CRITÉRIOS PARA RESTAURAÇÕES PROVISÓRIAS UTILIZADAS NA PREPARAÇÃO PARA A REABILITAÇÃO ABRANGENTE ORTODÔNTICA E ORTOPÉDICA**CRITERIA FOR PROVISIONAL RESTORATIONS USED IN PREPARATION FOR COMPREHENSIVE ORTHODONTIC AND ORTHOPEDIC REHABILITATION****ТРЕБОВАНИЯ К ВРЕМЕННЫМ РЕСТАВРАЦИЯМ, ИСПОЛЪЗУЕМЫХ В ПОДГОТОВКЕ К КОМПЛЕКСНОЙ ОРТОДОНТИЧЕСКОЙ И ОРТОПЕДИЧЕСКОЙ РЕАБИЛИТАЦИИ**

MAMEDOV, Adil¹; MOROZOVA, Natalia^{1*}; YUMASHEV, Alexey¹; DYBOV, Andrey¹; NIKOLENKO, Denis¹;

¹ I.M. Sechenov Moscow Medical State University (Sechenov University); Department of pediatric dentistry and orthodontics

* Correspondence author
e-mail: natalia.morozova.76@list.ru

Received 26 April 2019; received in revised form 20 June 2019; accepted 06 July 2019

RESUMO

Existem diferenças substanciais nos critérios no âmbito da reabilitação ortodôntica e ortopédica abrangente de pacientes com más oclusões e defeitos associados de tecidos duros do dente. Objetivo: Este artigo analisa os critérios modernos para a fabricação e qualidade de restaurações provisórias com base em dados da literatura sobre a reabilitação tradicional de pacientes com defeitos de tecidos duros e edentulismo. Materiais e Métodos: Um total de 32 pacientes foi submetido a tratamento ortopédico ou ortodôntico. Resultados: Antes e após o tratamento, os índices foram deduzidos com base nas seguintes escalas: OHIP-14-RU, IOTN e FDI. Critérios de qualidade para restaurações provisórias em pacientes com más oclusões e defeitos associados de tecidos duros em reabilitação ortodôntica e ortopédica foram formulados. Conclusão: As restaurações provisórias devem ser caracterizadas com base em vários parâmetros, incluindo estabilidade de cor, fixação estável do aparelho ortodôntico e alta retenção da base dental.

Palavras-chave: *reabilitação ortodôntica e ortopédica, más oclusões, edentulismo, defeitos de tecidos duros, restaurações provisórias.*

ABSTRACT

There are substantial differences in the criteria within the framework of the comprehensive orthodontic and orthopedic rehabilitation of patients with malocclusions and associated defects of hard tooth tissues. The purpose of this article is to analyze the modern criteria for the fabrication and quality of provisional restorations based on data from the literature regarding the traditional rehabilitation of patients with defects of hard tooth tissues and edentulism. A total of 32 patients were subjected to either orthopedic or orthodontic treatment. The results demonstrated that before and after treatment, indices were deduced based on the following scales: OHIP-14-RU, IOTN, and FDI. The quality criteria for the provisional restorations in patients with malocclusions and associated defects of hard tooth tissues in comprehensive orthodontic and orthopedic rehabilitation were formulated. It was concluded that provisional restorations should be characterized based on a number of parameters including color stability, stable fixation of the orthodontic appliance, and high retention to tooth stumps.

Keywords: *orthodontic and orthopedic rehabilitation, malocclusions, edentulism, defects of hard tooth tissues, provisional restorations.*

АННОТАЦИЯ

Существуют значительные различия в требованиях в рамках комплексной ортодонтической и ортопедической реабилитации пациентов с нарушениями прикуса и сопутствующими дефектами тканей твердого зуба. Целью данной статьи является анализ современных критериев изготовления и качества временных реставраций на основе данных литературы, касающейся традиционной реабилитации

пациентов с дефектами твердых тканей зуба и эдентулизмом. В исследовании, 32 пациента прошли ортопедическое или ортодонтическое лечение. Результаты показали, что до и после лечения показатели определялись по следующим шкалам: OHIP-14-RU, IOTN и FDI. Сформулированы критерии качества для временных реставраций у пациентов с нарушениями прикуса и ассоциированными дефектами тканей твердого зуба при комплексной ортодонтической и ортопедической реабилитации. Был сделан вывод о том, что временные реставрации должны характеризоваться на основе ряда параметров, включая стабильность цвета, стабильную фиксацию ортодонтического аппарата и высокую степень удержания культей зубов.

