

From Our Office to Yours....

Many dental implant procedures can be facilitated by knowing numbers related to the characteristics of biological structures, biomechanical relationships, and research data to obtain optimal results.

Dr. Dennis Tarnow et al have recently written an e-book for the "Compendium of Continuing Education in Dentistry" which presents a wide range of digits that may assist clinicians in providing predictable outcomes for implant dentistry.

In this current issue of The PerioDontaLetter, we present excerpts of this book, along with the suggestions and recommendations it contains for peri-implant monitoring, personal plaque control methods, and in-office maintenance techniques to reduce the incidence of peri-implant disease.

As always, we welcome your suggestions and comments.

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Dental Implantology: Numbers Clinicians Need to Know

Integers are like letters: alone they are meaningless. But when integrated into therapeutic endeavors, they provide a relevant basis for procedural planning and execution of therapy.

Tarnow's e-book presents lists of numbers which clinicians should be acquainted with when performing implant dentistry -- numeric parameters and guidelines for the treatment of teeth, placement of implants, consideration of esthetics, the prevention and resolution of surgical complications, treatment of edentulous ridges, and more.

Some of the numbers are means and are not intended to represent

all responses that clinicians may experience when treating patients.

Pre-Procedural Assessments and Treatment Planning

Periodontal and Peri-Implant Diagnostic Considerations

Probing Depth Evaluations

When interpreting probing measurements around teeth and implants, the following explanations should be considered.

Teeth: Probing depths of 1mm to 3mm are normal. A probing depth of



Figure 1. Probing an implant with a 9mm pocket with suppuration indicates the presence of infection.

4mm reflects the gray zone. At 5mm, there is concern, but not over concern if tissues are pink, there is no bleeding on probing, and the probing depths are not getting deeper. At ≥ 6 mm, surgical intervention may be necessary if a patient persistently manifests inflammation or increased pocketing, despite conservative therapy.

Implants: Desirable probing depths around dental implants are 2.5mm to 4mm, but deeper assessments can be associated with healthy peri-implant mucosa. In general, probing evaluations may be greater around implants than teeth, because there are no connective tissue fibers inserting into implants, and connective tissue adhesions adjacent to implants do not impede probe penetration similar to the connective tissue attachment to teeth.

Predicting Tooth and Implant Survival Based on the Amount Of Alveolar Bone

Teeth: Despite periodontitis, teeth with 50 percent bone loss are not a clinical challenge to treat and retain. This argument is supported by numerous studies which addressed long-term retention of teeth with advanced bone resorption that were successfully treated.

Implants: It has been suggested that if an implant manifests ≥ 50 percent bone loss it should be removed before additional bone resorption occurs. However, this

threshold is not sacrosanct and therapy may be considered even if there is less than 50 percent bone diminishment around an implant.

Incidence of Tooth Non-Vitality After Crowns Are Prepared

Post-periodontal surgery studies over a three- to 30-year period show 13.3 percent of teeth restored with crowns can become non-vital. Among patients with advanced periodontal disease, nine percent of crowned, and two percent of uncrowned teeth, may develop non-vitality after periodontal surgery.

Esthetics

Assessing the clinical smile line and its relationship to papillary display is critical when planning anterior restorations. In an older population, when patients are maximally smiling, display of midfacial gingival tissues and interdental papillae are seen as follows:

- 1.72 percent of individuals have a low smile line (do not reveal midfacial gingival tissues).
- 28 percent have a high smile line (demonstrate midfacial gingiva).
- 2.91 percent of all patients show their papillae when smiling.

Teeth Dimensions In the Esthetic Zone

The length of a maxillary central incisor is usually 10mm to 12mm. Women's incisors are typically

shorter than men's by 1mm. Maxillary lateral incisors are 1mm shorter cervically and incisally than central incisors. Canines are at the same level as central incisors cervically and incisally.

Among the maxillary anterior dentition, the width of central incisors ranges from 7mm to 10mm (mean 8.5mm), lateral incisors vary from 5.5mm to 8mm (mean 6.5mm), and canines range from 6.5mm to 9mm (mean 7.5mm).

