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# Thick vs. Thin Gingival Biotypes: A Key Determinant in Treatment Planning for Dental Implants

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ABSTRACT During the treatment planning process, it is important to recognize differences in gingival tissue can affect treatment outcomes. The concept that thick and thin gingival biotypes have different responses to inflammation and trauma was previously introduced. In this paper, this concept is expanded in that gingival biotypes dictate different procedures for implant site preparation. With appreciation of these differences, preparatory steps can be taken to create a more ideal implant placement site.

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Previously, the importance of taking into consideration the differences in gingival tissue during treatment planning has been emphasized. Specifically, it was pointed out how thick and thin gingival biotypes respond differently to inflammation, restorative trauma, and parafunctional habits.[1,2] These traumatic events result in various types of periodontal defects, which respond to different treatments. The authors also pointed out how periodontal surgery techniques have made it possible to change a thin gingival biotype into a thick gingival form. This provides a more favorable restorative environment and increases the predictability of treatment outcomes.

In this paper, the authors extend their earlier observations of thick vs. thin gingival tissues and describe why it is important to appreciate tissue biotypes during implant treatment planning.

## Thick and Thin Gingival Biotypes

Historically, Ochsenbein and Miller have discussed the importance of "thick vs. thin" gingiva in restorative treatment planning.[1] In a population study, thick periodontal biotypes (85 percent) were found to be more prevalent than thin scalloped forms (15 percent).[3] Subsequently, the authors published a paper that further analyzed thick and thin tissue biotypes in terms of their gingival and osseous architecture.[2]

Thick gingival tissue is probably the image most associated with periodontal health (FIGURE 1A, TABLE 1). The tissue is dense in appearance with a fairly large zone of attachment. The gingival topography is relatively flat with the suggestion of a thick underlying bony architecture. Surgical evaluation of these areas often reveals relatively thick underlying osseous forms (FIGURE 1B).

TABLE 1

**Characteristics of Thick Gingiva**

- Relatively flat soft tissue and bony architecture
- Dense fibrotic soft tissue
- Relatively large amount of attached gingiva
- Thick underlying osseous form
- Relatively resistant to acute trauma
- Reacts to disease with pocket formation and infrabony defect formation

1A.

1B.

**FIGURES 1A-B.** The clinical presentation of thick gingiva and the type of osseous architecture associated with this gingival tissue type.

TABLE 2

**Characteristics of Thin Gingiva**

- Highly scalloped soft tissue and bony architecture
- Delicate friable soft tissue
- Minimal amount of attached gingiva
- Thin underlying bone characterized by bony dehiscence and fenestration
- Reacts to insults and disease with gingival recession

2A.

2B.

**FIGURES 2A-B.** Clinical presentation of thin gingiva is characterized by thin friable tissue. It is associated with clefts, perforation, and gingival recession.

**FIGURE 2C.** The osseous architecture associated with this gingival tissue type is characterized by fenestration and dehiscence.

TABLE 3

**Comparison of Tissue Response to Inflammation, Surgery and Tooth Extraction**

| | Thick Gingival Biotype | Thin Gingival Biotype |
|---|---|---|
| Inflammation | Soft tissue: Marginal inflammation; cyanosis; bleeding on probing; edema/fibrotic changes<br>Hard tissue: bone loss with pocket formation/infrabony defects | Soft tissue: Thin marginal redness and gingival recession<br>Hard tissue: Rapid bone loss associated with soft tissue recession |
| Surgery | Predicable soft and hard tissue contour after healing. | Difficult to predict where tissue will heal and stabilize |
| Tooth Extraction | Minimal ridge atrophy | Ridge resorption in the apical and lingual direction |

Thin gingival tissue tends to be delicate and almost translucent in appearance (**FIGURES 2A-B, TABLE 2**). The tissue appears friable with a minimal zone of attached gingiva. The soft tissue is highly accentuated and often suggestive of thin or minimal bone over the labial roots. Surgical evaluation often reveals thin labial bone with the possible presence of fenestration and dehiscence (**FIGURE 2C**).

In the authors' previous paper, it was suggested that since these two tissue biotypes have different gingival and osseous architectures, they exhibit different pathological responses when subjected to inflammatory, traumatic, or surgical insults[2] (**TABLE 3**). These different responses dictate different treatment modalities. It also was noted that current periodontal surgical techniques have the potential to improve tissue quality, thereby enhancing the restorative environment. The paradigm shift proposed was that by taking into consideration the gingival tissue biotype during treatment planning, more appropriate strategies for periodontal management may be developed, resulting in more predictable treatment outcomes.