Ключевые слова: ортодонтическая и ортопедическая реабилитация, патологический прикус, эдентулизм, дефекты твердых тканей зуба, временные реставрации.

1. INTRODUCTION

The primary goal of orthodontic treatment is to achieve an esthetically functional optimal dentofacial system. This concept includes a functionally balanced occlusion, smile and face esthetics, temporomandibular joint (TMJ) and periodontium health, the integrity of hard tooth tissues, the maintenance of or increase in the airway volume, and the stability of the results obtained. To achieve a predicted treatment outcome, the close cooperation of an orthodontist with other dental specialists is required (Huang and Chen, 2015; Fradeani, 2006; Pinho *et al.*, 2012; Tanaka *et al.*, 2016; O'Rourke and Taylor, 2008; Sojka *et al.*, 2015; Gorbunkova *et al.*, 2016; Manfredini, 2018).

Patients with various types of hard tooth tissue defects, edentulism, or improperly performed restorative procedures require the aid of an orthopedist. The first step is for an orthodontist to rearrange the patient's teeth in the most favorable position to provide optimal working conditions for an orthopedist, a dental surgeon, and a dental therapist (Ma *et al.*, 2015; Lam, 2018).

The purpose of the manuscript is to formulate quality criteria for provisional restorations in patients with malocclusions and associated defects of hard tooth tissues in comprehensive orthodontic and orthopedic rehabilitation.

2. MATERIALS AND METHODS

A total of 32 patients aged 18 to 56 years were examined. All patients were divided into 2 groups. The first group ($n = 18$) consisted of participants who underwent orthopedic treatment, while the second group ($n = 14$) consisted of patients who underwent both orthodontic and orthopedic treatment. In addition to generally accepted primary and secondary examination methods, the centric occlusion and central ratio of

patients were analyzed using the SAM3 articulator, and by taking intraoral and facial photographs, as well as scanning diagnostic plaster casts at the beginning and end of treatment. To evaluate the results, the authors used the indices Oral Health Impact Profile (OHIP-14-RU), World Dental Federation (FDI), Index Of Treatment Need (IOTN).

During orthodontic treatment, temporary crowns which were suitable for the position of the tooth in the dentition were made. More specifically, the temporary crown conformed to the axis of the root, inclination, and angulation of the natural tooth. This is an important consideration to allow further movement of the tooth. Similarly, the temporary crowns made during orthopedic treatment conformed to the existing occlusal scheme of the natural dentition, reference plane, and adequate closure with antagonist teeth.

The authors observed the general principles of provisional crown fabrication. According to Fradeani (2006), the following are essential components of provisional crown fabrication:

1. *Replacing missing teeth:* Temporary bridge designs are fabricated to rehabilitate patients with bounded edentulous spaces (Pinho *et al.*, 2012; Hussein *et al.*, 2015). The modern approach recommends replacing missing teeth with implants to facilitate orthodontic and orthopedic rehabilitation (Mangano *et al.*, 2015). However, in the process of orthodontic correction, each tooth individually migrates; therefore, it is not possible to eliminate rotations or adjust the angulation and inclination of any tooth that serves as an abutment for the prosthetic bridge design (Ma *et al.*, 2015; Manfredini *et al.*, 2017; Lam, 2018). Restoration using temporary bridges relies entirely upon coordination of orthodontic and orthopedic treatment plans, and frequently, temporary bridges are not indicated in the initial phases of the orthodontic correction.

2. *Replacement of low-quality prostheses:* Existing, failed prostheses are replaced. Provisional restorations are made immediately after the removal of low-quality structures and should be fabricated in such a way that the existing problems are addressed (Tanaka *et al.*, 2016; Sarver, 2016; Abdel-Azim *et al.*, 2015) (Fig.1).

3. *Correction of tooth position:* Fabrication of dental prostheses may help correct any irregular tooth positioning (Hahn *et al.*, 2015; Sarver, 2016). While fixed prostheses are being fabricated, and provisional restorations are to be fabricated using the same template.⁸ However, in the phase of preparation for orthodontic treatment, the tooth root angulation, rotation, and inclination need to be meticulously reproduced when fabricating provisional restorations to replace broken down crowns.

