 60	0.3581
Side-by-Treatment	0.0100	0.60	1, 60	0.4409
Side-by-Sex	0.0086	0.52	1, 60	0.4751
Side-by-Treatment-by-Sex	0.0045	0.27	1, 60	0.6055

Table B-85. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal AGF L Initial and Sagittal AGF R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0902	1.80	3, 60	0.1561
Treatment	0.0858	5.15	1, 60	0.0268
Sex	0.0001	0.01	1, 60	0.9426
Treatment-by-Sex	0.0013	0.08	1, 60	0.7812
Within Subjects				
All Within Interactions	0.1659	3.32	3, 60	0.0258
Side	0.1580	9.48	1, 60	0.0031
Side-by-Treatment	0.1297	7.78	1, 60	0.0071
Side-by-Sex	0.0060	0.36	1, 60	0.5520
Side-by-Treatment-by-Sex	0.0177	1.06	1, 60	0.3073

Table B-86. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Sagittal AGF L Final and Sagittal AGF R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0115	0.23	3, 60	0.8757
Treatment	0.0027	0.16	1, 60	0.6874
Sex	0.0000	0.00	1, 60	0.9902
Treatment-by-Sex	0.0087	0.52	1, 60	0.4718
Within Subjects				
All Within Interactions				
Side	0.1402	8.41	3, 60	0.0052
Side-by-Treatment	0.0305	1.83	1, 60	0.1813
Side-by-Sex	0.0143	0.86	1, 60	0.3579
Side-by-Treatment-by-Sex	0.0060	0.36	1, 60	0.5493

Table B-87. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Sagittal AGF L and Change in Sagittal AGF R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.1710	3.42	3, 60	0.0228
Treatment	0.1539	9.24	1, 60	0.0035
Sex	0.0003	0.02	1, 60	0.8890
Treatment-by-Sex	0.0103	0.62	1, 60	0.4352
Within Subjects				
All Within Interactions	0.0263	0.53	3, 60	0.6668
Side	0.0010	0.06	1, 60	0.8044
Side-by-Treatment	0.0235	1.41	1, 60	0.2396
Side-by-Sex	0.0034	0.20	1, 60	0.6539
Side-by-Treatment-by-Sex	0.0018	0.11	1, 60	0.7468

Table B-88. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Coronal MJS L Initial and Coronal MJS R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0074	0.15	3, 60	0.9301
Treatment	0.0017	0.10	1, 60	0.7508
Sex	0.0055	0.33	1, 60	0.5665
Treatment-by-Sex	0.0012	0.07	1, 60	0.7912
Within Subjects				
All Within Interactions	0.0035	0.07	3, 60	0.9755
Side	0.0067	0.40	1, 60	0.5281
Side-by-Treatment	0.0002	0.01	1, 60	0.9059
Side-by-Sex	0.0029	0.18	1, 60	0.6761
Side-by-Treatment-by-Sex	0.0000	0.00	1, 60	0.9970

Table B-89. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Coronal MJS L Final and Coronal MJS R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0183	0.37	3, 60	0.7771
Treatment	0.0000	0.00	1, 60	0.9805
Sex	0.0146	0.88	1, 60	0.3533
Treatment-by-Sex	0.0028	0.17	1, 60	0.6816
Within Subjects				
All Within Interactions	0.1782	3.56	3, 60	0.0193
Side	0.0684	4.10	1, 60	0.0472
Side-by-Treatment	0.1681	10.08	1, 60	0.0024
Side-by-Sex	0.0001	0.01	1, 60	0.9435
Side-by-Treatment-by-Sex	0.0066	0.40	1, 60	0.5314

Table B-90. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Coronal MJS L and Change in Coronal MJS R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0432	0.86	3, 60	0.4647
Treatment	0.0013	0.08	1, 60	0.7822
Sex	0.0421	2.53	1, 60	0.1172
Treatment-by-Sex	0.0007	0.04	1, 60	0.8393
Within Subjects				
All Within Interactions	0.1575	3.15	3, 60	0.0314
Side	0.0229	1.38	1, 60	0.2456
Side-by-Treatment	0.1414	8.49	1, 60	0.0050
Side-by-Sex	0.0020	0.12	1, 60	0.7331
Side-by-Treatment-by-Sex	0.0051	0.30	1, 60	0.5836

Table B-91. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Coronal SJS L Initial and Coronal SJS R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0042	0.08	3, 60	0.9690
Treatment	0.0025	0.15	1, 60	0.7022
Sex	0.0004	0.02	1, 60	0.8808
Treatment-by-Sex	0.0016	0.10	1, 60	0.7559
Within Subjects				
All Within Interactions	0.0857	1.71	3, 60	0.1736
Side	0.0015	0.09	1, 60	0.7672
Side-by-Treatment	0.0805	4.83	1, 60	0.0318
Side-by-Sex	0.0001	0.00	1, 60	0.9448
Side-by-Treatment-by-Sex	0.0024	0.14	1, 60	0.7081

Table B-92. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Coronal SJS L F and Coronal SJS R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0541	1.08	3, 60	0.3639
Treatment	0.0273	1.64	1, 60	0.2057
Sex	0.0144	0.87	1, 60	0.3560
Treatment-by-Sex	0.0164	0.99	1, 60	0.3246
Within Subjects				
All Within Interactions	0.0471	0.94	3, 60	0.4257
Side	0.0183	1.10	1, 60	0.2989
Side-by-Treatment	0.0046	0.28	1, 60	0.6011
Side-by-Sex	0.0061	0.37	1, 60	0.5470
Side-by-Treatment-by-Sex	0.0336	2.02	1, 60	0.1607

Table B-93. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Coronal SJS L and Change in Coronal SJS R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0441	0.88	3, 60	0.4556
Treatment	0.0125	0.75	1, 60	0.3903
Sex	0.0092	0.55	1, 60	0.4613
Treatment-by-Sex	0.0242	1.45	1, 60	0.2331
Within Subjects				
All Within Interactions	0.0953	1.91	3, 60	0.1381
Side	0.0164	0.99	1, 60	0.3246
Side-by-Treatment	0.0548	3.29	1, 60	0.0747
Side-by-Sex	0.0043	0.26	1, 60	0.6130
Side-by-Treatment-by-Sex	0.0294	1.77	1, 60	0.1889

Table B-94. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Coronal LJS L Initial and Coronal LJS R Initial.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0688	1.38	3, 60	0.2590
Treatment	0.0604	3.63	1, 60	0.0617
Sex	0.0027	0.16	1, 60	0.6910
Treatment-by-Sex	0.0000	0.00	1, 60	0.9747
Within Subjects				
All Within Interactions	0.0207	0.41	3, 60	0.7440
Side	0.0189	1.13	1, 60	0.2912
Side-by-Treatment	0.0125	0.75	1, 60	0.3899
Side-by-Sex	0.0029	0.17	1, 60	0.6787
Side-by-Treatment-by-Sex	0.0064	0.39	1, 60	0.5365

Table B-95. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Coronal LJS L Final and Coronal LJS R Final.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0448	0.90	3, 60	0.4482
Treatment	0.0332	1.99	1, 60	0.1633
Sex	0.0181	1.09	1, 60	0.3014
Treatment-by-Sex	0.0003	0.02	1, 60	0.9011
Within Subjects				
All Within Interactions	0.0847	1.69	3, 60	0.1778
Side	0.0002	0.01	1, 60	0.9186
Side-by-Treatment	0.0013	0.08	1, 60	0.7803
Side-by-Sex	0.0171	1.02	1, 60	0.3156
Side-by-Treatment-by-Sex	0.0623	3.74	1, 60	0.0580

Table B-96. Results of mixed-model ANOVA testing for treatment (Edgewise with or without MARA) sex (male, female), and side (left, right TMJ) differences for Change in Coronal LJS L and Change in Coronal LJS R.

Source	SSQ	F ratio	df	P value
Between Subjects				
All Between	0.0468	0.94	3, 60	0.4292
Treatment	0.0020	0.12	1, 60	0.7282
Sex	0.0405	2.43	1, 60	0.1242
Treatment-by-Sex	0.0005	0.03	1, 60	0.8652
Within Subjects				
All Within Interactions	0.0480	0.96	3, 60	0.4174
Side	0.0223	1.34	1, 60	0.2516
Side-by-Treatment	0.0207	1.24	1, 60	0.2691
Side-by-Sex	0.0038	0.23	1, 60	0.6348
Side-by-Treatment-by-Sex	0.0196	1.18	1, 60	0.2820

**APPENDIX C. LEAST-SQUARES MEANS FOR THE VARIABLES, PARTITIONED BY TREATMENT, SEX,
AND TREATMENT-BY-SEX**

Table C-1. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial ML L Initial and Axial ML R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	17.233	17.478	Edgewise	17.471	17.685
Edgewise, Male	17.708	17.892	MARA+Edgewise	16.949	16.958
MARA+Edgewise, Female	16.193	16.057			
MARA+Edgewise, Male	17.705	17.858			

Table C-2. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial ML L Final and Axial ML R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	17.983	18.406	Edgewise	18.465	18.449
Edgewise, Male	18.946	18.492	MARA+Edgewise	17.567	17.790
MARA+Edgewise, Female	16.493	16.743			
MARA+Edgewise, Male	18.642	18.837			

Table C-3. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Axial ML L and Change in Axial ML R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	0.750	0.928	Edgewise	0.994	0.764
Edgewise, Male	1.238	0.600	MARA+Edgewise	0.618	0.832
MARA+Edgewise, Female	0.300	0.686			
MARA+Edgewise, Male	0.937	0.979			

Table C-4. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial AP L Initial and Axial AP R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	6.278	6.472	Edgewise	6.750	6.825
Edgewise, Male	7.223	7.177	MARA+Edgewise	7.023	7.075
MARA+Edgewise, Female	6.979	6.707			
MARA+Edgewise, Male	7.068	7.442			

