True dental esthetics comes from a delicate balance of the morphology and color of the dentition silhouetted against the backdrop of a healthy periodontium in a functionally sound occlusion. A major challenge for the restorative dentist is to reconstruct these natural biologic parameters when a tooth (or teeth) is (are) lost and the harmony of this biologic balance is upset. Tooth loss in the esthetic zone can be handled by placement of dental implants or by conventional crown and bridge procedures. Whichever route is chosen, the key to esthetic success lies in the preservation of facial and interproximal alveolar bone and symmetry of the soft tissue envelope that surrounds and frames the teeth. Only then can the contours and color of the dental units be exploited to create a maximal esthetic dental reconstruction. This article will describe a case where dental lasers (hard and soft tissue) and synthetic bone grafting material was used to create an esthetic periodontal environment for the replacement of porcelain laminates and an all ceramic bridge for a patient after a root fracture and resultant loss of the maxillary right lateral incisor.

Dental History

The patient (fig. 1) presented with porcelain laminate veneers on tooth numbers 4 to 12. Tooth number 7 had marginal gingivitis and was sensitive to percussion. She was treated for acute pulpitis with root canal therapy, but the pain persisted. The endodontics specialist made a diagnosis of root fracture and the tooth was scheduled for removal. Although there was adequate space for a dental implant to replace the lost tooth, the patient elected to have a three-unit bridge placed instead. Given the age of the patient (28 y/o), it is imperative to think about preserving the alveolar ridge for long-term esthetics. One of the advantages of implant placement is that the alveolar ridge will be preserved for the patient. In lieu of implant placement, bone (socket) grafting (filling the extraction site) will help preserve not only the interproximal alveolar ridge height that is critical for papillae retention, but just as important, the facial contour in the edentulous area.\(^1\)\(^2\) The surgical plan will involve atraumatic extraction of the maxillary right lateral incisor by carefully luxating the tooth toward the palatal aspect. Once the extraction site is filled with the bone grafting material, a provisional restoration with an ovate pontic design will form a primary closure over the surgical site retaining the graft material and helping to support the periodontal tissues during the healing phase of treatment.

Fig. 1 This is a full arch retracted preoperative view of a patient that has had elective esthetic dentistry in place on the maxillary arch for seven years. Tooth number seven has been diagnosed with a mid root fracture and is scheduled for removal.

Fig. 2-4 After extension of the preparations of abutment teeth, a full thickness mucoperiosteal flap is elevated from the palatal aspect. An Er,Cr: YSGG laser is used to carefully remove crestal bone so the tooth can be luxated toward the palatal direction preserving the interproximal bone and facial plate. The extraction socket is shown from the incisal aspect. Note the preservation of the interproximal bone and facial plate after a traumatic tooth removal. Synthetic graft material is placed into the extraction site after tooth removal to the level of the crest of bone.

Fig. 5 The provisional restoration is shown after carving and polishing. Note the shape of the ovate pontic, which needs to extend 2 to 3 millimeters into the extraction site.
Surgical Phase And Bone Grafting

After placement of local anesthesia, the porcelain laminate veneers on the teeth adjacent to tooth number 7 are prepared off using a thin, course tapered diamond (Brasseler: Brasseler USA). The preparations are extended interproximally and to the lingual (palatal) aspect to become full coverage abutments for the three-unit bridge. The treatment plan calls for a three unit pressed ceramic bridge, therefore, 1.0–1.2 millimeters of circumferential reduction is needed to create space for the restorative material. Once the preparations are complete, a “trap-door” design full thickness mucoperiosteal flap is raised on the palatal aspect exposing the alveolar crest. An Er,Cr: YSGG hard tissue laser (Waterlase: Biolase Technologies) is used to conservatively remove alveolar bone to gain access for a periotome to sever the periodontal ligament fibers (fig. 2).