Figure 2 illustrates the initial phase and fabrication of provisional restorations based on the orientation of the root. The previously fabricated denture was not in alignment with the tooth root positional orientation. When preparing the patient for the orthodontic treatment, the porcelain-fused-to-metal crowns were replaced with provisional temporary crowns, and the tooth stumps were pre-restored using temporary post-and-core inlays.

The difference in the fabrication of dentures is clearly seen in terms of camouflaging the abnormal development of the mandibular bones and with due consideration of the tooth root angulation, rotation, and inclination central and lateral incisors in the maxilla. Therefore, the change in the position of the teeth is unacceptable within the framework of the planned orthodontic treatment.

4. *Developing a stable occlusal scheme.* If stable occlusal contacts and functional directing appliances are not available, provisional restorations serve to achieve and verify the desired result (Sojka *et al.*, 2015; Manfredini, 2018; Dhillon *et al.*, 2015; O'Rourke and Taylor, 2018). The objective of complete orthodontic treatment is to develop a stable occlusal scheme (Ma *et al.*, 2015; Manfredini *et al.*, 2017; Sülün, 2016; Lam, 2018). If the anatomy of the teeth's masticatory surface is intact, the objective will be achieved after the removal of braces. If the anatomy is incorrect, dental prosthetic rehabilitation will follow the orthodontic treatment to achieve a stable result.

5. *Restoration of the occlusal vertical dimension.* The occlusal vertical dimension may

be restored in case of total orthopedic reconstruction of the dentofacial system (Tanaka *et al.*, 2016; Pinho *et al.*, 2012; Sojka *et al.*, 2015). Before the fabrication of the final restoration, provisional restorations on the occlusal vertical dimension are performed and verified (Silva *et al.*, 2018; Abdel-Azim *et al.*, 2015).

6. *Elimination of occlusal trauma.* Occlusal trauma refers to the forces periodically acting on a tooth and exceeding the organism's adaptational capacity. Occlusal trauma may be caused by premature contacts that may lead to the pathologic loosening of a tooth or its random migration. Wedge-shaped defects, excessive attrition of teeth, recessions, and hypertension of masticatory muscles, including trismus, may also occur. In a number of cases, structural and morphological changes in the temporomandibular joint (TMJ) (Sojka *et al.*, 2015; Manfredini, 2018; Okeson, 2015) may take place. To eliminate the existing occlusive trauma, provisional structures are fabricated, subject to modifications of tooth occlusal surfaces and situation stabilization. In the process of tooth migration in the rehabilitation phases, the occurrence of premature contacts cannot be prevented (Lam, 2018). This problem, as a rule, is resolved based on local grinding of the provisional restoration.

7. *Tooth protection after preparation.* Disregarding rules for pulp protection after preparation can lead to acute pulpitis, symptomatic or asymptomatic pulp necrosis, and apical periodontitis (Gorbunkova *et al.*, 2016). Failure to provide provisional restorations for vital teeth can lead to demineralization of hard tissues, and delayed orthopedic treatment (Choi *et al.*, 2015). Tooth protection after preparation is an essential requirement.

8. *Verification of parallelism of prepared stumps.* When preparing tooth stumps for dental bridgework or telescopic dentures, maintaining parallel stumps is important; otherwise, it would be impossible to achieve stability and a passive fit of the denture (Silva *et al.*, 2018). One option for verifying parallelism is fabricating provisional crowns, but this process is not performed when the orthodontic treatment is planned. This process is performed after orthodontic treatment when correct tooth movement in the dentition has been achieved.

9. *Support for associated therapy.* Throughout comprehensive orthodontic and orthopedic rehabilitation, provisional restorations support each phase that different specialists carry

out. Considering this fact, support for the associated therapy is a cornerstone of implementing comprehensive orthodontic and orthopedic rehabilitation for patients with malocclusions.

10. Assessing the need for adjuvant therapy. The need for periodontal adjustment is often assessed during the phase of planning and trying on provisional restorations (Fradeani, 2006). While aligning teeth based on orthopedic restorations, practitioners assess the scope of intervention regarding natural tooth tissues; if they expect larger scopes of intervention, preliminary orthodontic correction of the tooth position may be suggested as an alternative (Sojka *et al.*, 2015).

