A Study to Determine the Accuracy of Various Clinical Techniques of Ridge Mapping before Implant Fixture Placement

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ABSTRACT

Aim: The most important parameter to assess prior to implant fixture placement is the available bone width. Radiographic techniques have been found to be inadequate in providing this valuable information, unlike clinical techniques. The purpose of the present study was to determine the accuracy of various clinical techniques of ridge mapping before implant fixture placement.

Materials and methods: Ten patients with at least two missing teeth adjacent to each other were selected for the study. Direct and indirect techniques of ridge mapping were carried out to assess the available bone width.

Results: The data obtained were statistically analyzed using ANOVA and Tukey's Post Hoc analysis. The results indicate that there is no significant difference between direct and indirect technique of ridge mapping.

Conclusion: Either direct or indirect technique of ridge mapping can be used to assess the width of available bone before implant fixture placement.

Clinical significance: Clinical techniques of ridge mapping are handy and can be carried out chairside with ease and less cost and no radiation exposure. Indirect techniques of ridge mapping provide adequate and reliable data regarding bone width just like direct technique. In the absence of a bone mapping caliper, this technique can be used as a diagnostic procedure before implant placement. And during the indirect technique, any material can be utilized with equal efficacy for the fabrication of the guides.

Keywords: Bone calliper, Bone width measurement, Dental implants, Ridge mapping.

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INTRODUCTION

Prosthetically driven implant dentistry provides the best esthetic and functional outcome for the patient. To achieve the desired outcome, a detailed preoperative assessment and meticulous treatment planning is mandatory. The most important diagnostic factor prior to implant placement is to assess the width and height of the existing alveolar bone.^{1,2} Errors in the preoperative assessment of existing alveolar bone may lead to a critical situation once the flap is reflected. It may affect a change in the treatment plan on the operating table or may also lead to nonplacement of implants. To avoid such an embarrassment, various clinical and radiographic techniques are available to assess the level of alveolar bone before implant placement. Commonly used radiographic techniques are useful to find out only the height of alveolar bone and presence of anatomical structures. The cross-sectional width and contour of alveolar bone can be found out using conventional or computed tomography.³⁻⁶ But exposure to ionizing radiation, universal non-availability, and high cost limits their use in day to day practice. Whereas clinical techniques provide information about bone width and contour at relative ease without the above-mentioned drawbacks. This clinical technique is called a bone probing technique of ridge mapping or bone mapping.^{7,8} The two techniques of bone mapping are (a) direct, (b) indirect technique. The direct technique uses a specially designed bone caliper and indirect techniques employ specifically designed pre-fabricated guides.^{9,10} Even though both direct and indirect techniques are used commonly, the validity of the indirect technique has not been confirmed. Studies have been done to compare the efficacy of one radiographic technique over another.¹¹⁻¹⁴ There are no studies in the literature to confirm these techniques utilizing different materials for the guides. Hence, this study was taken up to compare the direct and indirect techniques of ridge mapping using two different materials, during treatment planning for dental implants.

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MATERIALS AND METHODS

After obtaining written, Informed consent to participate, the study was conducted on a group of 10 patients who reported to the Department of Prosthodontics, AB Shetty Memorial Institute of Dental Sciences, Nitte (Deemed to be University), Deralakatte, Mangaluru, Karnataka, India. Individuals of age group between 20–40 years and edentulous areas in the mandible with at least two teeth missing adjacent to each other were included in the study.

Two dentulous trays of the same size were selected for impression making, and they were modified with tissue stops using baseplate wax. This would ensure standardizing the pressure that is applied during the procedure of impression making. Two sets of impressions with opposing arch were recorded for each patient using irreversible hydrocolloid (Neocolloid, Zhermack Dental). Impressions were poured using type IV dental stone (Kalrock, Kalabhai) and the height of the casts was standardized (25 mm) by measuring the distance between cusp tip of adjacent teeth to the base of the sulcus using a divider. The base for the casts was

fabricated taking care to maintain occlusal plane parallel to the floor. Casts were identified as A (acrylic resin guide) and T (thermoplastic resin guide) on their bases.

