

# A METHOD FOR ESTIMATING PREOPERATIVE BONE VOLUME FOR IMPLANT SURGERY

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## KEY WORDS

Dental implants  
Bone volume  
Preoperative estimating

This is a simple method for estimating preoperatively the underlying bone volume of a proposed edentulous site for dental implant placement. It entails a localized imprint of the ridge, measurement of the depth of the overlying gingival of the site, and correlating the measurements on a tracing of the ridge arch taken from the imprint. The resultant shape shows a slice of the underlying bone, giving the surgeon insight regarding the width of implant the site will accept, angulation, and the need for bone augmentation.

## INTRODUCTION

When planning for implant placement at a particular site, the amount of available bone comes into question. There needs to be an assessment and determination regarding the volume of bone available to accept an implant.

It is desirable to have at least 5 mm of mesial to distal space and 5-mm facial-lingual crestal bone width to provide adequate bone volume for implant placement.<sup>1</sup> Some authors state a minimum of 4-mm facial-lingual width.<sup>2</sup> Adequate bone quantity is necessary.<sup>3-5</sup> Preoperative knowledge of the bone volume and morphology of a proposed implant site is desirable.<sup>6</sup> Palpation can be used to determine general morphologic characteristics.<sup>2,4,6</sup> The preoperative determination of the diameter, length, and position in the bone of an implant to be placed and the possible need for bone augmentation at that site is desirable information. Two- and three-dimensional radiography is possible but may be impractical.<sup>6-8</sup> What

follows is a simple nonradiographic means of estimating the shape and dimensions of bone of a proposed implant site.

## MATERIALS AND METHODS

First, study casts are made of the dentition. The site and occlusion are examined and assessed.<sup>4,6</sup>

A fast-set polyvinyl siloxane (Blu-Mousse, Parkell, Farmingdale, NY) impression is made of the ridge, adjacent teeth, and opposing teeth in occlusion. In this case, the proposed site is tooth site position 5 (Figs 1,2).

At sites bound by adjacent teeth, an exact measurement of the mesial-distal ridge length can be made between the proximal surfaces of these teeth registered on the impression mass. This measurement is an adequate 8.25 mm (Fig 3). The proposed center position on the mesial-distal line is marked to be cut at that point.

The mass of impression material is then cut with a Bard-Parker lab knife at the proposed implant site in a facial-

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FIGURE 1. Proposed site 5.

FIGURE 2. Impression mass.

FIGURE 3. Measuring the mesial-distal dimension.

FIGURE 4. Cutting the impression mass.

FIGURE 5. Cut halves of the impression mass.

FIGURE 6. Marking the crest of ridge/center of implant position.



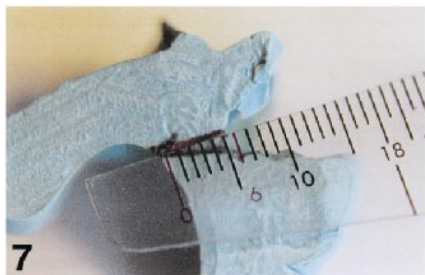


FIGURE 7. Measuring the interocclusal dimension.

FIGURE 8. Tracing of the ridge arch.

FIGURE 9. Bone sounding.

lingual plane (Fig 4). (If there are multiple implants to be placed, then as many cuts can be made at each site and the mass put back together as pieces of a three-dimensional puzzle.) The cut gives a flat surface that shows the arch form of the ridge (Fig 5).

At this time, it is helpful to mark the tentative facial-lingual-crestal center point of the proposed implant on the arch by noting the adjacent teeth and the shape of the ridge and estimating

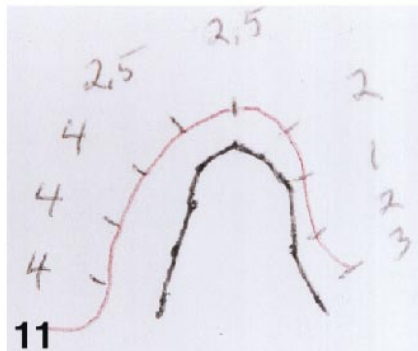
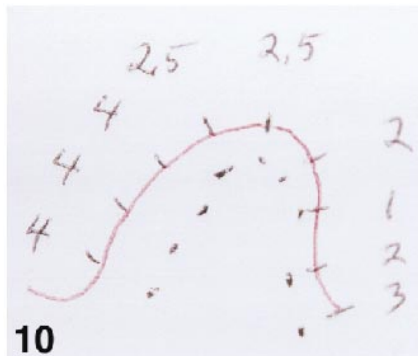


FIGURE 10. Sounding points marked.

FIGURE 11. Connected sounding points showing bone arch.

the position of the final restoration (Fig 6). This center point can be made by locating it 1–2 mm lingual to the facial-gingival of the adjacent teeth and adding the radius of the proposed implant and marking it on the mass.