The advantage of using the Er,Cr: YSGG laser for bone removal is that the laser can reach interproximally with minimal removal of bone, unlike conventional rotary instruments, which are larger and may remove more interproximal bone. The laser cuts only at the tip, so the maximum amount of interproximal bone will be conserved, yet create sufficient access for periotomes and small elevators. Once the tooth is loose in the socket, it is elevated carefully toward the palatal aspect. Remember, the buccal plate is very thin and care must be taken not to fracture it during tooth extraction. Figure 3 shows the extraction site with interproximal and facial crestal bone intact. Remember, do not compress the facial plate after tooth extraction. The next step is to place the synthetic bone graft material into the extraction site. The graft material comes packaged in a single socket dose syringe (Bioplant SSD). The tip of the syringe is placed into the extraction site and blood is drawn into it to be mixed with the graft material. This blood will contain progenitor cells important in the regeneration of bone in the socket. The mixture is then syringed into the extraction site to the crest of the bone (fig. 4). A provisional restoration is fabricated from a preoperative model and an ovate pontic is created that will extend 2 to 3 millimeters into the extraction site 2 (fig. 5). The bottom of the pontic is shaped like the large end of an egg. This shape will help to support the papillary and marginal gingiva in their preextraction positions by exerting horizontal pressure below the crest of the gingival tissues. Figure 6 shows a radiographic view of the provisional ovate pontic in place in the extraction site following placement of the bone graft. The interproximal bone has been maintained and the ovate pontic creates primary closure over the extraction site. As the gingival tissues heal, the ovate provisional pontic will appear to emerge from the extraction socket in much the same manner as the original crown (fig. 7). According to Kois, the restorative margin interproximally should be located four millimeters incisal to the alveolar crest. The tip of the interproximal gingival papillae will predictably extend five millimeters above the alveolar crest between roots in normal arch position, (two millimeters of space between adjacent teeth). As the extraction site (ovate site) heals, the interproximal restorative margin can be measured and adjusted by sounding to the crest of bone and using a diamond bur to make necessary marginal adjustment to place the margin four millimeters from the alveolar crest (figs. 8 to 10). Since the interproximal dental papillae can be expected to extend five millimeters incisal (coronal) to the alveolar crest, a margin adjusted to the four-millimeter level can be expected to ultimately be located one millimeter below the free gingival crest (intracrevicular).