Table C-5. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial AP L Final and Axial AP R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	6.256	6.472	Edgewise	6.755	6.778
Edgewise, Male	7.254	7.085	MARA+Edgewise	6.715	6.673
MARA+Edgewise, Female	6.493	6.393			
MARA+Edgewise, Male	6.937	6.953			

Table C-6. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Axial AP L and Change in Axial AP R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	-0.022	0.000	Edgewise	0.004	-0.046
Edgewise, Male	0.031	-0.092	MARA+Edgewise	-0.309	-0.402
MARA+Edgewise, Female	-0.486	-0.314			
MARA+Edgewise, Male	-0.132	-0.489			

Table C-7. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial MLCP L Initial and Axial MLCP R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	46.072	46.256	Edgewise	46.182	46.693
Edgewise, Male	46.292	47.131	MARA+Edgewise	46.055	46.007
MARA+Edgewise, Female	45.436	45.050			
MARA+Edgewise, Male	46.674	46.963			

Table C-8. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial MLCP L Final and Axial MLCP R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	47.333	47.333	Edgewise	47.486	48.055
Edgewise, Male	47.638	48.777	MARA+Edgewise	47.527	47.472
MARA+Edgewise, Female	46.786	46.464			
MARA+Edgewise, Male	48.268	48.479			

Table C-9. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Axial MLCP L and Change in Axial MLCP R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	1.261	1.078	Edgewise	1.304	1.362
Edgewise, Male	1.346	1.646	MARA+Edgewise	1.472	1.465
MARA+Edgewise, Female	1.350	1.414			
MARA+Edgewise, Male	1.595	1.516			

Table C-10. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial CA L Initial and Axial CA R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	63.528	62.833	Edgewise	63.387	63.247
Edgewise, Male	63.246	63.662	MARA+Edgewise	61.676	61.779
MARA+Edgewise, Female	61.814	60.100			
MARA+Edgewise, Male	61.537	63.458			

Table C-11. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial CA L Final and Axial CA R Final.

Group	Treatment-by-Sex			Sexes Combined	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	64.294	63.528	Edgewise	64.478	63.375
Edgewise, Male	64.662	63.223	MARA+Edgewise	62.754	62.270
MARA+Edgewise, Female	61.750	59.871			
MARA+Edgewise, Male	63.758	64.668			

Table C-12. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable change in Axial CA L and change in Axial CA R.

Group	Treatment-by-Sex			Sexes Combined	
	Left Change	Right Change		Left Change	Right Change
Edgewise-Alone, Female	0.767	0.694	Edgewise-Alone	1.091	0.128
Edgewise-Alone, Male	1.415	-0.438	MARA+Edgewise	1.078	0.491
MARA+Edgewise, Female	-0.064	-0.229			
MARA+Edgewise, Male	2.221	1.211			

Table C-13. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial LACP L Initial and Axial LACP R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	97.178	101.217	Edgewise	101.297	104.097
Edgewise, Male	105.415	106.977	MARA+Edgewise	100.231	102.859
MARA+Edgewise, Female	91.936	92.071			
MARA+Edgewise, Male	108.526	113.647			

Table C-14. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Axial LACP L Final and Axial LACP R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	102.250	104.406	Edgewise	108.113	107.260
Edgewise, Male	113.977	110.115	MARA+Edgewise	103.695	107.899
MARA+Edgewise, Female	92.279	94.850			
MARA+Edgewise, Male	115.111	120.947			

Table C-15. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Axial LACP L and Change in Axial LACP R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	5.072	3.189	Edgewise	6.817	3.164
Edgewise, Male	8.562	3.138	MARA+Edgewise	3.464	5.039
MARA+Edgewise, Female	0.343	2.779			
MARA+Edgewise, Male	6.584	7.300			

Table C-16. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal MJS L Initial and Sagittal AJS R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	1.956	1.356	Edgewise	2.009	1.351
Edgewise, Male	2.062	1.346	MARA+Edgewise	2.614	1.450
MARA+Edgewise, Female	2.507	1.379			
MARA+Edgewise, Male	2.721	1.521			

Table C-17. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal MJS L Final and Sagittal MJS R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	2.111	2.417	Edgewise	2.259	2.497
Edgewise, Male	2.408	2.577	MARA+Edgewise	2.456	2.671
MARA+Edgewise, Female	2.143	2.479			
MARA+Edgewise, Male	2.768	2.863			

Table C-18. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal AJS L Initial and Sagittal AJS R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise-Alone,Female	1.256	1.356	Edgewise-Alone	1.262	1.351
Edgewise-Alone,Male	1.269	1.346	MARA+Edgewise	1.424	1.450
MARA+Edgewise,Female	1.421	1.379			
MARA+Edgewise,Male	1.426	1.521			

Table C-19. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal AJS L Final and Sagittal AJS R Final.

Group	Treatment-by-Sex			Sexes Combined	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	2.583	1.417	Edgewise	2.742	1.343
Edgewise, Male	2.900	1.269	MARA+Edgewise	2.674	1.490
MARA+Edgewise, Female	2.686	1.364			
MARA+Edgewise, Male	2.663	1.616			

Table C-20. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal PJS L and Change in Sagittal PJS R.

Group	Treatment-by-Sex			Sexes Combined	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	-0.161	-0.061	Edgewise	-0.034	0.119
Edgewise, Male	0.092	0.300	MARA+Edgewise	-0.199	-0.349
MARA+Edgewise, Female	-0.336	-0.550			
MARA+Edgewise, Male	-0.063	-0.147			

Table C-21. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal FW L Initial and Sagittal FW R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	17.383	17.917	Edgewise	17.496	18.097
Edgewise, Male	17.608	18.277	MARA+Edgewise	17.208	16.751
MARA+Edgewise, Female	17.257	16.864			
MARA+Edgewise, Male	17.158	16.637			

Table C-22. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal FW L Final and Sagittal FW R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	17.478	18.100	Edgewise	17.635	18.500
Edgewise, Male	17.792	18.900	MARA+Edgewise	17.498	16.945
MARA+Edgewise, Female	17.121	16.486			
MARA+Edgewise, Male	17.874	17.405			

Table C-23. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal FW L and Change in Sagittal FW R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	0.094	0.183	Edgewise	0.140	0.403
Edgewise, Male	0.185	0.623	MARA+Edgewise	0.290	0.195
MARA+Edgewise, Female	-0.136	-0.379			
MARA+Edgewise, Male	0.716	0.768			

Table C-24. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal FD L Initial and Sagittal FD R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	7.017	7.372	Edgewise	7.070	7.371
Edgewise, Male	7.123	7.369	MARA+Edgewise	7.839	7.830
MARA+Edgewise, Female	7.636	7.729			
MARA+Edgewise, Male	8.042	7.932			

Table C-25. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal FD L Final and Sagittal FD R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	7.506	7.761	Edgewise	7.499	7.700
Edgewise, Male	7.492	7.638	MARA+Edgewise	7.995	7.972
MARA+Edgewise, Female	7.843	7.886			
MARA+Edgewise, Male	8.147	8.058			

Table C-26. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal FD L and Change in Sagittal FD R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	0.489	0.389	Edgewise	0.429	0.329
Edgewise, Male	0.369	0.269	MARA+Edgewise	0.156	0.142
MARA+Edgewise, Female	0.207	0.157			
MARA+Edgewise, Male	0.105	0.126			

Table C-27. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal FW L Initial and Sagittal FW R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	17.383	17.917	Edgewise	17.496	18.097
Edgewise, Male	17.608	18.277	MARA+Edgewise	17.208	16.751
MARA+Edgewise, Female	17.257	16.864			
MARA+Edgewise, Male	17.158	16.637			

Table C-28. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal FW L Final and Sagittal FW R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	17.478	18.100	Edgewise	17.635	18.500
Edgewise, Male	17.792	18.900	MARA+Edgewise	17.498	16.945
MARA+Edgewise, Female	17.121	16.486			
MARA+Edgewise, Male	17.874	17.405			

Table C-29. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal FW L and Change in Sagittal FW R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	0.094	0.183	Edgewise	0.140	0.403
Edgewise, Male	0.185	0.623	MARA+Edgewise	0.290	0.195
MARA+Edgewise, Female	-0.136	-0.379			
MARA+Edgewise, Male	0.716	0.768			

Table C-30. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal CHH L Initial and Sagittal CHH R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	6.400	6.494	Edgewise	6.596	6.732
Edgewise, Male	6.792	6.969	MARA+Edgewise	6.368	6.303
MARA+Edgewise, Female	5.979	6.100			
MARA+Edgewise, Male	6.758	6.505			

Table C-31. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal CHH L Final and Sagittal CHH R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	6.361	6.983	Edgewise	6.661	7.176
Edgewise, Male	6.962	7.369	MARA+Edgewise	6.538	6.489
MARA+Edgewise, Female	6.207	6.293			
MARA+Edgewise, Male	6.868	6.684			

Table C-32. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal CHH L and Change in Sagittal CHH R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	-0.039	0.489	Edgewise	0.065	0.444
Edgewise, Male	0.169	0.400	MARA+Edgewise	0.170	0.186
MARA+Edgewise, Female	0.229	0.193			
MARA+Edgewise, Male	0.111	0.179			

Table C-33. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal EAM-AE L Initial and Sagittal EAM-AE R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	22.761	24.072	Edgewise	23.123	24.582
Edgewise, Male	23.485	25.092	MARA+Edgewise	22.864	22.627
MARA+Edgewise, Female	22.964	22.664			
MARA+Edgewise, Male	22.763	22.589			