A measurement can now be taken at the crest of the ridge at the proposed implant site to the opposing tooth fossa, marginal ridge, cusp, or incisal edge as registered on the impression. This distance will be added to the millimeter reading obtained by bone sounding at this location to give the osseous interocclusal distance. This example measurement is 5.5 mm (Fig 7). The shape of the arch of the ridge is then traced on paper, noting facial and lingual aspects (Fig 8).

The patient is anesthetized and soundings are made down to hard bone with a periodontal probe piercing the gingiva, beginning at the crest of the ridge or at the proposed implant site center (Fig 9). The center of the implant can be located on the ridge by replacing the cut impression mass on the patient's ridge and marking the previously noted center on the ridge with an indelible pencil. One then proceeds onto the facial aspect of the ridge, sounding approximately every 2–4 mm, noting the depth and location on the ridge (millimeters from the starting point on the crest) until the bone curves facially. The depths are taken on the lingual aspect at 2–4-mm increments as well to within the bounds of the impression. Landmarks

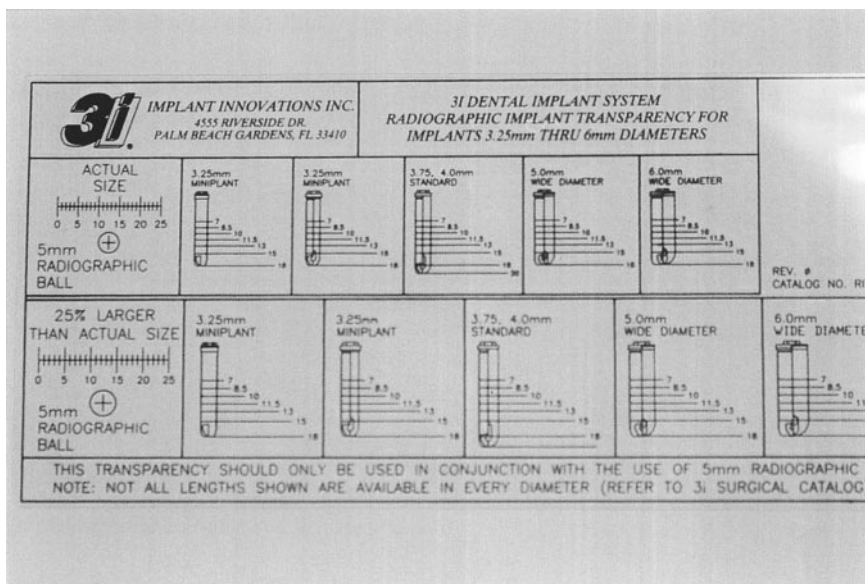


FIGURE 12. Implant sizing transparency (Implant Innovations, Inc., Palm Beach Gardens, Fla).

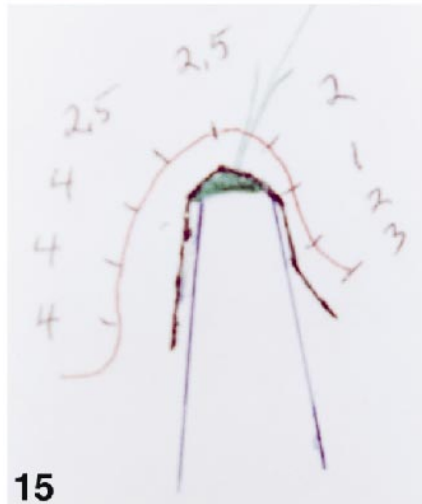
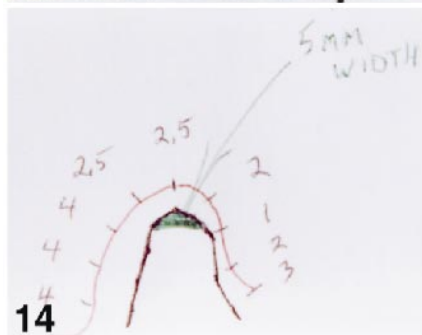
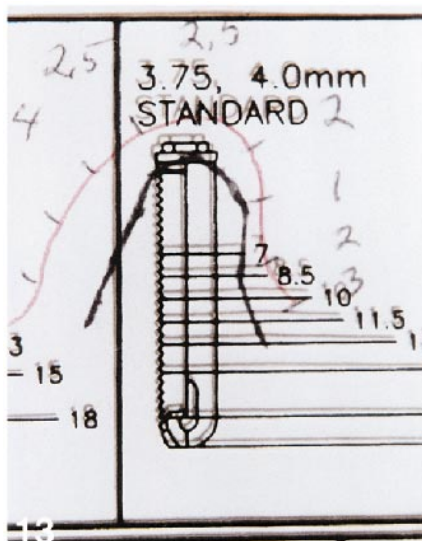


FIGURE 13. Transparency over drawn arch.

FIGURE 14. Line of 5-mm crest width.