**FIGURE 3A.** Tooth No. 9 has a fractured root.

**FIGURE 3B.** The crown is removed and the anchor post is placed into the root tip

**FIGURE 3C.** The anchor post is placed through a perforation in an impression tray containing bite registration material. Using the tray as a base, the anchor post is ratcheted such that the root is elevated.

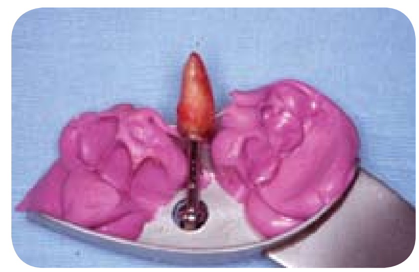

**FIGURE 3D.** The extracted root. This technique is advantageous since there is no force placed on the socket and surrounding bone

## Tissue Biotype in Implant Treatment Planning

If osseous and gingival tissues are different for thick and thin tissue biotypes, it seems logical that these distinctions would significantly influence implant site preparation and treatment planning. This is consistent with previous observations that the stability of the osseous crest and soft tissue is directly proportional to the thickness of the bone and gingival tissue.[4,5] Thick bony plates associated with thick biotypes and thin plates with potential fenestrations and dehiscence associated with thin biotypes respond differently to extraction and have a different pattern of osseous remodeling following this procedure. The trauma induced by the extraction procedure is more likely to result in fracture of the labial plate in the thin biotype than in the thick one. Also, the remodeling process that follows over the next few months will result in more dramatic alveolar resorption in the apical and lingual direction for the ridge associated with thin biotypes.

Even after initial alveolar ridge remodeling, the gingival tissue and bone are more likely to continue to recede, especially if the implant is labially inclined. This underscores the importance of appreciating gingival tissue biotypes during implant treatment planning. Furthermore, when these tissue biotypes are carefully considered, various periodontal and surgical strategies can be employed to improve the treatment outcome either by minimizing alveolar resorption or by providing a better tissue environment for implant placement.

## Extraction of Teeth in Thick vs. Thin Biotypes

Though extractions should always be atraumatic, teeth with thin gingival biotypes merit more attention due to their association with thin alveolar plates. Possible strategies that should be considered include:

- Minimizing leveraging forces toward the thin labial plate. Most of the manipulation should be focused on the interproximal area.
- Sectioning the root(s) from the tooth, when possible, to improve the likelihood for elevation.
- Using periotomes to expand and elevate the tooth with controlled force focused on the periodontal ligament space. The placement and elevation force should be focused on the interproximal space so leverage force is exerted on either the buccal or lingual plate.
- Using a ratchet extraction device to apply reciprocating force on adjacent teeth while extruding the amputated root tip out the socket (**FIGURE 3**). This may be the most effective and atraumatic approach for the broken tooth. The tooth is amputated to the level of the cementoenamel junction. After preparation of a post space, an "anchoring" device is used to engage the root. This device is passed through a quadrant tray with contact bite registration and impression material for the adjacent teeth. After the impression material has set, the anchoring device is ratcheted against the top of the quadrant tray. This strategy is atraumatic and applies no forces on the surrounding alveolar bone.

Atraumatic extraction and preservation of the alveolar plate are essential if the site is to be used for implant placement. Excessive force is likely to fracture the alveolar plate and result in bone resorption and unpredictable bone healing. This is more pronounced with the thin alveolar plate associated with thin gingival biotypes. When compromise of the alveolar plate is suspected, it is essential to utilize ridge preservation or augmentation protocols.

## Ridge Preservation in Thick vs. Thin Biotypes

Prevention of postextraction alveolar bone loss is critical in assuring implant success. Given the thin alveolar plate associated with thin periodontal biotypes, it is not unusual to see more extensive ridge

**FIGURE 4A.** Lower left lateral incisor No. 23 was extracted and extensive bone loss was present. A 12-mm tenting bone screw was placed to support the graft material and prevent collapse of the membrane.