11. Assessment and improvement of articulation. Practitioners may use phonetic tests to assess articulation during the use of provisional restorations to make corrections to improve the outcome. Since the inclination and vertical position of anterior teeth are frequently adjusted during an orthodontic correction, it is reasonable to plan the change in position and shape of anterior teeth only upon consultation with the orthodontist.

12. Facilitation of a personal oral hygiene routine. The oral hygiene routine for those using dental prostheses should be particularly thorough (Gorbunkova *et al.*, 2016; Hoerler *et al.*, 2017), and dental prostheses should not obstruct or complicate the process. Proper oral hygiene for patients using provisional restorations should be considered mandatory and, if required, restorations should be modified to produce the correct final restoration (Fig. 4).

13. Promotion of periodontal health and putting marginal gingiva into the required shape. This aspect deals with ensuring the correct fit to a tooth stump, absence of overhanging margins, and prevention of over contouring while fabricating provisional restorations. Avoiding such mistakes can help to prevent inflammatory phenomena. The regular form of the marginal gingiva is esthetically important in the anterior area and in forming a gingival contour around crowns on dental implants (Mangano *et al.*, 2015) (Fig. 5).

14. Visualization of final restorations. In planning any orthopedic reconstruction, a prototype of the final restoration is pre-modeled (Tanaka *et al.*, 2016; Pinho *et al.*, 2012; Sojka *et al.*, 2015; Fradeani, 2006). Such modeling may be used to transfer the model into the patient's mouth cavity and to assess the intended result in

terms of esthetics and function in the provisional restorations phase (Fig. 6).

The clinical observation has revealed differences in the criteria for the quality of fabrication of provisional restorations in patients who receive isolated orthopedic rehabilitations with a comprehensive orthopedic-orthodontic approach.

In addition to focusing on these differences, a clinician should pay attention to the materials and methods for fabricating provisional restorations.

2.1. Crown classification

Current literature on dental orthopedics provides various classifications for provisional crowns (Fradeani, 2006). Regarding the length of time, provisional crowns are specifically categorized as follows:

1. Short-term provisional crowns to be worn up to 1 month.
2. Medium-term provisional crowns to be worn from 1 to 3 months.
3. Long-term provisional crowns to be worn for more than 3 months.

Long-term provisional crowns should be used during orthodontic treatment.

Regarding the material and fabrication technique for provisional restorations, clinicians may propose the following options:

1. **First-order provisional crowns** are either fabricated by a direct technique using plastic dental blanks or subject to control by a template using the diagnostic wax-up technique before tooth preparation (Fradeani, 2006). As orthodontic treatment is a lengthy process, application of these restorations is extremely limited, especially if they are fixed with temporary dental cements. However, the use of composite materials and the ease of fabricating this type of crown are important factors in choosing this specific type of provisional restoration during orthodontic treatment. The fixation quality may be significantly improved by using dual-cure composite resin cement. When partial restoration of a vital tooth is necessary, primary composite provisional restorations with mandatory bonding may also be used, depending on the adhesive protocol.

2. **Second-order provisional crowns** are fabricated from methyl methacrylate, ethyl methacrylate, or a composite material using

laboratory techniques. The disadvantage of the first two options is the difficulty in bonding brackets to the restoration surfaces because the composite material has no chemical affinity for the bonding brackets (Fradeani, 2006). Second-order composite provisional crowns are given the highest priority when planning orthodontic treatment in comprehensive rehabilitation.

3. *Third-order provisional crowns* are related to medium-term or long-term restorations. Dental prostheses of this type are fabricated using laboratory techniques based on the data obtained after application of the second-order provisional crowns (Fradeani, 2006). Crowns of the third order are made of metal-ceramic material, of zirconium dioxide, or purely ceramic material.

The fact that orthodontists cannot implement adhesive bonding to attach the crown itself to tooth tissues or the bracket-system to the crown surface is the major disadvantage for using polymethyl methacrylate (PMMA) provisional restorations.

3. RESULTS AND DISCUSSION

The authors compared the results of two clinical groups that were treated in compliance with the criteria for the quality of temporary crowns that the authors formulated. Evaluation of the results was carried out in accordance with the recommendations of the International Dental Association (FDI), which includes:

Quality of edge adaptation of the material;

The presence of secondary caries;

Compliance with the restoration of the anatomical shape of the restored tooth;

Color matching of the restoration to the hard tissues of the tooth being restored;

Discoloration of the edges of the cavity;

The presence of roughness on the surface of the restoration;

Safety of the contact point.