FIGURE 15. Rays drawn on tracing—a 1-mm margin of buccal and lingual bone is left to allow adequate bone for implant placement.

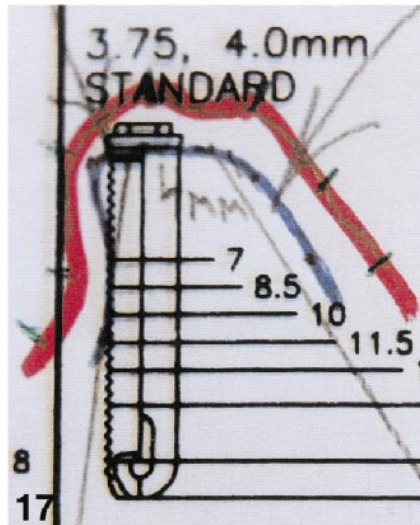
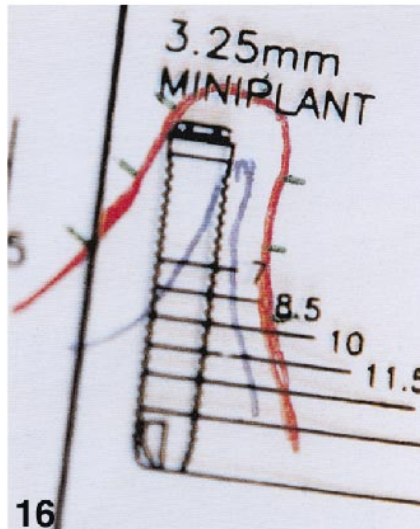


FIGURE 16. Tracing shows inadequate bone.

FIGURE 17. Tracing predicting a dehiscence at this angulation.

to be avoided during sounding, such as the mental foramen and thin sinus walls, should be noted radiographically to prevent injury to these structures.

These measurements are then marked as points on the ridge arch tracing (Fig 10). The points are connected, showing the approximate cross-sectional shape of the bony ridge (Fig 11). Measurements may then be taken to determine how wide of an implant the bone will accept. Transparent plastic sheets imprinted with various sized implants are available from implant companies (eg, Implant Innovations, Palm Beach Gardens, Fla) (Fig

12). These sheets may be placed over the tracing to aid in selecting the most appropriate size implant the bone site will accept (Fig 13). If the transparencies are not available, the dimensions of a proposed implant may be measured and drawn with a ruler on the tracing.

The interocclusal distance at the implant site may be calculated by taking the measurement from the crest of the gingival ridge to the opposing dentition on the impression mass and adding the dimension of the sounding at the site center or the crest of the ridge (Fig 5). The 5.5-mm measurement previously taken from the impression mass is added to the 2.5-mm ridge crest reading (Fig 10) to give the sum of 8.0 mm. Knowledge of this space is useful in determining the use of cement versus screw-retained abutments. A minimal interocclusal space of 5 mm is required for cement-retained abutments.<sup>2</sup>

#### DISCUSSION

In general, ridges with adequate bone have a large U shaped (or inverted U) tracing. The dimensions of a selected implant from a transparency should fit within the ridge to provide a 1-mm margin of remaining buccal and lingual bone.

Points can be made at the part of the U that is 5 mm wide to show how much crestal osteoplasty may be required or if the site should be better prepared with an osteotome or augmentation<sup>9</sup> (Fig 14). From these points, rays can be drawn 1 mm parallel to the cortex (Fig 15). This gives the possible range of position of placement of the implant without bone augmentation. By noting the interocclusal line made previously, the range of angles of placement can be measured with a protractor (Fig 16). The decision whether to use angled abutments or bone augmentation arises. The intraosseous angulation may present prosthetic problems that can be foreseen and surgically or prosthetically planned for or prevented.<sup>10</sup>

This method can predict the occur-



rence of dehiscences and fenestrations during implant surgery so the surgeon can be prepared to apply the most appropriate means of bone augmentation. The arch made from the sounding points will produce a shape into which the implant form on the transparency will not adequately fit. This gives insight into the need for preoperative or intraoperative bone augmentation or compensatory angulation of the implant position (Fig 16, 17).

A narrow U-shaped ridge presents a limited range of placement and may predict a dehiscence (Fig 16). When sounding narrow bone ridges, care must be taken in finding the thin crest and locating the facial and lingual aspects.

Ridges with an R shape (or reverse R shape) may result in a fenestration at time of implant placement, but the approximate location and size of the defect can be predicted (Fig 17). Minor dehiscences and fenestrations may not require treatment.<sup>2</sup>

Bone dehiscence site defects can be detected and outlined for augmentation procedures by making and noting

additional soundings at points lateral to the starting line of soundings.

This method is not useful in severely atrophic ridges where the facial and lingual aspects cannot be adequately impressed.

#### CONCLUSIONS

This is a preoperative, nonradiographic method for obtaining information about bone size and shape and predicting implant placement complications and angulations at a proposed site.

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