Table C-34. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal EAM-AE L Final and Sagittal EAM-AE R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	23.806	24.456	Edgewise	23.995	25.005
Edgewise, Male	24.185	25.554	MARA+Edgewise	23.765	23.207
MARA+Edgewise, Female	23.636	23.036			
MARA+Edgewise, Male	23.895	23.379			

Table C-35. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal EAM AE L and Change in Sagittal EAM AE R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	1.044	0.383	Edgewise	0.872	0.422
Edgewise, Male	0.700	0.462	MARA+Edgewise	0.902	0.580
MARA+Edgewise, Female	0.671	0.371			
MARA+Edgewise, Male	1.132	0.789			

Table C-36. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal EAM-C L Initial and Sagittal EAM-C R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	12.489	13.528	Edgewise	12.791	13.756
Edgewise, Male	13.092	13.985	MARA+Edgewise	13.255	13.009
MARA+Edgewise, Female	13.479	13.186			
MARA+Edgewise, Male	13.032	12.832			

Table C-37. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal EAM-C L Final and Sagittal EAM-C R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	13.833	13.678	Edgewise	13.705	14.066
Edgewise, Male	13.577	14.454	MARA+Edgewise	13.428	13.127
MARA+Edgewise, Female	13.714	13.229			
MARA+Edgewise, Male	13.142	13.026			

Table C-38. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal EAM C L and Change in Sagittal EAM C R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	1.344	0.150	Edgewise	0.915	0.310
Edgewise, Male	0.485	0.469	MARA+Edgewise	0.173	0.119
MARA+Edgewise, Female	0.236	0.043			
MARA+Edgewise, Male	0.111	0.195			

Table C-39. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal EAM-P L Initial and Sagittal EAM-C R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	5.489	13.528	Edgewise	5.441	13.756
Edgewise, Male	5.392	13.985	MARA+Edgewise	5.839	13.009
MARA+Edgewise, Female	5.957	13.186			
MARA+Edgewise, Male	5.721	12.832			

Table C-40. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal EAM-P L Final and Sagittal EAM-P R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	6.022	5.967	Edgewise	5.919	6.137
Edgewise, Male	5.815	6.308	MARA+Edgewise	6.199	6.047
MARA+Edgewise, Female	6.450	6.079			
MARA+Edgewise, Male	5.947	6.016			

Table C-41. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal EAM P L and Change in EAM P R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	0.533	0.067	Edgewise	0.478	-0.001
Edgewise, Male	0.423	-0.069	MARA+Edgewise	0.360	0.184
MARA+Edgewise, Female	0.493	0.136			
MARA+Edgewise, Male	0.226	0.232			

Table C-42. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal ATA L Initial and Sagittal ATA R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	36.544	37.256	Edgewise	36.803	36.605
Edgewise, Male	37.062	35.954	MARA+Edgewise	43.948	44.862
MARA+Edgewise, Female	43.929	45.314			
MARA+Edgewise, Male	43.968	44.411			

Table C-43. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal ATA L Final and Sagittal ATA R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	38.239	39.394	Edgewise	37.854	38.020
Edgewise, Male	37.469	36.646	MARA+Edgewise	42.010	42.933
MARA+Edgewise, Female	43.179	43.893			
MARA+Edgewise, Male	40.842	41.974			

Table C-44. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal ATA L and Change in Sagittal ATA R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	1.694	2.139	Edgewise	1.051	1.416
Edgewise, Male	0.408	0.692	MARA+Edgewise	-1.938	-1.929
MARA+Edgewise, Female	-0.750	-1.421			
MARA+Edgewise, Male	-3.126	-2.437			

Table C-45. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal CHA L Initial and Sagittal CHA R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise-Alone,Female	140.222	143.644	Edgewise-Alone	141.853	144.061
Edgewise-Alone,Male	143.485	144.477	MARA+Edgewise	141.404	137.986
MARA+Edgewise,Female	142.850	138.43			
MARA+Edgewise,Male	139.958	137.537			

Table C-46. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal CHA L Final and Sagittal CHA R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise-Alone,Female	132.056	137.050	Edgewise-Alone	135.701	139.010
Edgewise-Alone,Male	139.346	140.969	MARA+Edgewise	133.828	132.227
MARA+Edgewise,Female	136.171	134.864			
MARA+Edgewise,Male	131.484	129.589			

Table C-47. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable change in Sagittal CHA L and change in Sagittal CHA R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise-Alone,Female	-8.167	-6.594	Edgewise-Alone	-6.153	-5.051
Edgewise-Alone,Male	-4.138	-3.508	MARA+Edgewise	-7.576	-5.759
MARA+Edgewise,Female	-6.679	-3.571			
MARA+Edgewise,Male	-8.474	-7.947			

Table C-48. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal ACP L Initial and Sagittal ACP R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	48.600	49.850	Edgewise	48.665	49.179
Edgewise, Male	48.731	48.508	MARA+Edgewise	42.239	41.660
MARA+Edgewise, Female	39.257	39.293			
MARA+Edgewise, Male	45.221	44.026			

Table C-49. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal ACP L Final and Sagittal ACP R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	48.628	47.450	Edgewise	50.499	50.560
Edgewise, Male	52.369	53.669	MARA+Edgewise	41.512	41.884
MARA+Edgewise, Female	37.593	39.500			
MARA+Edgewise, Male	45.432	44.268			

Table C-50. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in ACP L and Change in Sagittal ACP R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	0.028	-2.400	Edgewise	1.833	1.381
Edgewise, Male	3.638	5.162	MARA+Edgewise	-0.727	0.225
MARA+Edgewise, Female	-1.664	0.207			
MARA+Edgewise, Male	0.211	0.242			

Table C-51. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal AAE L Initial and Sagittal AAE R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	82.811	79.983	Edgewise	86.736	87.738
Edgewise, Male	90.662	95.492	MARA+Edgewise	89.428	96.289
MARA+Edgewise, Female	86.414	95.336			
MARA+Edgewise, Male	92.442	97.242			

Table C-52. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal AAE L Final and Sagittal AAE R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise-Alone,Female	95.061	92.339	Edgewise-Alone	97.604	98.281
Edgewise-Alone,Male	100.146	104.223	MARA+Edgewise	99.048	102.240
MARA+Edgewise,Female	94.543	102.464			
MARA+Edgewise,Male	103.553	102.016			

Table C-53. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal AAE L and Change in Sagittal AAE R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	12.250	12.356	Edgewise-Alone	10.867	10.543
Edgewise, Male	9.485	8.731	MARA+Edgewise	9.620	5.951
MARA+Edgewise, Female	8.129	7.129			
MARA+Edgewise, Male	11.111	4.774			

Table C-54. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal AGF L Initial and Sagittal AGF R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	70.522	78.322	Edgewise-Alone	69.834	78.253
Edgewise, Male	69.146	78.185	MARA+Edgewise	82.147	82.561
MARA+Edgewise, Female	80.336	83.086			
MARA+Edgewise, Male	83.958	82.037			

Table C-55. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Sagittal AGF L Final and Sagittal AGF R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	78.828	86.383	Edgewise	77.687	84.707
Edgewise, Male	76.546	83.031	MARA+Edgewise	81.466	84.021
MARA+Edgewise, Female	78.843	83.921			
MARA+Edgewise, Male	84.089	84.121			

Table C-56. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Sagittal AGF L and Change in Sagittal AGF R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	8.306	8.061	Edgewise	7.853	6.454
Edgewise, Male	7.400	4.846	MARA+Edgewise	-0.681	1.460
MARA+Edgewise, Female	-1.493	0.836			
MARA+Edgewise, Male	0.132	2.084			

Table C-57. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Coronal MJS L Initial and Coronal MJS R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	1.933	1.800	Edgewise	1.844	1.758
Edgewise, Male	1.754	1.715	MARA+Edgewise	1.880	1.821
MARA+Edgewise, Female	1.929	1.821			
MARA+Edgewise, Male	1.832	1.821			

Table C-58. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Coronal MJS L Final and Coronal MJS R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	1.739	1.917	Edgewise	1.816	1.935
Edgewise, Male	1.892	1.954	MARA+Edgewise	2.151	1.609
MARA+Edgewise, Female	2.064	1.450			
MARA+Edgewise, Male	2.237	1.768			

Table C-59. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Coronal MJS L and Change in Coronal MJS R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	-0.194	0.117	Edgewise	-0.028	0.178
Edgewise, Male	0.138	0.238	MARA+Edgewise	0.270	-0.212
MARA+Edgewise, Female	0.136	-0.371			
MARA+Edgewise, Male	0.405	-0.053			

Table C-60. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Coronal SJS L Initial and Coronal SJS R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	1.939	1.833	Edgewise	1.985	1.859
Edgewise, Male	2.031	1.885	MARA+Edgewise	1.780	1.945
MARA+Edgewise, Female	1.807	1.943			
MARA+Edgewise, Male	1.753	1.947			

Table C-61. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Coronal SJS L Final and Coronal SJS R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	2.006	1.900	Edgewise	1.968	1.927
Edgewise, Male	1.931	1.954	MARA+Edgewise	1.797	1.673
MARA+Edgewise, Female	1.557	1.593			
MARA+Edgewise, Male	2.037	1.753			

Table C-62. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Coronal SJS L and Change in Coronal SJS R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	0.067	0.067	Edgewise	-0.017	0.068
Edgewise, Male	-0.100	0.069	MARA+Edgewise	0.017	-0.272
MARA+Edgewise, Female	-0.250	-0.350			
MARA+Edgewise, Male	0.284	-0.195			

Table C-63. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Coronal LJS L Initial and Coronal LJS R Initial.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Initial	Right Initial		Left Initial	Right Initial
Edgewise, Female	2.689	2.489	Edgewise	2.648	2.468
Edgewise, Male	2.608	2.446	MARA+Edgewise	2.294	2.275
MARA+Edgewise, Female	2.271	2.350			
MARA+Edgewise, Male	2.316	2.200			

Table C-64. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Coronal LJS L Final and Coronal LJS R Final.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Final	Right Final		Left Final	Right Final
Edgewise, Female	2.483	2.439	Edgewise	2.538	2.569
Edgewise, Male	2.592	2.700	MARA+Edgewise	2.337	2.323
MARA+Edgewise, Female	2.143	2.371			
MARA+Edgewise, Male	2.532	2.274			

Table C-65. Descriptive statistics (least-square means) of the sample partitioned by treatment and sex for the variable Change in Coronal LJS L and Change in Coronal LJS R.

