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# The Role of Periodontal Plastic Microsurgery in Oral Facial Esthetics

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## ABSTRACT

Periodontal plastic microsurgery incorporates the use of a surgical dissecting microscope in an attempt to increase visibility, minimize trauma, and enhance surgical results. This paper will attempt to demonstrate how periodontal plastic surgery utilizing periodontal microsurgery could contribute in the role of soft tissue modification to enhance the smile and ideally allow for improved oral facial esthetics.

Periodontal plastic microsurgery incorporates the use of a surgical dissecting microscope in an attempt to increase visibility, minimize trauma, and enhance surgical results. Miniature instruments such as microscalpels and microsutures have been developed with hopes to assist the surgeon and minimize tissue injury. Surgical magnification can allow the operator to see things that are not distinguishable with the naked eye, such as the difference between a composite restorative material, dentin, and enamel. Surgical magnification utilizes high-intensity illumination, which it is hoped can illuminate, magnify, and simplify tunneling procedures. It is also hoped that with increased magnification and visibility greater attention to the details of wound closure through microsuturing and knot-tying can be accomplished. If smaller incisions can

accomplish what larger incisions had previously, then microsurgery is expected to translate into more rapid healing and less tissue trauma. Because the public is very aware of modern arthroscopic procedures, patients will readily recognize and accept the value of smaller access incisions, which can allow for more rapid healing. Microsurgery cannot accelerate epithelial healing rates unless it can create smaller distances for epithelial migration during the healing process. Assumptions should not be made that smaller incisions translate into more rapid healing unless reduced tissue trauma occurs and better wound closure through enhanced tissue approximation is demonstrated. Microsurgery may not make a procedure faster but could instead lengthen surgical time. Well-controlled studies are needed to determine if microsurgery will minimize trauma and improve healing.

## Symmetry, Shape, and Proportion

In as much as an individual's smile contributes to oral facial esthetics, then symmetry, shape, and proportion of the smile can play its own role in oral facial esthetics. The framing of the smile is dictated by the lip position, and the framing of the teeth is dictated by the gingival architecture. The gingival architecture can be modified with periodontal plastic surgery.<sup>1</sup> Many of the existing periodontal surgical techniques<sup>2-5</sup> have now been accomplished with a microsurgical approach, and new microsurgical modifications to those techniques are now possible. This paper will attempt to demonstrate how periodontal plastic surgery utilizing periodontal microsurgery could contribute in the role of soft tissue modification to enhance the smile and ideally allow for improved oral facial esthetics.

Variables of gingival architecture affecting symmetry, shape, and proportion will include excessive gingival display, uneven gingival levels, gingival recession/root coverage, interden-



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tal papillae reconstruction, alveolar ridge deficiencies, and preservation of the interdental papillae and alveolus following extraction and esthetic implant reconstruction. Although these variables can sometimes occur in combination, they will be discussed individually.

#### Excessive Gingival Display

Excessive gingival display — commonly referred to as a gummy smile — is a description for the situation whereby the patient shows too much gingiva. Another older synonym for this situation is delayed passive eruption. Commonly in the adult, the gingival margin will be located at or near the cemento-enamel junction, and normally a patient will show very little if any gingiva over the central incisors when smiling. Three common causes of an excessive gingival display are vertical maxillary excess, excessive alveolar bone, and excessive gingiva. These can occur individually and in combination.

Vertical maxillary excess exists if there is an abnormally tall maxilla. In this situation, orthognathic surgery can be considered to move the maxilla to a new level. Orthodontic and oral surgical consultations will determine the ideal position of the maxilla.

In a classic study, Gargiulo measured dentogingival anatomy in humans and described four phases of gingival tissue position. In the case type where the gingival tissues cover the enamel, the distance from the marginal epithelium to the crest of the alveolar bone demonstrated tremendous individual variation.<sup>6</sup> If one tries to develop a clinical consensus as to precisely how much bone resection is necessary when planning an esthetic crown-lengthening case, the answer is unclear and somewhat controversial. Several



**Figure 1.** A patient who exhibits an excessive gingival display five years after orthodontic treatment states that she feels that she “has always had baby teeth.”



**Figure 2.** A photo taken six weeks post-operatively following soft-tissue and bone recontouring with placement of the gingival margin at the cemento-enamel junction displays the full enamel profile and a brighter smile.