Esthetic Gingival Correction Using Laser Technology

It has been suggested by Rufenacht, and others that the height of the free gingival margin above the maxillary central incisors should be about one millimeter apical to the free gingival margin above the maxillary lateral incisors. The height of the free gingival margin above the maxillary cuspids should be at the same level as the maxillary central incisors or slightly apical to that level. After thirty days of healing in the ovate pontic site, the facial margin of the free gingiva extends approximately one millimeter apical to the central incisors (fig. 11) and must be corrected for proper esthetic balance. A diode laser (Twilight: Biolase Technologies) is used to adjust the level of the gingival tissues above the maxillary central incisors so that they are about one millimeter apical to the free gingiva on the facial of the ovate pontic (fig. 12). Biologic width may be encroached upon and require adjustment of the bony crest later. The heights
Hard and soft tissue laser utilizing a “closed” crown lengthening just used the Er,Cr: YSGG (Waterlase: Biolase Technologies) and soft tissue laser using a “closed” crown lengthening technique (fig. 16). The laser tip is placed adjacent to the root surface, parallel to the long axis of the tooth. The tip is moved apically in a “sewing machine stitch type fashion” to remove crestal bone. Since the laser cuts only from the tip, the root and the internal epithelium of the gingival sulcus will not be affected. Once “closed crown lengthening” has been completed, the surgical area is rechecked with a periodontal probe to make sure that three millimeters exists from the restorative margins to the bony crest (fig. 17). Most of these types of facial esthetic crown lengthening occur between “ten and two o’clock” and therefore will not involve the interproximal areas. Once the surgical phase is completed, the provisional restoration is corrected to the new marginal levels (fig. 18). When using bisacrylic provisional material, correction of cervical profiles on the affected teeth can be easily done using flowable composite resin followed by microhybrid composite on the surface. The existing provisional restoration should be beveled 3 to 4 millimeters in the area to be added. As long as the surface is clean, there will be enough micromechanical retention to directly add a layer of flowable composite over the bevel and exposed tooth surface. Light cure this first layer, and then add the microhybrid composite layer directly over the top of the flowable resin layer. A soft, sable artists’ brush can be used to feather the unset microhybrid material and blend it with the existing provisional restoration contours. After light curing, eight-fluted composite finishing carbides (ET 3, ET 9: Brasseler USA) are used to sculpt the surface and finish the gingival margins. After two weeks of healing post laser closed crown lengthening, the gingival tissues are shown with and without provisional restorations in Figures 19 and 20. It is not unusual to need a secondary procedure to refine gingival zenith architecture, especially for a very discriminating patient that shows gingival display upon smiling. A minor gingivoplasty is all that is required to create symmetry for this patient. The correction is outlined with a fine marker so that the correction can be compared to the adjacent central incisor prior to removal of the gingival tissue (fig. 21). A diode laser (fig. 22) (Twilight: Biolase Technologies) is used to make the gingival correction of free gingival only. Biologic width was not violated by the correction. Had the base of the sulcus been reached, closed bony crown lengthening with the ErCr: YSGG hard and soft tissue laser would have been needed. The gingival margin of the preparation is repositioned using a fine diamond instrument. Next, microhybrid composite is used to refine the cervical contours of the provisional restoration (fig. 23). The margins must be precise and the cervical contour correct so that the marginal gingiva will heal properly and be held in place creating a refined gingival zenith that more closely resembles the one on the adjacent central incisor. After a few additional weeks of healing (figs. 24 and 25), the tissue health and gingival contours are assessed. The heights of the gingival tissues above the maxillary central incisors are now slightly higher (apical) to the maxillary lateral incisors. The gingival tissues above the maxillary canines are at approximately the same level as the maxillary central incisors. At this point, final impressions can be taken to complete the case. A two-cord technique is used to capture the margins of the preparations and .5 millimeters of the tooth surface apical to the margin. A #00 cord is placed into the gingival sulcus and trimmed so that there is no overlap. Next, a #1 cord is placed on top of the #00, trimmed, and left is place for two to three minutes, as the dental assistant gets ready to load the impression tray with heavy bodied impression material. When ready, the #1 cord is carefully removed from the gingival sulcus using the tine of an explorer to pull the buccal margin of the cord incisally. A cotton forceps is then used to circumferentially remove the #1 cord, leaving the #00 in the sulcus. A defined space should now be present between the marginal surface and the displaced gingival tissue exposing the entire restorative margin. At this point, the dental assistant can begin to fill the impression tray as the dentist syringes the light bodied impression material around the gingival sulcus of the prepared teeth. The completed master impression is shown in Figure 26. The case is fabricated by the ceramist and placed using dual cure resin cement. The delivered case is shown in a retracted view in Figure 27. Note the difference in width to length ratio and gingival levels when compared to Figure 1. Through the use of the technique of socket preservation, the edentulous site in the...
right maxillary lateral incisor position is virtually indistinguishable from the contralateral side. The facial marginal gingiva is supported by the ovate pontic as well as the interproximal gingival papillae. The use of dental lasers (diode and Er,Cr: YSGG laser: Biolase Technologies) allowed minimal intervention bony surgery to be performed to correct esthetic levels of gingival and bony structures without the need of open flap surgery and the extended healing times associated with that procedure. The patient is extremely happy with her new smile.

**Conclusion**

Techniques have been described to maximize esthetic outcomes utilizing ridge (socket) preservation and dental lasers. Use of these technologies will continue to cause a paradigm shift in the way surgical esthetic correction of the dental patient is performed. The goals of shorter and more predictable healing times and less post-operative discomfort can be realized while at the same time, creating an esthetic and functional result that is satisfying to the doctor and the patient.

**References**


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