Group	<u>Treatment-by-Sex</u>			<u>Sexes Combined</u>	
	Left Change	Right Change		Left Change	Right Change
Edgewise, Female	-0.206	-0.050	Edgewise	-0.110	0.102
Edgewise, Male	-0.015	0.254	MARA+Edgewise	0.044	0.048
MARA+Edgewise, Female	-0.129	0.021			
MARA+Edgewise, Male	0.216	0.074			

**APPENDIX D. RESULTS OF PAIRED T-TESTS ASSESSING FOR
SYSTEMATIC MEASUREMENT DIFFERENCES IN THE INTRAOBSERVER
REPETITIONS**

Table D-1. Assessment of intraobserver repeatability for the variable Overjet Final.

Statistic	Value
Session Two (mean)	2.6750
Session One (mean)	2.5750
Mean Difference	0.1000
Standard Error	0.1066
Upper 95%	0.3346
Lower 95%	-0.1346
Sample size	12
Correlation	0.9401
Paired t test	0.9381
Degrees freedom	11
P value (2 tail)	0.3683

Table D-2. Assessment of intraobserver repeatability for the variable ANB Final.

Statistic	Value
Session Two (mean)	4.8500
Session One (mean)	4.7333
Mean Difference	0.1167
Standard Error	0.0767
Upper 95%	0.2855
Lower 95%	-0.0522
Sample size	12
Correlation	0.9900
Paired t test	1.5210
Degrees freedom	11
P value (2 tail)	0.1565

Table D-3. Assessment of intraobserver repeatability for the variable ANB Initial.

Statistic	Value
Session Two (mean)	5.5250
Session One (mean)	5.7000
Mean Difference	-0.1750
Standard Error	0.0552
Upper 95%	-0.0535
Lower 95%	-0.2965
Sample size	12
Correlation	0.9926
Paired t test	-3.1691
Degrees freedom	11
P value (2 tail)	0.0089

Table D-4. Assessment of intraobserver repeatability for the variable Axial AP L Final.

Statistic	Value
Session Two (mean)	6.5083
Session One (mean)	6.4250
Mean Difference	0.0833
Standard Error	0.0705
Upper 95%	0.2386
Lower 95%	-0.0719
Sample size	12
Correlation	0.9521
Paired t test	1.1815
Degrees freedom	11
P value (2 tail)	0.2623

Table D-5. Assessment of intraobserver repeatability for the variable Axial AP L Initial.

Statistic	Value
Session Two (mean)	6.5667
Session One (mean)	6.4083
Mean Difference	0.1583
Standard Error	0.1190
Upper 95%	0.4202
Lower 95%	-0.1036
Sample size	12
Correlation	0.8863
Paired t test	1.3306
Degrees freedom	11
P value (2 tail)	0.2103

Table D-6. Assessment of intraobserver repeatability for the variable Axial AP R Final.

Statistic	Value
Session Two (mean)	6.2583
Session One (mean)	6.0417
Mean Difference	0.2167
Standard Error	0.1218
Upper 95%	0.4846
Lower 95%	-0.0513
Sample size	12
Correlation	0.8756
Paired t test	1.7796
Degrees freedom	11
P value (2 tail)	0.1028

Table D-7. Assessment of intraobserver repeatability for the variable Axial AP R Initial.

Statistic	Value
Session Two (mean)	6.6000
Session One (mean)	6.4667
Mean Difference	0.1333
Standard Error	0.1257
Upper 95%	0.4101
Lower 95%	-0.1434
Sample size	12
Correlation	0.7776
Paired t test	1.0605
Degrees freedom	11
P value (2 tail)	0.3117

Table D-8. Assessment of intraobserver repeatability for the variable Axial APCD Final.

Statistic	Value
Session Two (mean)	-0.5333
Session One (mean)	-0.5417
Mean Difference	0.0083
Standard Error	0.1777
Upper 95%	0.3995
Lower 95%	-0.3828
Sample size	12
Correlation	0.9707
Paired t test	0.0469
Degrees freedom	11
P value (2 tail)	0.9634

Table D-9. Assessment of intraobserver repeatability for the variable Axial APCD Initial.

Statistic	Value
Session Two (mean)	0.4417
Session One (mean)	0.7333
Mean Difference	-0.2917
Standard Error	0.1848
Upper 95%	0.1151
Lower 95%	-0.6985
Sample size	12
Correlation	0.9484
Paired t test	-1.5781
Degrees freedom	11
P value (2 tail)	0.1429

Table D-10. Assessment of intraobserver repeatability for the variable Axial CA L Final.

Statistic	Value
Session Two (mean)	61.2833
Session One (mean)	60.7833
Mean Difference	0.5000
Standard Error	0.8465
Upper 95%	2.3631
Lower 95%	-1.3631
Sample size	12
Correlation	0.8427
Paired t test	0.5907
Degrees freedom	11
P value (2 tail)	0.5667

Table D-11. Assessment of intraobserver repeatability for the variable Axial CA L Initial.

Statistic	Value
Session Two (mean)	60.0500
Session One (mean)	59.6667
Mean Difference	0.3833
Standard Error	0.7393
Upper 95%	2.0104
Lower 95%	-1.2437
Sample size	12
Correlation	0.8924
Paired t test	0.5185
Degrees freedom	11
P value (2 tail)	0.6143

Table D-12. Assessment of intraobserver repeatability for the variable Axial CA R Final.

Statistic	Value
Session Two (mean)	59.8500
Session One (mean)	60.4167
Mean Difference	-0.5667
Standard Error	0.5026
Upper 95%	0.5396
Lower 95%	-1.6729
Sample size	12
Correlation	0.6884
Paired t test	-1.1274
Degrees freedom	11
P value (2 tail)	0.2836

Table D-13. Assessment of intraobserver repeatability for the variable Axial CA R Initial.

Statistic	Value
Session Two (mean)	60.0750
Session One (mean)	60.2833
Mean Difference	-0.2083
Standard Error	0.5749
Upper 95%	1.0570
Lower 95%	-1.4737
Sample size	12
Correlation	0.9200
Paired t test	-0.3624
Degrees freedom	11
P value (2 tail)	0.7239

Table D-14. Assessment of intraobserver repeatability for the variable Axial LACP L Final.

Statistic	Value
Session Two (mean)	113.3750
Session One (mean)	110.0250
Mean Difference	3.3500
Standard Error	2.1356
Upper 95%	8.0504
Lower 95%	-1.3504
Sample size	12
Correlation	0.9449
Paired t test	1.5687
Degrees freedom	11
P value (2 tail)	0.1450

Table D-15. Assessment of intraobserver repeatability for the variable Axial LACP L Initial.

Statistic	Value
Session Two (mean)	102.5000
Session One (mean)	100.5830
Mean Difference	1.9167
Standard Error	1.2719
Upper 95%	4.7161
Lower 95%	-0.8827
Sample size	12
Correlation	0.9786
Paired t test	1.5069
Degrees freedom	11
P value (2 tail)	0.1600

Table D-16. Assessment of intraobserver repeatability for the variable Axial LACP R Final.

Statistic	Value
Session Two (mean)	106.4920
Session One (mean)	102.8670
Mean Difference	3.6250
Standard Error	2.1545
Upper 95%	8.3670
Lower 95%	-1.1170
Sample size	12
Correlation	0.9181
Paired t test	1.6825
Degrees freedom	11
P value (2 tail)	0.1206

Table D-17. Assessment of intraobserver repeatability for the variable Axial LACP R Initial.

Statistic	Value
Session Two (mean)	105.2500
Session One (mean)	102.6670
Mean Difference	2.5833
Standard Error	1.5085
Upper 95%	5.9034
Lower 95%	-0.7367
Sample size	12
Correlation	0.9431
Paired t test	1.7126
Degrees freedom	11
P value (2 tail)	0.1148

Table D-18. Assessment of intraobserver repeatability for the variable Axial ML L Final.

Statistic	Value
Session Two (mean)	18.2417
Session One (mean)	18.4583
Mean Difference	-0.2167
Standard Error	0.1173
Upper 95%	0.0415
Lower 95%	-0.4749
Sample size	12
Correlation	0.9804
Paired t test	-1.8469
Degrees freedom	11
P value (2 tail)	0.0918

Table D-19. Assessment of intraobserver repeatability for the variable Axial ML L Initial.

Statistic	Value
Session Two (mean)	17.7250
Session One (mean)	17.6750
Mean Difference	0.0500
Standard Error	0.1469
Upper 95%	0.3734
Lower 95%	-0.2734
Sample size	12
Correlation	0.9686
Paired t test	0.3403
Degrees freedom	11
P value (2 tail)	0.7401

Table D-20. Assessment of intraobserver repeatability for the variable Axial ML R Final.

Statistic	Value
Session Two (mean)	18.0667
Session One (mean)	18.0167
Mean Difference	0.0500
Standard Error	0.1721
Upper 95%	0.4288
Lower 95%	-0.3288
Sample size	12
Correlation	0.9404
Paired t test	0.2905
Degrees freedom	11
P value (2 tail)	0.7768

Table D-21. Assessment of intraobserver repeatability for the variable Axial ML R Initial.

