REVIEW ARTICLE

SOFT TISSUE AND BONE QUALITY AND QUANTITY IN AESTHETIC IMPLANT PLACEMENT

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ABSTRACT:
Aesthetics in the anterior region relies heavily on healthy keratinized gingival tissue; this fact applies to both natural dentition and implant-supported restorations. Gingival components that contribute to an aesthetically pleasing implant-supported restoration are the marginal radicular form, the interdental tissues, and the color and texture of healthy keratinized tissues.Meticulous assessment of the soft tissue status related to the future implant site should be established during the clinical examination at the presurgical stage.
Key words: Implants, Aesthetics, Bone quality, biotype.

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INTRODUCTION:

Aesthetics in the anterior region relies heavily on healthy keratinized gingival tissue; this fact applies to both natural dentition and implant-supported restorations.[1]Gingival components that contribute to an aesthetically pleasing implant-supported restoration are the marginal radicular form, the interdental tissues, and the color and texture of healthy keratinized tissues.

Meticulous assessment of the soft tissue status related to the future implant site should be established during the clinical examination at the presurgical stage. The healthy soft tissue profile plays a critical role not only in establishing optimal aesthetics, but also in facilitating long term maintenance of implant-supported restorations.[2]Some authors have shown conclusive results concerning the relationship between the condition of soft tissue and the implant survival; they concluded that neither the absence of inflamed soft tissue nor a specific amount of keratinized mucosa is required to ensure a successful osseointegration. On the contrary, some authors have confirmed that the absence of a keratinized mucosa might jeopardize implant survival. In addition, some authors have stated that a minimum of 2 mm of keratinized tissue width is needed to achieve optimal health of the tissues surrounding natural dentition.[3] Others have suggested that less than 1 mm of keratinized tissue can be adequate, provided the bacterial plaque is well controlled.[4] Generally speaking, the presence of a sufficient band of keratinized mucosa will surely improve the aesthetic outcome of the definitive implant-supported restoration. The presence of the keratinized band can also minimize postoperative gingival recession, endure the trauma of brushing, resist masticatory muscle pull, and reduce the probability of soft tissue dehiscence above implant fixtures. Because soft tissues have the tendency to recede almost 1 mm after surgical and restorative implant procedures, a sufficient amount of healthy keratinized gingival tissue should exist prior to implant placement for compensation. Therefore, optimizing the soft tissue quality and quantity before commencing on implant therapy becomes a vital prerequiste. In the presurgical planning stage, the timing of soft tissue augmentation therapy (whether it is to be performed before, during, or after implant placement) will be determined.

TISSUE BIOTYPES

Healthy human periodontium is comprised of radicular cementum, periodontal ligament, gingiva, and investing alveolar bone. It is the integration of all these biological elements that maintains the periodontium in a state of harmony that makes it unique. The natural morphology of the healthy periodontium is characterized by a rise and fall of the marginal gingiva following the underlying alveolar crest contour both facially and proximally. Two different distinctive periodontal patterns are present in the human oral cavity: the thin scalloped biotype and the thick flat biotype. The thick flat type is more prevalent (85%) than the thin scalloped biotype (15%).[5] Each type has morphological characteristics of its own with its distinctive adjoining structures. Recognizing and distinguishing these basic types is essential in selecting the implant size, implant type, and surgical approach, and in predicting the overall prognosis that will result in biological harmony

between the dental implants and the existing dentogingival structures.

Figure 1: Thin Biotype

The thick flat biotype is characterized by adequate amounts of masticatory mucosa. It is dense and fibrous in nature with minimal height difference between the highest and lowest points on the proximal and facial aspects of the marginal gingiva; therefore, it is called flat. Larger sized teeth that are most likely square shaped characterize this type of periodontium. This bulkiness of the tooth shape results in a broader, more apically positioned contact area, a cervical convexity that has greater prominence, and an embrasure that is completely filled with the interdental papilla. The root dimensions are broader mesiodistally, almost equal to the width of the crown at the cervix, which causes a diminution in the amount of bone interproximally. The typical reaction of this tissue biotype to trauma such as tooth preparation or impression making is inflammation and apical migration of the junctional epithelium with a resultant pocket formation.