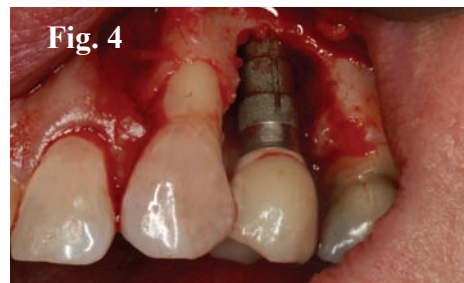
The three types of front teeth (central and lateral incisors, canine) manifest the "golden ratio" with respect to their height and width. The width of maxillary anterior teeth is about 81 percent of their height.

Mean dimensions of proximal contact areas between maxillary anterior teeth are as follows: central incisors, 4.2mm; central and lateral incisors, 2.9mm; lateral incisors and canines, 2mm; and canines and first premolars, 1.5mm.

Radiographs

A radiograph is a snapshot of one moment in time. Multiple films are required to demonstrate ongoing disease activity, and past bone resorption is not a sensitive indicator of future bone loss.

Radiographs underestimate the magnitude of bone resorption by nine percent to 20 percent.



Figures 2, 3 and 4. Periodontal probing reveals a 9mm pocket with purulent exudate, indicating the presence of infection and loss of periodontal attachment. Flap reflection shows extensive bone loss.

4mm of clinical attachment loss occurs before bone deterioration is detected around teeth on radiographs.

A 30 percent to 40 percent decrease in bone mineralization occurs before alterations in bone density are detected on an X-ray.

Implant Measurements

Implant Diameter: Increasing the diameter of an implant one size (eg, from 3.3mm to 4.1mm) increases the implant's surface area approximately 30 percent. This is equivalent to extending the implant's length by 3mm.

Implant Length: Short textured implants can reliably support posterior prostheses. Nevertheless, implants less than 8mm long (4mm to 7mm) should be used cautiously, because they demonstrate greater failure risks compared to standard implants.

Tooth Extraction Issues

Management of Perforations Into the Maxillary Sinus When Extracting Teeth: After an extraction, if a small hole into the sinus (≤ 2 mm) is present at the apical or lateral end of the socket, it can be ignored, because a clot will usually form and heal uneventfully.

If a perforation is > 2 mm, a resorbable barrier should be placed over the puncture before bone grafting over it.

Bone Resorption After Extractions: Six months after tooth removal that

includes flap elevation, sockets manifest a mean 1.24mm vertical bone loss (range 0.9mm to 3.6mm), and there is approximately 3.79mm less horizontal bone (range 2.46mm to 4.56mm).

In contrast, after a flapless extraction, there is approximately 1mm vertical and horizontal bone loss.

Dry Sockets: A small percentage of extraction sites (3.2 percent) develop a local osteitis after tooth removal. This occurs most often in mandibular molar areas. Pain frequently manifests three days after an extraction. Patients may need to be medicated with a dry socket paste for three to ten days to eliminate discomfort.

Platform Switching

A systematic review indicated that platform switching (abutment narrower than implant platform) results in less vertical bone loss around implants (0.055mm to 0.99mm) than implants restored without platform switching (0.19mm to 1.67mm).

Proper Distances Between Teeth and Implants And Between Implants

Span Between a Tooth and an Implant: This span should be at least 1.5mm to 2mm for non-platform-switched implants. Bone loss is

inversely proportional to how close an implant is to a tooth.

Minimum Space Between Two Implants: To maintain interproximal bone height for non-platform-switched implants, 3mm is needed between the implants. If the expanse is ≤ 3 mm, the mean vertical bone decrease is 1.04mm, and if the inter-implant space is > 3 mm, the expected vertical bone resorption is 0.45mm. Platform-switched implants can be placed slightly closer together — at a 1mm distance. The mean vertical bone decrease is 0.43mm.

Space Required for a 4mm Diameter Implant: To place a 4mm diameter implant, a span of 7mm mesiodistally is needed between adjacent teeth at the coronal region.

Numbers Associated With Prosthetic Issues

Abutment Height: A 5mm tall abutment is desired for retention of a cementable implant crown. The minimum abutment heights necessary to provide adequate retention for narrow-platform (3.5mm), and wide platform (5mm), implants restored with single cement-retained restorations are respectively, 3mm and 4mm. A 2mm increase in abutment height amplifies retention by 40 percent.