The face-bow transfer was done and casts were mounted on a semi-adjustable articulator. Diagnostic wax-up was done, and the center of each tooth was identified as a site for future implant placement. Through the center of each artificial tooth, a hole was drilled corresponding to its central fossa to contact the crest of the ridge below. This represents the future sites (points C₁ and C₂) for implant placement (Fig. 1). Guides were fabricated on cast A and T using acrylic and thermoplastic resin, respectively.

Fabrication of Acrylic Resin Guide

A groove was made on the buccal and lingual side of the cast in the sulcus using no 8 round bur. This groove will act as a positive stop for the putty index when the acrylic is being flown into space. A modeling wax of 1 mm thickness was adapted on to the ridge to extend up to the groove on both sides. Next, an index was made of silicone putty material (Speed ex coltene-whaledent) and the adapted wax was removed. Separating medium was applied on the edentulous ridge, two adjacent teeth and inner surface of the index. Auto polymerizing acrylic resin (DPI PR Cold cure) was mixed and was placed on the edentulous site in the dough stage. Over this, the prepared silicone index was placed ensuring proper seating on the prepared groove. This was done to avoid

applying undue pressure on the index. The auto-polymerizing resin was allowed to polymerize completely before it was removed from the cast and excess material was trimmed off. The acrylic guide was trimmed, polished and the fit was verified on the cast (Fig. 2).

Fabrication of Thermoplastic Resin Guide

A 1mm thick thermoplastic resin sheet was selected and was adapted over the cast using vacuum forming machine (Raintree Essix-vacuum forming machine, Dentsply) Excess resin sheet beyond the groove was cut and the fit was verified on the cast. The cut sides were smoothened and polished (Fig. 3).

Preparation for Ridge Mapping

Each guide was placed separately on the cast and the site of implant placement was marked as C1 and C2, on the crest of the ridge. From point C1, 3 mm distance buccally and lingually was marked as B1 and L1, respectively (First Level), and from point C2, 6 mm distance buccally and lingually was marked as B2 and L2 respectively (second level). The same procedure was repeated for the second implant site and identified as C2. These points were transferred to the guide and holes were prepared on the points B1, B2, L1, L2 using no 6 round bur.

The guides were stored in 2% Glutaraldehyde for 10 minutes before ridge mapping.

Then the cast was sectioned at points C1 and C2 starting from the crest, along with the two points marked buccally and lingually.

Ridge Mapping Procedure

The procedure of ridge mapping was explained to the patient prior to initiating. Topical local anesthesia was sprayed on the selected site and the disinfected thermoplastic resin guide was placed on the edentulous area. Once satisfactory anesthesia was achieved, a sterile endodontic file no. 15 with stopper was placed through the hole corresponding to C1. It was pushed through the mucosa until it contacted the bone. The stopper of the file was adjusted to make contact with the guide (Fig. 4). Then the file was pulled out and was held against the sectioned cast corresponding to C1 point. The stopper was held in contact the surface of the cast at that point and the point where the tip of the file contacts along the cut surface of the cast is marked using a lead pencil. The above procedure was carried out for all the points and on both the sites of implant placement.

Fig. 1: Implant site identification

Fig. 2: Acrylic guide

Fig. 3: Thermoplastic resin guide

Fig. 4: Using endodontic file

Fig. 5: Measuring the width

Fig. 6: Direct technique of ridge mapping

Then the thermoplastic resin guide was replaced by acrylic resin guide, and the same procedure was carried out.

After the above, all the five points on each side were connected using lead pencil on the cut surface of the cast. Using a divider and scale the distance between B1, L1, and B2, L2 was measured for each guide and each site. This represents the bone width available for implants at the first level and second level at each implant site (C1 and C2) (Fig. 5).

Direct Technique

Measurements were recorded directly from the patient using bone caliper in the predetermined points obtained through the indirect technique. These points were identified as bleeding spots created during the indirect technique of ridge mapping (Fig. 6).

Once all the measurements were made, the area was cleaned and wiped off blood using sterile gauze. Necessary instructions were given to the patient before dismissing. The values obtained were then tabulated.

RESULTS

The values obtained were tabulated and statistically analyzed using one way ANOVA test for individual comparisons and multiple

comparisons among the groups were performed using Tukey's HSD test.

Comparison between B1L1 and B2L2 values between Direct Technique and Indirect Technique Guide T and Guide A using one way ANOVA test revealed there was no statistically significant difference observed at B1L1 and B2L2 levels Using direct technique and indirect technique using guide T and guide A (Table 1).