The thick flat tissue type is ideal for placing dental implants. Here the gingival and osseous scalloping is normally parallel to the cementoenamel junction (CEJ). The minimal undulation of the CEJ between adjacent teeth, which predictably follows the natural contour of the alveolar crest, makes the gingival tissues more stable. Consequently, this type of periodontium is less likely to exhibit soft tissue shrinkage postoperatively.

Figure 2: Thick Biotype

On the other hand, the thin scalloped biotype of periodontium exhibits its own distinctive features. These include thin, friable gingiva with a narrow band of attached masticatory mucosa, and a thin facial bone that usually exhibits dehiscence and fenestration. The tooth crown shape usually exhibits a triangular or thin cylindrical form, and the contact areas are smaller and located in a further incisal location. The cervical convexity is less prominent than that of the thick biotype, while the interdental papilla is thin and long but does not fill the embrasure space completely, resulting in a scalloped appearance. Additionally, this biotype possesses a root that is narrow with an attenuated taper allowing for an increased amount of inter-radicular bone. When inflicted with trauma, this tissue type undergoes gingival recession both facially and interproximally. Placing dental implants in the aesthetic zone becomes a critical task with this particular tissue biotype because it is difficult to achieve symmetrical soft tissue contours probably due to the proximity of the implant to the natural tooth periodontium next to it, and the reduced amount of masticatory mucosa. The resultant recession and bone resorption leave a flat profile between the roots, with marginal exposure of the restoration and subsequent partial loss of the interproximal papilla.[6] A proper appraisal of the periodontium should be performed prior to commencing any implant therapy in the aesthetic zone. Each tissue type reacts differently to surgical intervention, thereby warranting a specific treatment protocol. The thin scalloped tissue type should be treated with an exceptional caution and utmost care (especially for patients with a high smile line).

BONE QUANTITY AND QUALITY

Replacing missing dentition with dental implants demands both optimized bone quantity and bone quality at the edentulous site. Optimal osseous volume has a positive influence on osseointegration. Therefore, emphasis should be placed on inserting an implant in a sufficient osseous foundation when a predictable, successful aesthetic and functional outcome is to be achieved.

It has been reported that the alveolar bone loses almost 30% of its size within two years following tooth extraction. Both maxilla and mandible have distinctive resorption patterns that affect both the width and height of the alveolar bone . Subsequently, bone dimensions become insufficient to host the implant fixture, thus negatively affecting the overall prognosis of the implant-supported prosthesis. It follows that alveolar bone quantity and quality are an absolute necessity for dental implant success on both levels—aesthetically and functionally.

The significance of the quantitative and qualitative parameters of the osseous structure is immense; consequently, the subject has been discussed at length in most textbooks. Many authors have classified the remaining alveolar bone differently in order to assess and diagnose the remaining alveolar bone. Misch and Judy [7] classified the available alveolar bone into four distinct divisions:

Division A (Abundant Bone). Alveolar bone width is more than 5 mm, height greater than 10-13 mm, and mesiodistal length greater than 7 mm, and the load's angulation does not exceed 30 degrees between the occlusal plan and the implant body. In addition, the crown-implant body ratio is less than one. This type of bone is optimal for hosting an implant with a diameter between 4 and 5 mm.

Division B (Barely Sufficient Bone). A slight to moderate atrophy has occurred, leading to a decrease in the width of the available bone at the expense of only the facial cortical bone. The height remains stable at a minimum of 10 mm. The remaining available bone width varies between 3 and 5 mm and is thus able to accommodate an implant of 4 mm maximum width. The load's angulation may not exceed 20 degrees. Treatment options presented for this type are osteoplasty, bone augmentation, or the use of narrower diameter root form dental implants.