**Figure 3.** Localized gingival hypertrophy was noted to last one year after orthodontic debanding.



**Figure 4.** Simple sculpting of the gingival tissue only will allow for a normal contour.

authors have suggested surgically removing the periodontal support to an extent, leaving a distance from the level of a planned restorative margin to the level of the newly recontoured osseous crest of 3 mm,<sup>7</sup> 2.5 to 3.5 mm,<sup>8</sup> and 4 mm<sup>9</sup> in the exposed tooth. Unfortunately, not enough research presently exists to make exacting statements about how much bone should be removed when crown lengthening or sculpting in the esthetic zone.

Sometimes patients can present with gingiva covering so much of the tooth that it can create a diminutive appearance. When excessive gingiva covers enamel, the sulcus depth will increase, thereby allowing a safe har-

bor for bacteria and decreasing the ease of access for plaque removal. Osseous resective procedures have been developed to reshape the dentoalveolar architecture to create a more favorable environment for periodontal maintenance and health.<sup>10</sup> In esthetic crown-lengthening surgery, patient biotypes<sup>11</sup> can play a role in the amount of rebound healing of the newly established gingival margin.<sup>12</sup> Individual variation in gingival thickness will modify final tissue healing levels postoperatively. “Thick” tissue biotypes show the greatest tendency to rebound in a coronal direction.<sup>12</sup>

Excessive alveolar bone can be seen in both height and thickness.





**Figure 5.** A patient presents with composite restorations on the root surface and desires a more natural framing of her smile without long teeth.



**Figure 6.** A photo taken six weeks postoperatively following gingival augmentation with connective tissue grafting and tetracycline root demineralization shows complete root coverage.



**Figure 7.** A preoperative view of a patient desiring veneers. She had tetracycline staining and scrubbed vigorously for years, creating significant recession.



**Figure 8.** A six-week postoperative view following connective tissue grafts with tetracycline dentin demineralization. Root coverage to the cemento-enamel junction will now allow normal length veneers and maximum bond strength to enamel.

Because the full enamel profile is not visible, the anterior teeth will appear short and square (Figure 1). If there is excessive gingiva covering the enamel, reduction of gingiva and bone can create a more esthetic smile (Figure 2). Both bone height and thickness can also vary considerably. If the alveolar bone is abnormally high or thick, both the bone and gingiva must be treated together during surgery. Because excessive bony contours can predispose a patient toward gingivitis and periodontitis due to an inability to remove bacterial plaque effectively,<sup>10</sup> the recontouring of the tissues can provide a functional as well as cosmetic benefit.

Excessive gingiva (gingival hypertrophy) can occur without an excessive amount of underlying bone. In this case, simple excision of the soft tissue without manipulation of the bone can achieve a normal-appearing result (Figures 3 and 4).

#### *Uneven Gingival Levels*

Uneven gingival levels can be seen when uneven incisal edge wear occurs. This is often seen as wear occurs with teeth that are rotated or angulated. As teeth wear and ongoing eruption occurs, gingival margins will be located at varying levels. Incisal edge fracture with ongoing eruption will also move the gingival margin

on an individual tooth, giving it a different gingival margin height than the neighboring teeth. Adult orthodontic treatment that does not take incisal edge wear into consideration can mistakenly align worn incisal edges instead of positioning the cemento-enamel junctions in their appropriate positions. Because the gingival level is usually located at or near the cemento-enamel junction, uneven cemento-enamel junctions will create uneven gingival levels. Orthodontic intrusion or extrusion can correct uneven gingival levels. Surgical resection of the marginal gingiva can also be considered to create symmetry, shape, and proportion as long as roots are not exposed.

#### *Gingival Recession and Root Coverage*

Gingival recession can occur with a lack of attached keratinized gingiva (in height or in thickness), tooth prominence, trauma, inflammation, ill-fitting restorations, and pull from frena. Gingival recession exposes dentin root surfaces with potential sensitivity to hot, cold, sweets, and touch and a greater risk of caries. Root-coverage surgical procedures have demonstrated predictability in covering areas of exposed dentin.<sup>13</sup> Root coverage with gingival augmentation can reduce or eliminate these concerns. (Figures 5 and 6). New attachment of gingival connective tissue to a previously exposed root surface has been demonstrated.<sup>14</sup> When root exposure poses a cosmetic or restorative concern, smile esthetics can be enhanced when the normal gingival anatomy is replaced with gingiva rather than placement of a tooth-colored, bonded restoration that can make a tooth appear longer (Figures 7 and 8).