**FIGURE 4B.** Bone graft material and a resorbable membrane were placed, *(Biomend Extend. Zimmer Dental. Carlsbad, Calif.)*

**FIGURE 4C.** Re-entry at five months, which illustrates bone regeneration up to the top of the bone screw.

remodeling when compared to the thicker alveolar plate associated with thick biotypes. Not only is atraumatic extraction critical to minimize this postextraction remodeling, it is important to consider strategies to preserve the alveolar bone, such as socket preservation or ridge preservation procedures. A number of studies have shown that without intervention, significant alterations in most extraction ridge dimensions will occur.[6-9]

This loss can be 1.5 to 2.0 mm over the first 12 months with most loss occurring during the initial three months.[9] A variety of approaches can be employed to address this problem, but most involve grafting the extraction socket and using membranes to support missing/perforated bony walls. Ridge preservation should be considered for most thin biotype cases and in thick biotype cases where excessive trauma or a previous history of endodontic surgery/fistula tracts may have compromised the alveolar plate.

Classically, socket or ridge preservation involves the use of a graft material placed in the socket followed by a variety of other substances such as demineralized freeze-dried bone allograft, mineralized freeze-dried bone allograft, xenograft (mostly of bovine source), and alloplastic materials (β-tricalcium phosphate, durapatite, hydroxyapatite). Since the site will be used for implant placement approximately three months to four months after grafting, it is important to select a graft material that resorbs quickly since only newly formed bone will contribute to the osseointegration of the dental implants. For that reason, slow resorption graft materials such as xenografts and nonresorbable alloplastic materials (durapatite, hydroxyapatite) should be avoided. When there is excessive volume of nonresorbable graft materials, there is inadequate room for bone ingrowth to provide implant osteointegration.

Additionally, the ridge preservation strategy is only successful if the graft material is retained in the extraction socket. A variety of approaches can be utilized to achieve socket closure. These include the use of barrier membranes, tenting pins, collagen plugs, connective tissue grafts, free gingival grafts, acellular dermal grafts, and advancement of the buccal flap. An advanced case of socket preservation with regeneration of the labial plate and vertical dimension is seen in **FIGURE 4**. Whereas simple cases with intact buccal and lingual plates can be easily managed with grafting and socket coverage, advanced cases may require space-maintaining devices such as tenting pins and membranes. All of these options work to a certain extent and the selection should be based on individual cases/requirements.

When excessive bone is lost to resorption, leaving a narrow ridge with a large buccal deficiency or decreased vertical height, a block graft is generally the technique that yields predictable results.[10-11] The block graft material can be of autologous or allograft origin. Autologous graft material is commonly harvested from either the mandibular ramus or mandibular symphysis. Allograft block grafts can be obtained from several commercial providers. The advantage of this technique is that the graft is placed as a block instead of in particulate form, providing increased structural support.

A case of block grafting is presented where there is a narrowed anterior maxillary ridge defect (**FIGURE 5A**). These situations generally require two-stage surgical procedures that included a bone graft surgery followed by implant placement after graft healing. In this situation, it is critical that soft tissue incisions be carefully planned to allow for flap relaxation over the increased volume gained by the graft and to ensure tensionless primary closure. Once adequate access was gained, the graft and recipient bed were prepared to obtain intimate, broad contact between the surfaces.

The recipient bed was perforated to enhance revascularization and the graft was stabilized using fixation screws to maintain close bone contact and prevent graft rotation (**FIGURE 5B**). Adequate primary fixation is essential for graft survival. Particulate bone can be packed around the block and a resorbable collagen membrane can be placed over the entire graft. The soft tissue flap is then advanced and sutured for primary closure. After a healing period of five to six months, the site can be re-entered and integration of the graft to the recipient bone confirmed. Using an appropriate surgical stent, implants can then be properly placed into the widened ridge (**FIGURE 5C**).

**FIGURE 5A.** Extensive defect noted upon flap elevation.

**FIGURE 5B.** The area was prepared and a block allograft was trimmed and fixated with two bone screws *(J Block Cortico-Cancellous Bone Allograft, Zimmer Dental).*

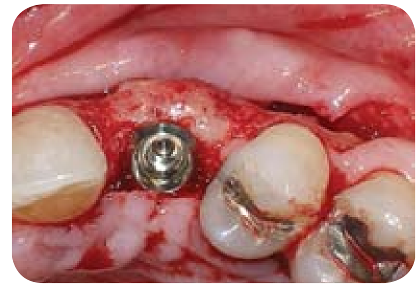

**FIGURE 5C.** Re-entry at six months. Note the excellent ridge width obtained and the ideal implant placement in the augmented site.

**FIGURE 6A.** The initial defect after tooth extraction. The defect is mainly a three-wall defect with almost complete loss of facial bone.

**FIGURE 6B.** The defect was filled with FDBA and a tenting pin was placed for space maintenance.

**FIGURE 6C.** A pediculated connective tissue graft was used to cover the grafted defect, maintaining soft tissue height and width.