Statistic	Value
Session Two (mean)	17.6750
Session One (mean)	17.4500
Mean Difference	0.2250
Standard Error	0.1610
Upper 95%	0.5794
Lower 95%	-0.1294
Sample size	12
Correlation	0.9383
Paired t test	1.3973
Degrees freedom	11
P value (2 tail)	0.1899

Table D-22. Assessment of intraobserver repeatability for the variable Axial MLCP L Final.

Statistic	Value
Session Two (mean)	49.4667
Session One (mean)	49.2833
Mean Difference	0.1833
Standard Error	0.2380
Upper 95%	0.7072
Lower 95%	-0.3405
Sample size	12
Correlation	0.9495
Paired t test	0.7703
Degrees freedom	11
P value (2 tail)	0.4573

Table D-23. Assessment of intraobserver repeatability for the variable Axial MLCP L Initial.

Statistic	Value
Session Two (mean)	47.7250
Session One (mean)	47.8000
Mean Difference	-0.0750
Standard Error	0.1900
Upper 95%	0.3431
Lower 95%	-0.4931
Sample size	12
Correlation	0.9641
Paired t test	-0.3949
Degrees freedom	11
P value (2 tail)	0.7005

Table D-24. Assessment of intraobserver repeatability for the variable Axial MLCP R Final.

Statistic	Value
Session Two (mean)	48.9583
Session One (mean)	49.6333
Mean Difference	-0.6750
Standard Error	0.2529
Upper 95%	-0.1184
Lower 95%	-1.2316
Sample size	12
Correlation	0.9528
Paired t test	-2.6690
Degrees freedom	11
P value (2 tail)	0.0218

Table D-25. Assessment of intraobserver repeatability for the variable Axial MLCP R Initial.

Statistic	Value
Session Two (mean)	47.6417
Session One (mean)	47.6083
Mean Difference	0.0333
Standard Error	0.1852
Upper 95%	0.4409
Lower 95%	-0.3743
Sample size	12
Correlation	0.9717
Paired t test	0.1800
Degrees freedom	11
P value (2 tail)	0.8604

Table D-26. Assessment of intraobserver repeatability for the variable Coronal LJS L Final.

Statistic	Value
Session Two (mean)	2.4167
Session One (mean)	2.3000
Mean Difference	0.1167
Standard Error	0.0366
Upper 95%	0.1972
Lower 95%	0.0362
Sample size	12
Correlation	0.9915
Paired t test	3.1890
Degrees freedom	11
P value (2 tail)	0.0086

Table D-27. Assessment of intraobserver repeatability for the variable Coronal LJS L Initial.

Statistic	Value
Session Two (mean)	2.5417
Session One (mean)	2.5000
Mean Difference	0.0417
Standard Error	0.0468
Upper 95%	0.1447
Lower 95%	-0.0613
Sample size	12
Correlation	0.9848
Paired t test	0.8902
Degrees freedom	11
P value (2 tail)	0.3924

Table D-28. Assessment of intraobserver repeatability for the variable Coronal LJS R Final.

Statistic	Value
Session Two (mean)	2.5583
Session One (mean)	2.5750
Mean Difference	-0.0167
Standard Error	0.0548
Upper 95%	0.1040
Lower 95%	-0.1373
Sample size	12
Correlation	0.9692
Paired t test	-0.3040
Degrees freedom	11
P value (2 tail)	0.7668

Table D-29. Assessment of intraobserver repeatability for the variable Coronal LJS R Initial.

Statistic	Value
Session Two (mean)	2.1917
Session One (mean)	2.1750
Mean Difference	0.0167
Standard Error	0.0297
Upper 95%	0.0821
Lower 95%	-0.0488
Sample size	12
Correlation	0.9889
Paired t test	0.5606
Degrees freedom	11
P value (2 tail)	0.5863

Table D-30. Assessment of intraobserver repeatability for the variable Coronal MJS L Final.

Statistic	Value
Session Two (mean)	2.3000
Session One (mean)	2.1917
Mean Difference	0.1083
Standard Error	0.0633
Upper 95%	0.2477
Lower 95%	-0.0310
Sample size	12
Correlation	0.9413
Paired t test	1.7110
Degrees freedom	11
P value (2 tail)	0.1151

Table D-31. Assessment of intraobserver repeatability for the variable Coronal MJS L Initial.

Statistic	Value
Session Two (mean)	2.4333
Session One (mean)	2.4750
Mean Difference	-0.0417
Standard Error	0.0484
Upper 95%	0.0649
Lower 95%	-0.1482
Sample size	12
Correlation	0.9678
Paired t test	-0.8610
Degrees freedom	11
P value (2 tail)	0.4076

Table D-32. Assessment of intraobserver repeatability for the variable Coronal MJS R Final.

Statistic	Value
Session Two (mean)	2.3000
Session One (mean)	2.2750
Mean Difference	0.0250
Standard Error	0.0509
Upper 95%	0.1371
Lower 95%	-0.0871
Sample size	12
Correlation	0.9747
Paired t test	0.4908
Degrees freedom	11
P value (2 tail)	0.6332

Table D-33. Assessment of intraobserver repeatability for the variable Coronal MJS R Initial.

Statistic	Value
Session Two (mean)	2.0750
Session One (mean)	2.1083
Mean Difference	-0.0333
Standard Error	0.0376
Upper 95%	0.0494
Lower 95%	-0.1161
Sample size	12
Correlation	0.9926
Paired t test	-0.8864
Degrees freedom	11
P value (2 tail)	0.3944

Table D-34. Assessment of intraobserver repeatability for the variable Coronal SJS L Final.

Statistic	Value
Session Two (mean)	2.0667
Session One (mean)	2.0083
Mean Difference	0.0583
Standard Error	0.0583
Upper 95%	0.1867
Lower 95%	-0.0701
Sample size	12
Correlation	0.9749
Paired t test	1.0000
Degrees freedom	11
P value (2 tail)	0.3388

Table D-35. Assessment of intraobserver repeatability for the variable Coronal SJS L Initial.

Statistic	Value
Session Two (mean)	2.1000
Session One (mean)	2.0750
Mean Difference	0.0250
Standard Error	0.0566
Upper 95%	0.1495
Lower 95%	-0.0995
Sample size	12
Correlation	0.9863
Paired t test	0.4419
Degrees freedom	11
P value (2 tail)	0.6671

Table D-36. Assessment of intraobserver repeatability for the variable Coronal SJS R Final.

Statistic	Value
Session Two (mean)	1.8667
Session One (mean)	1.8750
Mean Difference	-0.0083
Standard Error	0.0633
Upper 95%	0.1310
Lower 95%	-0.1477
Sample size	12
Correlation	0.9681
Paired t test	-0.1316
Degrees freedom	11
P value (2 tail)	0.8977

Table D-37. Assessment of intraobserver repeatability for the variable Coronal SJS R Initial.

Statistic	Value
Session Two (mean)	2.1167
Session One (mean)	2.0583
Mean Difference	0.0583
Standard Error	0.0435
Upper 95%	0.1540
Lower 95%	-0.0373
Sample size	12
Correlation	0.9811
Paired t test	1.3426
Degrees freedom	11
P value (2 tail)	0.2064

Table D-38. Assessment of intraobserver repeatability for the variable Mesial Molar Relation Final.

Statistic	Value
Session Two (mean)	-0.6000
Session One (mean)	-0.8750
Mean Difference	0.2750
Standard Error	0.1431
Upper 95%	0.5899
Lower 95%	-0.0399
Sample size	12
Correlation	0.8971
Paired t test	1.9219
Degrees freedom	11
P value (2 tail)	0.0809

Table D-39. Assessment of intraobserver repeatability for the variable Mesial Molar Relation Initial.

Statistic	Value
Session Two (mean)	1.3417
Session One (mean)	0.9917
Mean Difference	0.3500
Standard Error	0.1258
Upper 95%	0.6270
Lower 95%	0.0731
Sample size	12
Correlation	0.9211
Paired t test	2.7815
Degrees freedom	11
P value (2 tail)	0.0179

Table D-40. Assessment of intraobserver repeatability for the variable Overbite Final.

Statistic	Value
Session Two (mean)	1.2417
Session One (mean)	0.9583
Mean Difference	0.2833
Standard Error	0.1260
Upper 95%	0.5607
Lower 95%	0.0059
Sample size	12
Correlation	0.9547
Paired t test	2.2481
Degrees freedom	11
P value (2 tail)	0.0460

Table D-41. Assessment of intraobserver repeatability for the variable Overbite Initial.

Statistic	Value
Session Two (mean)	4.2500
Session One (mean)	4.1083
Mean Difference	0.1417
Standard Error	0.1340
Upper 95%	0.4365
Lower 95%	-0.1532
Sample size	12
Correlation	0.9625
Paired t test	1.0574
Degrees freedom	11
P value (2 tail)	0.3130

Table D-42. Assessment of intraobserver repeatability for the variable Overjet Initial.

Statistic	Value
Session Two (mean)	5.6083
Session One (mean)	5.7750
Mean Difference	-0.1667
Standard Error	0.0882
Upper 95%	0.0274
Lower 95%	-0.3608
Sample size	12
Correlation	0.9805
Paired t test	-1.8898
Degrees freedom	11
P value (2 tail)	0.0854

Table D-43. Assessment of intraobserver repeatability for the variable Sagittal AAE L Final.

Statistic	Value
Session Two (mean)	100.9080
Session One (mean)	106.1670
Mean Difference	-5.2583
Standard Error	2.4645
Upper 95%	0.1660
Lower 95%	-10.6830
Sample size	12
Correlation	0.8936
Paired t test	-2.1336
Degrees freedom	11
P value (2 tail)	0.0562

Table D-44. Assessment of intraobserver repeatability for the variable Sagittal AAE L Initial.