The quality assessment criteria are determined by the codes: Alpha (A), Bravo (B), Charlie (C), Delta (D), Oscar (O), Hotel (H), with certain gradations. In clinical quality assessments, it is necessary to clarify whether the restoration is satisfactory (category Alpha, Bravo) or unacceptable (category Charlie, Delta).

The authors also applied the Oral Health Impact Profile — OHIP-14-RU quality

assessment of dental health. The questions for this assessment are divided into three blocks: food-related, communication problems, and problems in everyday life. A specific score corresponded to each answer in the questionnaire: “never” - 0, “extremely rarely” - 1, “often” - 2, “usually” - 3, “constantly” - 4. The points were then summed up, and higher rates were interpreted as worsening quality of life. The evaluation of the influence of dentoalveolar anomalies was carried out according to the total average score, with the points of the subscale of the subjects based on the DHC component class of the Index of Orthodontic Treatment Need (IOTN). The data results were processed by standard methods of variation statistics using statistical software package Statistica 6.0 for Windows (Table 1). The assessment of the reliability of differences (p) between the groups was determined using the Student's t-test.

4. CONCLUSIONS

Based on these parameters, the authors have summarized the quality criteria for provisional restorations in patients with malocclusions, edentulism, hard tooth tissues, etc. within the framework of comprehensive orthodontic and orthopedic rehabilitation.

Provisional restorations should be characterized based on the following:

1. Color stability;
2. Stable fixation of the orthodontic appliance;
3. High retention to tooth stump;
4. Single crown;
5. Correspondence to correct anatomical tooth shape;
6. Alignment of the provisional restoration axis with the tooth root axis;
7. Perfect marginal fit;
8. Unobstructed personal oral hygiene;
9. Fabrication with due regard to the planned increase in occlusal vertical dimension in the course of orthodontic treatment.

The issue of communication between the orthopedist and dental lab technician remains open because provisional restorations are fabricated in the dental technical laboratory. Within the framework of preparation for comprehensive orthodontic and orthopedic rehabilitation, the question of the quality of

provisional restoration fabrication with consideration of the above criteria is still relevant currently and requires further study.