Division C (Compromised Bone). Moderate to advanced atrophy is present, with the width less than 2.5 mm, height less than 10 mm, load angulation greater than 30 degrees, and crown-implant body ratio equal to or greater than one. The posterior maxillary and mandibular regions demonstrate this type of alveolar bone more than the anterior segments.

Division D (Deficient Bone). This type demonstrates severe atrophy, accompanied by basal bone loss. Therefore, the use of autogenous bone grafts is strongly recommended to augment the deficient alveolar bone. This kind of bone usually results in complications related to soft tissue management, grafting, and early implant failure.

The above classification can help the practitioner to precisely determine the specific bone category of each particular patient. This, in turn, enables the clinician to select the appropriate treatment protocol. The necessity of undergoing a bone grafting procedure exists in many conditions, and subsequently, a surgical technique can be chosen that provides a treatment prognosis with maximum predictability from either an aesthetic or functional aspect.

Salama and Salama have introduced another classification that considers the available bone according to the socket condition that will host the future implant fixture. [8] This classification can be helpful when an immediate implant placement is the treatment of choice, because the condition of the alveolar socket will dictate the treatment plan. Details of this classification are provided later in this chapter.

Several techniques are now available for evaluation of bone quantity and quality. Radiographic examination, especially tomograms or CT scans, can provide the accurate dimension for the alveolar ridge at a specific predetermined location, as well as the bone density. Bone density in the aesthetic zone generally falls into the D3 category, where 65% of the anterior maxilla constitutes this category.[9] In many conditions, it is extremely important to assess the bone architecture using a CT scan or a ridge mapping method because the anterior maxilla usually exhibits labial concavities that might necessitate bone grafting procedures or placing the implant fixture at an angle and using a pre-angled abutment.

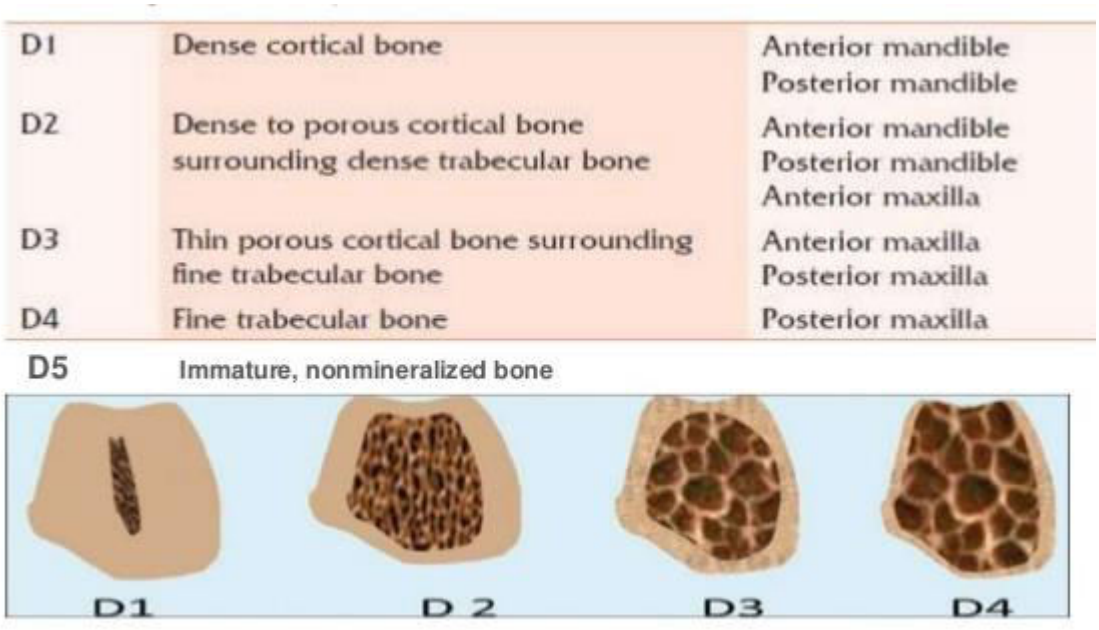

Figure 3: Misch Classification of Bone Density

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