Restorations bonded to enamel have proven very successful when





**Figure 9.** A preoperative view of a patient desiring new crowns. Note the 7 mm recession on the facial of tooth No. 10, most likely due to prominent root surfaces, thin tissues, overhanging crown margins, and overzealous oral hygiene. Without gingival augmentation, a significant asymmetry of new crowns would result.



**Figure 10.** Gingival augmentation with connective tissue grafts provides proper framing for the new, well-fitting restorative dentistry.



**Figure 11.** Tooth No. 7 presents with a Nordland-Tarnow Classification 3-1 papilla, and tooth No. 8 presents with a Class 3-0 papilla. Several attempts by periodontists to graft the lost interdental papilla were made as well as overbuilding the mesial surface contour of tooth No. 7 with composite to reduce the black space.



**Figure 12.** A six-week postoperative view following microsurgical papilla grafting reducing the papillae to a Nordland-Tarnow Classification 1-2 papilla for tooth No. 7 and a Class 1-4 for tooth No. 8. The patient is now ready for restorative dentistry to close the remaining space and restore symmetrical contour to the maxillary anterior teeth.



**Figure 13.** Restoration of the maxillary anterior teeth with porcelain veneers. Note how the increase in the cervical restoration contour can be utilized to completely fill the residual embrasure space.



**Figure 14.** An obvious ridge collapse deformity in the tooth No. 8 area following extraction of an endodontically treated fractured root without bone grafting at the time of extraction is common. Note also the flattening of the papillae of teeth Nos. 7 and 9.



**Figure 15.** The patient presents with a vertical root fracture of tooth No. 8, necessitating extraction.



**Figure 16.** A human freeze-dried demineralized bone graft with a collagen membrane to retain the bone graft particles is placed to help preserve an anatomical soft-tissue contour.

compared with bonding to dentin. Dental restorations placed solely in enamel present greater bond strengths and reduced microleakage creating higher predictability for long-term success as compared with dentinal bonding.<sup>15,16</sup> Because resin-dentin bond strengths degrade dramatically within a few years,<sup>17</sup> it is preferable to avoid bonded restorations placed on root surfaces when possible. It is, therefore, more desirable to restore a tooth to the cemento-enamel junction and then cover any exposed dentin with its natural covering, gingiva. Additionally, if





**Figure 17.** A provisional replacement for tooth No. 8 is constructed using an ovate pontic. The pontic extends 2 mm below the soft tissue for support.



**Figure 18.** Six months after extraction and bone grafting, there is a slight depression above tooth No. 8 requiring gingival augmentation.



**Figure 19.** Gingival augmentation is performed to plump the tissue over tooth No. 8.



**Figure 20.** Tissue contours are developed to create the prominence of the normal anatomical root form.

restoration is planned on a tooth that has gingival recession, it is more desirable to have any exposed root surface protected and covered with gingiva, thereby allowing a more predictable enamel bonded restoration. Ideally, the dentist should consider altering the gingival height if recession is present rather than risk increased failure with bonded finish lines on dentin. If the root is not covered with gingiva, the dentist might also face patient dissatisfaction with regard to sensitivity or cosmetic issues (Figures 9 and 10).

Modern gingival augmentation techniques can offer predictability in root coverage, regeneration of attachment, and cosmetics.<sup>1</sup>

#### *Interdental Papilla Reconstruction*

The lost interdental papilla can create phonetic problems, saliva bubbles, and cosmetic deficiencies. A papillary deficiency can be created through iatrogenic surgical removal, as part of tissue collapse following extraction, with periodontal pocket elimination surgery, with periodontal bone loss, and with orthodontic separation of overlapped teeth. Recently, classification of degrees of loss of the interdental papilla have been developed.<sup>18</sup> Classification of degrees of tissue loss can help the practitioner evaluate the success of differing treatment modalities. The restoration of the lost interdental papillae may require orthodontic root alignment, restorative

dentistry, or surgical addition of tissue. Some cases may require one treatment modality or all three, together or in various combinations. Microsurgical techniques have been developed to replace the lost interdental papilla.<sup>19</sup> Dental restoration can become complex and involve multidisciplinary care when there is a loss of the interdental papilla (Figures 11 through 13).