Occlusal Clearance Necessary for Different Restorative Materials: At



Figures 4, 5, 6 and 7. This patient presented in 2013 with 40 to 50 percent bone loss circumferentially around the implant. Treatment consisted of debridement and bone grafting with an occlusive membrane. Bone regeneration successfully restored lost bone support and has remained stable and periodontally healthy since the surgical procedure.

least 2mm of space is required to provide room for porcelain-fused-to-metal (PFM) occlusal materials (opaque, 0.3mm; metal, 0.5mm; and porcelain, 1mm). Monolithic zirconia or lithium disilicate crowns (press or CAD/CAM) require less vertical space than PFM crowns. Restorations made with these materials need as little as 1mm occlusal clearance, because no space is required for metal understructures.

Crown Margin Placement: It is difficult to remove subgingival cement entirely around a crown placed deeper than 1mm into the sulcus. Therefore, implant margins of cementable crowns should not be placed more than 1mm subgingivally. Ideally, margins should be placed as follows:

- Posterior implants, 0.5mm subgingivally on the mid-buccal, mesio-buccal, and mesio-lingual; 0mm at other locations.
- Anterior implants, 1mm subgingivally mid-buccally, 0.5mm subgingivally mesio and disto-buccally, and 0mm lingually.

Papillae

Return of Papillary Height After Crown Placement on an Implant: After a transitional partial restoration is worn and a crown is initially placed, 90 percent of the time there is an open area under the contact point between the crown and adjacent tooth. Within one year, about 80 percent of papillae

rebound and fill the interproximal space due to reformation of the gingival col under the contact area.

Papillary Tallness Between Implants: Average height of a papilla between two implants is 3.4mm, and more than 50 percent of papillae between implants are ≤ 3 mm high.

Papillary Size Between an Implant and a Tooth: The mean distance from osseous bony crest to the papilla tip is 3.85mm to 4.2mm.

Interproximal Papillary Recession After Implant Surgery: When thick and thin periodontal phenotypes are compared with respect to alterations of papillary and facial tissue height after single-tooth implant placement which included flap surgery, the thin phenotype demonstrates shorter papillae by approximately 0.7mm. Facial tissue height is also about 0.4mm less than tissues associated with a thick phenotype.

Papilla Dimensions for Tooth to Pontic and Implant to Pontic: Although not included in the e-book, other researchers have found the following tissue heights are needed from the contact point to the alveolar crestal bone level in order to maintain 100 per cent papillae appearance:

- Implant to implant, 3.5mm
- Tooth to implant, 4.5mm
- Tooth to Tooth, 5mm
- Implant to pontic, 5.5mm
- Tooth to pontic, 6.5mm

Open Contact Between Teeth and Dental Implants

After an implant restoration is inserted next to a natural tooth, an interproximal gap develops 34 percent to 66 percent of the time. This event often occurs on the mesial aspect of an implant restoration due to mesial migration of teeth, and this happens as early as three months after prosthetic rehabilitation.

Peri-Implantitis

A systematic review indicated that 18.8 percent of patients with implants (9.6 percent of the implants) develop peri-implantitis. However, this number varies in the literature, because it depends on the quantity of bone loss used to define peri-implantitis.

Implant Failure Rates

About two to three percent of implants are lost prior to prosthetic loading, and another two to three percent that supported fixed partial dentures failed within five years. A systematic review retrospectively evaluated ten long-term studies of less than 15 years each, and it was noted that implant survival rates among these studies ranged from 70 to 100 percent. Nevertheless, eight of the ten studies indicated implant survival rates were less than 90 percent.

Conclusion

When applying numbers addressed in this primer, the following axioms should be observed: always adhere to sound biologic principles; keep the therapeutic plan as simple as possible; be prepared to improvise; maintain a standard of excellence, and, finally treat patients the way you would like to be treated.



Figure 8. What appears to be pathologic bone loss is normal recontouring of the osseous crest down to the implant platform. The design of the implant automatically creates a platform switch between the implant and the abutment. The two implants are spaced ideally for papilla preservation.