When multiple comparisons between B1L1 and B2L2 levels using Tukey HSD test was done.

It showed there was no statistically significant difference between B1L1 and B2L2 using direct technique and indirect technique using guide T and guide A (Table 2).

Results show that the mean value of B1L1 indirect technique and indirect technique using guide and guide A is 3.38 and the standard deviation is 0.495. There was no statistically significant difference observed at B1L1 levels using the direct and indirect technique. Also, the mean value of B2L2 indirect technique and indirect technique using guide T and guide A is 6.42 and the standard deviation is 0.776. Hence, there was no statistically significant difference observed at B2L2 levels using direct technique and indirect technique using guide T and guide A.

DISCUSSION

The similar values might be due to the astute care taken for standardization in the study.

Standardization was given the prime importance in the study since the values expected from the study is only of a few millimeters. So it can be understood that both direct and indirect techniques are satisfactory to measure bone width. Similar results were also obtained when multiple comparisons were done using Tukey's HSD test. Both the intergroup comparison and intragroup comparison were done. All the comparisons revealed the equality of both direct and indirect technique in the assessment of available bone width. This shows that the indirect technique is equally effective as a direct technique. In the absence of a bone caliper, the indirect technique can be implemented.

If an indirect technique is utilized, the guide can be fabricated using either acrylic resin or thermoplastic resin depending on the availability in the dental office. Studies have concluded that CBCT was less consistent when compared to direct caliper measurements and CBCT did not provide any additional significant diagnostic information.¹⁵ Also, recent studies indicate that ridge mapping is

Table 1: Comparison between b1l1 and b2l2 values between direct technique and indirect technique guide t and guide a using one way anova test

		N	Mean	Std. deviation	Mean Square	F	Sig.
B1 L1	Indirect t	8	3.38	0.518	0	0	1
	Indirect a	8	3.38	0.518			
	Direct technique	8	3.38	0.518			
	Total	24	3.38	0.495			
B2L2	Indirect t	8	6.38	0.744	0.292	0.462	0.636
	Indirect a	8	6.25	0.707			
	Direct technique	8	6.63	0.916			
	Total	24	6.42	0.776			

Table 2: Multiple comparisons between B1L1 and B2L2 levels using Tukey HSD test

Multiple comparisons					
TukeyHSD					
Dependent variable	(I) technique	(J) Technique	Mean difference (I-J)	Std. error	Sig.
B1 L1	Indirect t	Indirect A	0.000	0.259	1.000
		Direct technique	0.000	0.259	1.000
	Indirect a	Direct technique	0.000	0.259	1.000
B2 L2	Indirect t	Indirect A	0.125	0.397	0.947
		Direct technique	-0.250	0.397	0.806
	Indirect a	Direct technique	-0.375	0.397	.619

an accurate indicator of available bone width when compared with other radiographic methods.¹⁶⁻²¹

From the present study, it can be concluded that ridge mapping is a significant diagnostic tool for the preoperative assessment of available bone width which can be performed chairside, economical and without any radiation exposure. Use of bone caliper or guides prepared using thermoplastic resin or auto polymerizing acrylic resin yields the same clinical results. This is the first study conducted of its kind comparing the various techniques of ridge mapping, and it may serve as a protocol for future studies to follow in this field. Indirect technique is as effective as compared to direct technique. In the absence of a bone caliper, the indirect technique can be implemented. If the indirect technique is utilized, the guide can be fabricated using either acrylic resin or thermoplastic resin depending on the availability in the dental office.

CONCLUSION

From the present study, it can be concluded that:

- Both direct and indirect techniques can be used with equal reliability to determine the width of the available bone before dental implant placement.
- Both, thermoplastic and autopolymerising acrylic resins yield similar results when used for determination of bone width during indirect ridge mapping procedure.

CLINICAL SIGNIFICANCE

Clinical techniques of ridge mapping are handy and can be carried out chairside with ease and less cost and no radiation exposure. indirect techniques of ridge mapping provide adequate and reliable data regarding bone width just like direct technique. In the absence of a bone mapping caliper, this technique can be used as a diagnostic procedure before implant placement. And during the indirect technique, any material can be utilized with equal efficacy for the fabrication of the guides.

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