5. REFERENCES

1. Tanaka, M. M. Y., Jóias, R. M., Jóias, R. P., Josgrilberg, E. B., de M. Rode, S. Evaluation of TMD signals and symptoms in individuals undergoing orthodontic treatment. *Braz Dent Sci*, **2016**, *19*, 70-75.
2. Pinho, T., Neves, M., Alves, C. Multidisciplinary management including periodontics, orthodontics, implants, and prosthetics for an adult. *Am J Orthod Dentofacial Orthop*, **2012**, *142*, 235-245.
3. Gorbunkova, A., Pagni, G., Brizhak, A., Farronato, G., Rasperini, G. Impact of orthodontic treatment on periodontal tissues: a narrative review of multidisciplinary literature. *Int J Dent*, **2016**, *4723589*, 1-9.
4. Ma, Z., Yang, C., Fang, B., Xia, Y., Mao, L., Feng, Y. Three-D imaging of dental alveolar bone change after fixed orthodontic treatment in patients with periodontitis. *Int J Clin Exp Med*, **2015**, *8*, 2385-2391.
5. Choi, S., Kim, B., Cha, J., Hwang, C. Impact of malocclusion and common oral diseases on oral health-related quality of life in young adults. *Am J Orthod Dentofacial Orthop*, **2015**, *147*, 587-595.
6. Hussein, M. A., Watted, N., Abdulgani, A., Kontoes, N. Prosthodontic-orthodontic treatment plan with two-unit cantilevered resin-bonded fixed partial denture. *IOSR J Dent Med Sci*, **2015**, *14*, 131-136.
7. Mangano, C., Levrini, L., Mangano, A., Mangano, F., Macchi, A., Caprioglio, A. Esthetic evaluation of implants placed after orthodontic treatment in patients with congenitally missing lateral incisors. *Journal of Advanced Medical and Dental Sciences Research*, **2015**, *3*, 110-118.
8. Dietschi, D. Post-orthodontic restorative approach for young patients with missing anterior teeth: no-prep and ultraconservative techniques. *Italian Journal of Dental Medicine*, **2016**, *1*, 13-17.
9. Hahn, T., Tomita, D., Ciobanu, C., Cigu, T., Ardeshtir, S., Popovici, M., et al. Daily practice of total prosthetics I. *International Journal of Medical Dentistry*, **2015**, *5*, 315-320.
10. Huang, C.S., Chen, Y.R. Orthodontic principles and guidelines for the surgery-first approach to orthognathic surgery. *Int J Oral Maxillofac Surg*, **2015**, *44*, 1457-1462.
11. Sójka, A., Huber, J., Kaczmarek, E., Hędzielek, W. Ascertaining of temporomandibular disorders (TMD) with clinical and instrumental methods in the group of young adults. *J Med Sci*, **2015**, *93*, 552-559.
12. Manfredini, D. Occlusal equilibration for the management of temporomandibular disorders. *Oral Maxillofac Surg Clin North Am*, **2018**, *30*, 257-264.
13. Fradeani, M., ed. *Analisi estetica. Barcelona: Quintessence*, **2006**, 115-154.
14. Manfredini, D., Lombardo, L., Siciliani, G. Temporomandibular disorders and dental occlusion. A systematic review of association studies: end of an era? *J Oral Rehab*, **2017**, *44*, 908-923.
15. Hoerler, S. B., Nietz, S. K., Zook, V. L., Lohse, C. M., Salinas, T. J., Carr, A. B., et al. Consistency of dental hygiene therapy utilizing various dental hygiene instrumentation and its effect on peri-implant health and survival of dental implants: a retrospective study. *Int J Oral Maxillofac Implants*, **2017**, *32*, 1371-1376.
16. Sülün, T. Establishing occlusal relationships. *Removable Partial Dentures*, **2016**, 135-148.
17. Lam, A. Digital planning and custom orthodontic treatment. *Eur J Orthod*, **2018**, *40*, 113-114.
18. Silva, J. M. F., Lisboa, J. C., Motta, R. B., Pierre, F. Z. Multidisciplinary dentistry - ceramic laminate veneers for orthodontic finalization: clinical case report. *J Dent Oral Implants*, **2018**, *2*, 1-5.
19. Dhillon, N., Dhiman, R. K., Kumar, D., Rath, M. K. Restoring smile: an integrated prosthodontic approach. *Med J Armed Forces India*, **2015**, *71*, 517-520.
20. Sarver, D. M. Orthodontics & esthetic dentistry: mission possible! A broader approach to interdisciplinary esthetic treatment. *Journal of Cosmetic Dentistry*, **2016**, *31*, 14-26.
21. Christensen L, Luther F. Adults seeking orthodontic treatment: expectations, periodontal, and TMD issues. *Br Dent J* **2015**; *218*:117-117.
22. Abdel-Azim, T., Zandinejad, A., Metz, M., Morton, D. Maxillary, and mandibular rehabilitation in the esthetic zone using a digital impression technique and

- CAD/CAM-fabricated prostheses: a multidisciplinary clinical report. *Oper Dent*, **2015**, 350-356.
23. Okeson, J. P. Evolution of occlusion and temporomandibular disorder in orthodontics: past, present, and future. *Am J Orthod Dentofacial Orthop*, **2015**, 147, 216-223.
 24. O'Rourke, N., Taylor, N. Options for replacing missing teeth during orthodontic treatment. *Orthodontic Update*, **2018**, 11, 106-109.

Table 1. Evaluation of results based on three scales

Scale	Indices (in points)	
	Before treatment	After treatment
OHIP-14-RU	14.50±0.68	8.46±0.81
IOTN	27±0.48	5±0.52
FDI	2	4

Figure 1. Restoration of correct tooth shape using provisional restorations. The top row shows images from before the provisional restoration and the bottom row shows images after the provisional restoration

Figure 2. Situation after removal of an ill-fitting bridge.

Figure 3. *Provisional crowns fabricated with consideration of the orientation of tooth root axes.*

Figure 4. *Pronounced contour height in the area of restoration left central incisor on the maxilla.*

Figure 5. *Establishing gingival contour using provisional crowns.*

Figure 6. Visualization of the possible outcome by transferring the wax-up.