Statistic	Value
Session Two (mean)	154.5500
Session One (mean)	156.1170
Mean Difference	-1.5667
Standard Error	4.1265
Upper 95%	7.5157
Lower 95%	-10.6490
Sample size	12
Correlation	0.9978
Paired t test	-0.3797
Degrees freedom	11
P value (2 tail)	0.7114

Table D-45. Assessment of intraobserver repeatability for the variable Sagittal AAE R Final.

Statistic	Value
Session Two (mean)	107.9330
Session One (mean)	113.6170
Mean Difference	-5.6833
Standard Error	2.8928
Upper 95%	0.6837
Lower 95%	-12.0500
Sample size	12
Correlation	0.9299
Paired t test	-1.9647
Degrees freedom	11
P value (2 tail)	0.0752

Table D-46. Assessment of intraobserver repeatability for the variable Sagittal AAE R Initial.

Statistic	Value
Session Two (mean)	103.2250
Session One (mean)	104.0330
Mean Difference	-0.8083
Standard Error	2.6012
Upper 95%	4.9170
Lower 95%	-6.5336
Sample size	12
Correlation	0.8985
Paired t test	-0.3108
Degrees freedom	11
P value (2 tail)	0.7618

Table D-47. Assessment of intraobserver repeatability for the variable Sagittal ACP L Final.

Statistic	Value
Session Two (mean)	46.8250
Session One (mean)	49.1167
Mean Difference	-2.2917
Standard Error	1.5544
Upper 95%	1.1296
Lower 95%	-5.7130
Sample size	12
Correlation	0.9129
Paired t test	-1.4743
Degrees freedom	11
P value (2 tail)	0.1684

Table D-48. Assessment of intraobserver repeatability for the variable Sagittal ACP L Initial.

Statistic	Value
Session Two (mean)	46.3250
Session One (mean)	48.7583
Mean Difference	-2.4333
Standard Error	1.3444
Upper 95%	0.5256
Lower 95%	-5.3923
Sample size	12
Correlation	0.9499
Paired t test	-1.8100
Degrees freedom	11
P value (2 tail)	0.0977

Table D-49. Assessment of intraobserver repeatability for the variable Sagittal ACP R Final.

Statistic	Value
Session Two (mean)	50.0083
Session One (mean)	50.5583
Mean Difference	-0.5500
Standard Error	1.5393
Upper 95%	2.8380
Lower 95%	-3.9380
Sample size	12
Correlation	0.8981
Paired t test	-0.3573
Degrees freedom	11
P value (2 tail)	0.7276

Table D-50. Assessment of intraobserver repeatability for the variable Sagittal ACP R Initial.

Statistic	Value
Session Two (mean)	48.2000
Session One (mean)	47.5833
Mean Difference	0.6167
Standard Error	1.2340
Upper 95%	3.3326
Lower 95%	-2.0993
Sample size	12
Correlation	0.8974
Paired t test	0.0000
Degrees freedom	11
P value (2 tail)	0.6271

Table D-51. Assessment of intraobserver repeatability for the variable Sagittal AGF L Final.

Statistic	Value
Session Two (mean)	82.4500
Session One (mean)	81.7500
Mean Difference	0.7000
Standard Error	2.4684
Upper 95%	6.1329
Lower 95%	-4.7329
Sample size	12
Correlation	0.8619
Paired t test	0.2836
Degrees freedom	11
P value (2 tail)	0.7820

Table D-52. Assessment of intraobserver repeatability for the variable Sagittal AGF L Initial.

Statistic	Value
Session Two (mean)	77.7167
Session One (mean)	77.6083
Mean Difference	0.1083
Standard Error	1.5888
Upper 95%	3.6053
Lower 95%	-3.3886
Sample size	12
Correlation	0.9441
Paired t test	0.0682
Degrees freedom	11
P value (2 tail)	0.9469

Table D-53. Assessment of intraobserver repeatability for the variable Sagittal AGF R Final.

Statistic	Value
Session Two (mean)	85.3500
Session One (mean)	86.4083
Mean Difference	-1.0583
Standard Error	3.3157
Upper 95%	6.2394
Lower 95%	-8.3561
Sample size	12
Correlation	0.7871
Paired t test	-0.3192
Degrees freedom	11
P value (2 tail)	0.7556

Table D-54. Assessment of intraobserver repeatability for the variable Sagittal AGF R Initial.

Statistic	Value
Session Two (mean)	80.0750
Session One (mean)	78.2083
Mean Difference	1.8667
Standard Error	2.5385
Upper 95%	7.4539
Lower 95%	-3.7205
Sample size	12
Correlation	0.9201
Paired t test	0.7353
Degrees freedom	11
P value (2 tail)	0.4775

Table D-55. Assessment of intraobserver repeatability for the variable Sagittal AJS L Final.

Statistic	Value
Session Two (mean)	1.2083
Session One (mean)	1.1333
Mean Difference	0.0750
Standard Error	0.0279
Upper 95%	0.1363
Lower 95%	0.0137
Sample size	12
Correlation	0.9336
Paired t test	2.6915
Degrees freedom	11
P value (2 tail)	0.0210

Table D-56. Assessment of intraobserver repeatability for the variable Sagittal AJS L Initial.

Statistic	Value
Session Two (mean)	1.3333
Session One (mean)	1.3333
Mean Difference	0.0000
Standard Error	0.0426
Upper 95%	0.0939
Lower 95%	-0.0939
Sample size	12
Correlation	0.9669
Paired t test	0.0000
Degrees freedom	11
P value (2 tail)	1.0000

Table D-57. Assessment of intraobserver repeatability for the variable Sagittal AJS R Final.

Statistic	Value
Session Two (mean)	1.7500
Session One (mean)	1.6917
Mean Difference	0.0583
Standard Error	0.0379
Upper 95%	0.1417
Lower 95%	-0.0250
Sample size	12
Correlation	0.9801
Paired t test	1.5409
Degrees freedom	11
P value (2 tail)	0.1516

Table D-58. Assessment of intraobserver repeatability for the variable Sagittal AJS R Initial.

Statistic	Value
Session Two (mean)	1.4083
Session One (mean)	1.3667
Mean Difference	0.0417
Standard Error	0.0468
Upper 95%	0.1447
Lower 95%	-0.0613
Sample size	12
Correlation	0.9627
Paired t test	0.8902
Degrees freedom	11
P value (2 tail)	0.3924

Table D-59. Assessment of intraobserver repeatability for the variable Sagittal ATA L Final.

Statistic	Value
Session Two (mean)	36.6000
Session One (mean)	39.1333
Mean Difference	-2.5333
Standard Error	1.8710
Upper 95%	1.5846
Lower 95%	-6.6513
Sample size	12
Correlation	0.4635
Paired t test	-1.3540
Degrees freedom	11
P value (2 tail)	0.2029

Table D-60. Assessment of intraobserver repeatability for the variable Sagittal ATA L Initial.

Statistic	Value
Session Two (mean)	39.2750
Session One (mean)	39.6500
Mean Difference	-0.3750
Standard Error	0.6965
Upper 95%	1.1581
Lower 95%	-1.9081
Sample size	12
Correlation	0.8929
Paired t test	-0.5384
Degrees freedom	11
P value (2 tail)	0.6010

Table D-61. Assessment of intraobserver repeatability for the variable Sagittal ATA R Final.

Statistic	Value
Session Two (mean)	38.4167
Session One (mean)	38.0917
Mean Difference	0.3250
Standard Error	0.2769
Upper 95%	0.9345
Lower 95%	-0.2845
Sample size	12
Correlation	0.9845
Paired t test	1.1736
Degrees freedom	11
P value (2 tail)	0.2653

Table D-62. Assessment of intraobserver repeatability for the variable Sagittal ATA R Initial.

Statistic	Value
Session Two (mean)	38.9083
Session One (mean)	38.5833
Mean Difference	0.3250
Standard Error	0.4068
Upper 95%	1.2203
Lower 95%	-0.5703
Sample size	12
Correlation	0.9858
Paired t test	0.7989
Degrees freedom	11
P value (2 tail)	0.4412

Table D-63. Assessment of intraobserver repeatability for the variable Sagittal CH L Final.

Statistic	Value
Session Two (mean)	17.5333
Session One (mean)	17.5750
Mean Difference	-0.0417
Standard Error	0.0723
Upper 95%	0.1174
Lower 95%	-0.2007
Sample size	12
Correlation	0.9954
Paired t test	-0.5767
Degrees freedom	11
P value (2 tail)	0.5758

Table D-64. Assessment of intraobserver repeatability for the variable Sagittal CH L Initial.

Statistic	Value
Session Two (mean)	15.7083
Session One (mean)	15.6750
Mean Difference	0.0333
Standard Error	0.0732
Upper 95%	0.1944
Lower 95%	-0.1277
Sample size	12
Correlation	0.9953
Paired t test	0.4556
Degrees freedom	11
P value (2 tail)	0.6576

Table D-65. Assessment of intraobserver repeatability for the variable Sagittal CH R Final.

Statistic	Value
Session Two (mean)	16.8750
Session One (mean)	16.7000
Mean Difference	0.1750
Standard Error	0.1142
Upper 95%	0.4264
Lower 95%	-0.0764
Sample size	12
Correlation	0.9843
Paired t test	1.5320
Degrees freedom	11
P value (2 tail)	0.1538

Table D-66. Assessment of intraobserver repeatability for the variable Sagittal CH R Initial.

Statistic	Value
Session Two (mean)	15.4333
Session One (mean)	15.2917
Mean Difference	0.1417
Standard Error	0.0892
Upper 95%	0.3379
Lower 95%	-0.0546
Sample size	12
Correlation	0.9938
Paired t test	1.5890
Degrees freedom	11
P value (2 tail)	0.1404

Table D-67. Assessment of intraobserver repeatability for the variable Sagittal CHA L Final.