**FIGURE 6D.** On re-entry, there is both adequate volume of hard, as well as soft, tissue for implant placement.

In this second case of deficient alveolar ridge, it is essential to rebuild both the hard and soft tissue components in a single procedure to improve the esthetics and to minimize surgical visits (FIGURE 6A).

This case illustrates a three-wall defect, which has better regenerative potential than the one-wall type discussed previously. For this defect, particulate bone can be used as long as two critical components of regeneration are included: space maintenance and adequate soft tissue closure. In order to maintain the defect space, a tenting pin was placed in the socket in an orientation to help support both the facial and vertical dimensions. Particulate freeze-dried bone allograft material was packed into the socket around the tenting pin, slightly overfilling the defect (FIGURE 6B), and a resorbable collagen membrane was trimmed and placed over the graft material.

Soft tissue closure over the membrane and graft is critical for proper healing. If the facial flap is advanced over the defect, the vestibular tissue will be pulled coronally, possibly resulting in a lack of adequate attached tissue, and thereby creating a "thin" case that will compromise future implant placement.

A technique for covering the socket after tooth extraction using a pediculated connective tissue graft was described by Mathews.[12] Utilizing this closure technique over the grafted socket permitted complete soft tissue coverage. Additionally, it maintained both vertical and horizontal soft tissue components, and increased the thickness of facial attached tissue (FIGURE 6C). After healing for five to six months, the site was re-entered and an implant was placed (FIGURE 6D). This case illustrates the transformation of a severely "thin" defect into a more advantageous "thick" periodontium.

## Immediate Implants in Thick vs. Thin Biotypes

Whether a practitioner chooses to place an implant as a delayed or immediate treatment will depend on the conditions of each case. A delayed implant approach might be taken when there is not enough thickness in periodontal tissues to predictably minimize alveolar resorption secondary to healing, or a lack of anchoring bone to ensure stabilization. The decision is also dependent on the practitioner's comfort level in available reconstructive techniques. For a thin biotype case, practitioners must be aware of the possibility of significant resorption, which may have an impact on esthetics.

Furthermore, the loss of peri-implant structures may result in thin, trans-

**FIGURE 7A.** Initial presentation of maxillary left central with fractured root. Relatively minor facial inflammation and recession are present.

**FIGURE 7C.** Radiograph of implant prior to implant exposure.

**FIGURE 7B.** Incisal view of immediate implant placement after tooth extraction.

**FIGURE 7D.** Final crown restoration.

lucent tissue over the implant, which appears grayish, especially if the facial plate is lost and implant threads are exposed. In these cases, further bone and soft tissue grafting procedures may be necessary. However, once an implant is in place, it may be difficult to regain pre-extraction tissue contours.

In a thick biotype environment, immediate placement of an implant can be completed with predictable results.[13] There also is evidence that placement of an immediate implant can help preserve the osseous structures.[14] Even in cases where there is relatively thick tissue present, simultaneous soft and hard tissue preservation/augmentation techniques along with immediate implant placement may be necessary to achieve the best esthetic outcome.

Proper treatment planning between the implant surgeon and restorative dentist is essential when optimal esthetic results are desired. An illustrative case is a patient presented with a fracture in the root of the maxillary left central incisor (**FIGURE 7A**). After appropriately evaluating periodontal tissue characteristics and other necessary surgical and restorative information, a treatment plan was developed that called for extraction of the tooth and immediate implant placement (**FIGURE 7B**).

After hard tissue grafting to fill the facial gap of the socket, closure of the implant-socket was completed with a pediculated connective tissue graft.[12] A radiograph (**FIGURE 7C**) was taken prior to exposure of the implant. The implant was then exposed and the patient was referred back to his restorative dentist for placement of the final crown (**FIGURE 7D**).

## Summary

In this paper, the authors continue to develop the thesis that evaluation of gingival tissue biotypes is important in treatment planning. Since thick and thin gingival biotypes are associated with thick and thin osseous patterns, the two tissue types will respond differently to the trauma of extraction and have different patterns of osseous remodeling following the procedure.

By understanding the nature of the tissue biotype, the practitioner can employ appropriate periodontal and surgical procedures to minimize alveolar resorption and provide a more favorable tissue environment for implant placement. This is especially important in thin periodontal biotypes where the thin alveolar plate is highly susceptible to remodeling. Additionally, these techniques when appropriately applied can save on treatment time and cost for patients. ■■■■

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