#### *Alveolar Ridge Deficiencies*

An alveolar ridge deficiency or ridge collapse will occur when a tooth is extracted and the dentoalveolus and soft tissue collapses inward. Ridge deformities can create esthetic and functional dilemmas for the patient and restorative dentist. Abrams reported that 91 percent of the time, the loss of an anterior tooth caused a significant deformity.<sup>20</sup> Ridge deformities have both soft-tissue (papilla and attached gingiva) and bony-alveolus components. Soft-tissue deformities can occur when surgical incisions are made in delicate areas (thin gingiva, alveolar mucosa, and papillae). Deformities of bone can occur following extraction of a tooth that has a thin dentoalveolus, previous endodontic surgery, endodontic failure, iatrogenic bone removal, intentional bone removal to gain a purchase, root fracture, or periodontal bone loss (Figure 14). Pressure atrophy from a removable prosthetic appliance (a flipper) can compress the alveolar ridge and allow the collapse of the adjacent papillae.

#### *Preservation of the Interdental Papilla and Alveolus Following Extraction*

Bone loss can compromise dental implant placement or make it impossible. A ridge deficiency will necessitate the overbuilding of prosthetic tooth structure, prosthetic gingiva, or acceptance of a space that can appear dark. Phonetics can be affected where





**Figure 21.** An osseointegrated implant was placed using a surgical guide stent with indexing at the time of implant placement.



**Figure 22.** A full smile is restored with an implant in the No. 8 location. Bone, soft tissue grafting and implant tooth replacement have assisted in providing normal soft tissue, hard tissue, and tooth contours.



**Figure 23.** A close-up view of the implant crown and soft tissue reconstruction.

the space can allow for the passage of air and saliva. Modern exodontia techniques focus on atraumatic tooth extraction and rebuilding of the alveolar ridge while maintaining the soft-tissue surroundings. Bone fill into an extraction socket originates from osteoblast progenitor cells at the periphery of the bony defect. If there is a large volume of progenitor cells, the defect will be small; however, if there is a paucity of progenitor cells (thin bony alveolus), a significant deformity will result. Addition of bone into the extraction socket and placement of a membrane at the time of extraction can minimize or eliminate a post-extraction ridge deformity (Figures 15 and 16).

Additionally, soft-tissue collapse can occur along with bone collapse unless steps are taken to maintain the soft tissue. Papilla preservation can be initiated prior to tooth extraction with interdisciplinary treatment planning. Ideally, the restorative dentist will fabricate an immediate tooth replacement using an ovate pontic bonded or bridged to the adjacent teeth (Figure 17). The concept of the ovate pontic allows for a natural-appearing emergence profile of the replacement and an ease

of oral hygiene cleansability.<sup>5</sup> The pontic should extend 1.5 to 2 mm below the gingival margin to support the surrounding facial gingiva and the interdental papilla. Occasionally, there can be a soft-tissue residual deficiency even after the meticulous attention to delicate extraction, bone grafting, and immediate placement of an ovate pontic (Figure 18).

This technique will not only maintain bone and soft tissue, but also allow the extraction of an anterior tooth without the patient feeling toothless. This will also allow the patient time to make a decision as to the final tooth replacement modality such as a bridge or an implant.

#### **Esthetic Implant Reconstruction**

If there is a deficiency in the surrounding dental anatomy following tooth loss, tooth replacement will be compromised. A ridge deficiency will require that the tooth restoration be anatomically larger to fill the extra space; or, if the tooth dimensions are anatomically correct, a residual space will result. Occasionally, dental restorations have masked deficiencies by adding gingiva-colored materials to disguise lost bone and soft tissue.

If attention is paid to the aforementioned details of maintaining the interdental papillae, gingival architecture, and alveolar bone, implant reconstruction can proceed without loss of the pre-existing dental anatomy. When the surrounding dental anatomy is maintained, implant tooth replacement can restore an anatomically correct implant crown (Figures 19 through 23).

#### **Conclusion**

Periodontal plastic microsurgery may play a role in oral facial esthetics. Microsurgical procedures could assist the surgeon with visibility and might minimize trauma for the patient; however, well-controlled studies are needed to determine if microsurgical techniques can create a difference in the final surgical outcome. **CDA**

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