Statistic	Value
Session Two (mean)	140.3580
Session One (mean)	140.2170
Mean Difference	0.1417
Standard Error	0.5062
Upper 95%	1.2559
Lower 95%	-0.9726
Sample size	12
Correlation	0.9820
Paired t test	0.2798
Degrees freedom	11
P value (2 tail)	0.7848

Table D-68. Assessment of intraobserver repeatability for the variable Sagittal CHA L Initial.

Statistic	Value
Session Two (mean)	146.5000
Session One (mean)	147.7080
Mean Difference	-1.2083
Standard Error	0.9410
Upper 95%	0.8628
Lower 95%	-3.2795
Sample size	12
Correlation	0.8829
Paired t test	-1.2841
Degrees freedom	11
P value (2 tail)	0.2255

Table D-69. Assessment of intraobserver repeatability for the variable Sagittal CHA R Final.

Statistic	Value
Session Two (mean)	140.9420
Session One (mean)	141.7000
Mean Difference	-0.7583
Standard Error	0.5803
Upper 95%	0.5189
Lower 95%	-2.0355
Sample size	12
Correlation	0.9833
Paired t test	-1.3068
Degrees freedom	11
P value (2 tail)	0.2179

Table D-70. Assessment of intraobserver repeatability for the variable Sagittal CHA R Initial.

Statistic	Value
Session Two (mean)	144.4080
Session One (mean)	145.0750
Mean Difference	-0.6667
Standard Error	0.5920
Upper 95%	0.6364
Lower 95%	-1.9697
Sample size	12
Correlation	0.9622
Paired t test	-1.1261
Degrees freedom	11
P value (2 tail)	0.2841

Table D-71. Assessment of intraobserver repeatability for the variable Sagittal CHH L Final.

Statistic	Value
Session Two (mean)	6.4250
Session One (mean)	6.4083
Mean Difference	0.0167
Standard Error	0.0520
Upper 95%	0.1311
Lower 95%	-0.0977
Sample size	12
Correlation	0.9820
Paired t test	0.3206
Degrees freedom	11
P value (2 tail)	0.7545

Table D-72. Assessment of intraobserver repeatability for the variable Sagittal CHH L Initial.

Statistic	Value
Session Two (mean)	5.9917
Session One (mean)	6.0333
Mean Difference	-0.0417
Standard Error	0.0645
Upper 95%	0.1003
Lower 95%	-0.1836
Sample size	12
Correlation	0.9609
Paired t test	-0.6460
Degrees freedom	11
P value (2 tail)	0.5315

Table D-73. Assessment of intraobserver repeatability for the variable Sagittal CHH R Final.

Statistic	Value
Session Two (mean)	6.5667
Session One (mean)	6.5333
Mean Difference	0.0333
Standard Error	0.0700
Upper 95%	0.1874
Lower 95%	-0.1207
Sample size	12
Correlation	0.9421
Paired t test	0.4762
Degrees freedom	11
P value (2 tail)	0.6432

Table D-74. Assessment of intraobserver repeatability for the variable Sagittal CHH R Initial.

Statistic	Value
Session Two (mean)	6.3750
Session One (mean)	6.3500
Mean Difference	0.0250
Standard Error	0.0730
Upper 95%	0.1856
Lower 95%	-0.1356
Sample size	12
Correlation	0.8969
Paired t test	0.3427
Degrees freedom	11
P value (2 tail)	0.7383

Table D-75. Assessment of intraobserver repeatability for the variable Sagittal CHW L Final.

Statistic	Value
Session Two (mean)	8.9333
Session One (mean)	8.9500
Mean Difference	-0.0167
Standard Error	0.0613
Upper 95%	0.1183
Lower 95%	-0.1517
Sample size	12
Correlation	0.9850
Paired t test	-0.2717
Degrees freedom	11
P value (2 tail)	0.7909

Table D-76. Assessment of intraobserver repeatability for the variable Sagittal CHW L Initial.

Statistic	Value
Session Two (mean)	9.0833
Session One (mean)	9.0167
Mean Difference	0.0667
Standard Error	0.0689
Upper 95%	0.2183
Lower 95%	-0.0850
Sample size	12
Correlation	0.9767
Paired t test	0.9676
Degrees freedom	11
P value (2 tail)	0.3541

Table D-77. Assessment of intraobserver repeatability for the variable Sagittal CHW R Final.

Statistic	Value
Session Two (mean)	8.9167
Session One (mean)	8.9833
Mean Difference	-0.0667
Standard Error	0.0527
Upper 95%	0.0493
Lower 95%	-0.1827
Sample size	12
Correlation	0.9918
Paired t test	-1.2649
Degrees freedom	11
P value (2 tail)	0.2320

Table D-78. Assessment of intraobserver repeatability for the variable Sagittal CHW R Initial.

Statistic	Value
Session Two (mean)	8.9417
Session One (mean)	8.9583
Mean Difference	-0.0167
Standard Error	0.0649
Upper 95%	0.1263
Lower 95%	-0.1596
Sample size	12
Correlation	0.9772
Paired t test	-0.2567
Degrees freedom	11
P value (2 tail)	0.8022

Table D-79. Assessment of intraobserver repeatability for the variable Sagittal EAM-AE L Final.

Statistic	Value
Session Two (mean)	24.1917
Session One (mean)	24.2333
Mean Difference	-0.0417
Standard Error	0.1276
Upper 95%	0.2392
Lower 95%	-0.3225
Sample size	12
Correlation	0.9024
Paired t test	-0.3265
Degrees freedom	11
P value (2 tail)	0.7501

Table D-80. Assessment of intraobserver repeatability for the variable Sagittal EAM-AE L Initial.

Statistic	Value
Session Two (mean)	23.3417
Session One (mean)	23.3833
Mean Difference	-0.0417
Standard Error	0.1334
Upper 95%	0.2520
Lower 95%	-0.3353
Sample size	12
Correlation	0.9537
Paired t test	-0.3123
Degrees freedom	11
P value (2 tail)	0.7606

Table D-81. Assessment of intraobserver repeatability for the variable Sagittal EAM-AE R Final.

Statistic	Value
Session Two (mean)	25.1750
Session One (mean)	25.1583
Mean Difference	0.0167
Standard Error	0.1107
Upper 95%	0.2603
Lower 95%	-0.2269
Sample size	12
Correlation	0.9815
Paired t test	0.1506
Degrees freedom	11
P value (2 tail)	0.8830

Table D-82. Assessment of intraobserver repeatability for the variable Sagittal EAM-AE R Initial.

Statistic	Value
Session Two (mean)	24.1667
Session One (mean)	24.3083
Mean Difference	-0.1417
Standard Error	0.1118
Upper 95%	0.1044
Lower 95%	-0.3877
Sample size	12
Correlation	0.9851
Paired t test	-1.2674
Degrees freedom	11
P value (2 tail)	0.2312

Table D-83. Assessment of intraobserver repeatability for the variable Sagittal EAM-C L Final.

Statistic	Value
Session Two (mean)	14.1083
Session One (mean)	14.0000
Mean Difference	0.1083
Standard Error	0.0596
Upper 95%	0.2396
Lower 95%	-0.0229
Sample size	12
Correlation	0.9965
Paired t test	1.8171
Degrees freedom	11
P value (2 tail)	0.0965

Table D-84. Assessment of intraobserver repeatability for the variable Sagittal EAM-C L Initial.

Statistic	Value
Session Two (mean)	13.0250
Session One (mean)	12.9417
Mean Difference	0.0833
Standard Error	0.0787
Upper 95%	0.2565
Lower 95%	-0.0898
Sample size	12
Correlation	0.9666
Paired t test	1.0595
Degrees freedom	11
P value (2 tail)	0.3121

Table D-85. Assessment of intraobserver repeatability for the variable Sagittal EAM-C R Final.

Statistic	Value
Session Two (mean)	13.7083
Session One (mean)	13.6000
Mean Difference	0.1083
Standard Error	0.0783
Upper 95%	0.2807
Lower 95%	-0.0640
Sample size	12
Correlation	0.9861
Paired t test	1.3837
Degrees freedom	11
P value (2 tail)	0.1939

Table D-86. Assessment of intraobserver repeatability for the variable Sagittal EAM-C R Initial.

Statistic	Value
Session Two (mean)	13.5917
Session One (mean)	13.4833
Mean Difference	0.1083
Standard Error	0.1138
Upper 95%	0.3588
Lower 95%	-0.1421
Sample size	12
Correlation	0.9662
Paired t test	0.9520
Degrees freedom	11
P value (2 tail)	0.3615

Table D-87. Assessment of intraobserver repeatability for the variable Sagittal EAM-P L Final.

Statistic	Value
Session Two (mean)	6.1167
Session One (mean)	6.1167
Mean Difference	0.0000
Standard Error	0.0508
Upper 95%	0.1117
Lower 95%	-0.1117
Sample size	12
Correlation	0.9846
Paired t test	0.0000
Degrees freedom	11
P value (2 tail)	1.0000

Table D-88. Assessment of intraobserver repeatability for the variable Sagittal EAM-P L Initial.

Statistic	Value
Session Two (mean)	5.9667
Session One (mean)	5.9000
Mean Difference	0.0667
Standard Error	0.0541
Upper 95%	0.1858
Lower 95%	-0.0525
Sample size	12
Correlation	0.9884
Paired t test	1.2318
Degrees freedom	11
P value (2 tail)	0.2437

Table D-89. Assessment of intraobserver repeatability for the variable Sagittal EAM-P R Final.

Statistic	Value
Session Two (mean)	6.4083
Session One (mean)	6.3500
Mean Difference	0.0583
Standard Error	0.0543
Upper 95%	0.1778
Lower 95%	-0.0612
Sample size	12
Correlation	0.9875
Paired t test	1.0743
Degrees freedom	11
P value (2 tail)	0.3057

Table D-90. Assessment of intraobserver repeatability for the variable Sagittal EAM-P R Initial.

Statistic	Value
Session Two (mean)	6.4167
Session One (mean)	6.2583
Mean Difference	0.1583
Standard Error	0.0398
Upper 95%	0.2460
Lower 95%	0.0707
Sample size	12
Correlation	0.9956
Paired t test	3.9775
Degrees freedom	11
P value (2 tail)	0.0022

Table D-91. Assessment of intraobserver repeatability for the variable Sagittal FD L Final.

Statistic	Value
Session Two (mean)	8.0083
Session One (mean)	8.0667
Mean Difference	-0.0583
Standard Error	0.0468
Upper 95%	0.0447
Lower 95%	-0.1613
Sample size	12
Correlation	0.9855
Paired t test	-1.2463
Degrees freedom	11
P value (2 tail)	0.2385

Table D-92. Assessment of intraobserver repeatability for the variable Sagittal FD L Initial.

Statistic	Value
Session Two (mean)	7.5750
Session One (mean)	7.5417
Mean Difference	0.0333
Standard Error	0.0450
Upper 95%	0.1323
Lower 95%	-0.0656
Sample size	12
Correlation	0.9906
Paired t test	0.7416
Degrees freedom	11
P value (2 tail)	0.4739

Table D-93. Assessment of intraobserver repeatability for the variable Sagittal FDR Final.

Statistic	Value
Session Two (mean)	7.6667
Session One (mean)	7.6250
Mean Difference	0.0417
Standard Error	0.0679
Upper 95%	0.1912
Lower 95%	-0.1079
Sample size	12
Correlation	0.9685
Paired t test	0.6133
Degrees freedom	11
P value (2 tail)	0.5521

Table D-94. Assessment of intraobserver repeatability for the variable Sagittal FDR Initial.

Statistic	Value
Session Two (mean)	7.6250
Session One (mean)	7.5917
Mean Difference	0.0333
Standard Error	0.0711
Upper 95%	0.1898
Lower 95%	-0.1231
Sample size	12
Correlation	0.9765
Paired t test	0.4690
Degrees freedom	11
P value (2 tail)	0.6482

Table D-95. Assessment of intraobserver repeatability for the variable Sagittal FW L Final.

Statistic	Value
Session Two (mean)	16.5500
Session One (mean)	17.8667
Mean Difference	-1.3167
Standard Error	1.2895
Upper 95%	1.5215
Lower 95%	-4.1549
Sample size	12
Correlation	0.5263
Paired t test	-1.0211
Degrees freedom	11
P value (2 tail)	0.3292

Table D-96. Assessment of intraobserver repeatability for the variable Sagittal FW L Initial.

Statistic	Value
Session Two (mean)	17.9667
Session One (mean)	17.6500
Mean Difference	0.3167
Standard Error	0.1381
Upper 95%	0.6206
Lower 95%	0.0128
Sample size	12
Correlation	0.9855
Paired t test	2.2934
Degrees freedom	11
P value (2 tail)	0.0425

Table D-97. Assessment of intraobserver repeatability for the variable Sagittal FW R Final.

Statistic	Value
Session Two (mean)	18.6500
Session One (mean)	18.5417
Mean Difference	0.1083
Standard Error	0.1215
Upper 95%	0.3758
Lower 95%	-0.1591
Sample size	12
Correlation	0.9596
Paired t test	0.8915
Degrees freedom	11
P value (2 tail)	0.3917

Table D-98. Assessment of intraobserver repeatability for the variable Sagittal FW R Initial.

Statistic	Value
Session Two (mean)	18.2500
Session One (mean)	18.2500
Mean Difference	0.0000
Standard Error	0.1161
Upper 95%	0.2556
Lower 95%	-0.2556
Sample size	12
Correlation	0.9816
Paired t test	0.0000
Degrees freedom	11
P value (2 tail)	1.0000

Table D-99. Assessment of intraobserver repeatability for the variable Sagittal MJS L Final.

Statistic	Value
Session Two (mean)	2.3333
Session One (mean)	2.3417
Mean Difference	-0.0083
Standard Error	0.0557
Upper 95%	0.1142
Lower 95%	-0.1309
Sample size	12
Correlation	0.9459
Paired t test	-0.1497
Degrees freedom	11
P value (2 tail)	0.8837

Table D-100. Assessment of intraobserver repeatability for the variable Sagittal MJS L Initial.

Statistic	Value
Session Two (mean)	2.1750
Session One (mean)	2.2000
Mean Difference	-0.0250
Standard Error	0.0463
Upper 95%	0.0768
Lower 95%	-0.1268
Sample size	12
Correlation	0.9810
Paired t test	-0.5404
Degrees freedom	11
P value (2 tail)	0.5997

Table D-101. Assessment of intraobserver repeatability for the variable Sagittal MJS R Final.

Statistic	Value
Session Two (mean)	2.5667
Session One (mean)	2.5667
Mean Difference	0.0000
Standard Error	0.0461
Upper 95%	0.1014
Lower 95%	-0.1014
Sample size	12
Correlation	0.8559
Paired t test	0.0000
Degrees freedom	11
P value (2 tail)	1.0000

Table D-102. Assessment of intraobserver repeatability for the variable Sagittal MJS R Initial.

Statistic	Value
Session Two (mean)	2.5333
Session One (mean)	2.5167
Mean Difference	0.0167
Standard Error	0.0423
Upper 95%	0.1099
Lower 95%	-0.0765
Sample size	12
Correlation	0.9702
Paired t test	0.3936
Degrees freedom	11
P value (2 tail)	0.7014

Table D-103. Assessment of intraobserver repeatability for the variable Sagittal PJS L Initial.

Statistic	Value
Session Two (mean)	2.275
Session One (mean)	2.28333
Mean Difference	-0.0083
Standard Error	0.04516
Upper 95%	0.09106
Lower 95%	-0.1077
Sample size	12
Correlation	0.98182
Paired t test	-0.18454
Degrees freedom	11
P value (2 tail)	0.8569

Table D-104. Assessment of intraobserver repeatability for the variable Sagittal PJS L Final.

Statistic	Value
Session Two (mean)	2.08333
Session One (mean)	2.09167
Mean Difference	-0.0083
Standard Error	0.03786
Upper 95%	0.07499
Lower 95%	-0.0917
Sample size	12
Correlation	0.99274
Paired t test	-0.22013
Degrees freedom	11
P value (2 tail)	0.8298

Table D-105. Assessment of intraobserver repeatability for the variable Sagittal PJS R Final.

Statistic	Value
Session Two (mean)	2.5083
Session One (mean)	2.4750
Mean Difference	0.0333
Standard Error	0.0498
Upper 95%	0.1428
Lower 95%	-0.0762
Sample size	12
Correlation	0.9788
Paired t test	0.6701
Degrees freedom	11
P value (2 tail)	0.5166

Table D-106. Assessment of intraobserver repeatability for the variable Sagittal PJS R Initial.

Statistic	Value
Session Two (mean)	2.5667
Session One (mean)	2.6417
Mean Difference	-0.0750
Standard Error	0.0687
Upper 95%	0.0762
Lower 95%	-0.2261
Sample size	12
Correlation	0.9758
Paired t test	-1.0921
Degrees freedom	11
P value (2 tail)	0.2981

Table D-107. Assessment of intraobserver repeatability for the variable Sella-vertical-M Final.

Statistic	Value
Session Two (mean)	48.9250
Session One (mean)	49.2083
Mean Difference	-0.2833
Standard Error	0.2962
Upper 95%	0.3685
Lower 95%	-0.9351
Sample size	12
Correlation	0.9874
Paired t test	-0.9567
Degrees freedom	11
P value (2 tail)	0.3593

Table D-108. Assessment of intraobserver repeatability for the variable Sella-vertical-M Initial.

Statistic	Value
Session Two (mean)	46.1250
Session One (mean)	46.3250
Mean Difference	-0.2000
Standard Error	0.4902
Upper 95%	0.8789
Lower 95%	-1.2789
Sample size	12
Correlation	0.8955
Paired t test	-0.4080
Degrees freedom	11
P value (2 tail)	0.6911

Table D-109. Assessment of intraobserver repeatability for the variable SNA Final.

Statistic	Value
Session Two (mean)	81.4833
Session One (mean)	81.3083
Mean Difference	0.1750
Standard Error	0.2206
Upper 95%	0.6605
Lower 95%	-0.3105
Sample size	12
Correlation	0.9809
Paired t test	0.7934
Degrees freedom	11
P value (2 tail)	0.4443

Table D-110. Assessment of intraobserver repeatability for the variable SNA Initial.

Statistic	Value
Session Two (mean)	81.8833
Session One (mean)	82.1333
Mean Difference	-0.2500
Standard Error	0.1351
Upper 95%	0.0474
Lower 95%	-0.5474
Sample size	12
Correlation	0.9902
Paired t test	-1.8502
Degrees freedom	11
P value (2 tail)	0.0913

Table D-111. Assessment of intraobserver repeatability for the variable SNB Final.

Statistic	Value
Session Two (mean)	76.6167
Session One (mean)	76.5667
Mean Difference	0.0500
Standard Error	0.1964
Upper 95%	0.4822
Lower 95%	-0.3822
Sample size	12
Correlation	0.9829
Paired t test	0.2546
Degrees freedom	11
P value (2 tail)	0.8037

Table D-112. Assessment of intraobserver repeatability for the variable SNB Initial.

Statistic	Value
Session Two (mean)	76.3500
Session One (mean)	76.4500
Mean Difference	-0.1000
Standard Error	0.1128
Upper 95%	0.1483
Lower 95%	-0.3483
Sample size	12
Correlation	0.9928
Paired t test	-0.8864
Degrees freedom	11
P value (2 tail)	0.3944

VITA

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