Crown lengthening in the aesthetic zone

Comparing laser and conventional surgery

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In the following article, two methods for correction or reduction of minor gummy smile will be discussed: conventional surgery and laser-assisted surgery. The aesthetic outcomes of the two methods will be compared, and differences in pain, discomfort, swelling, predictability of the results and patient satisfaction according to the visual analogue scale will be discussed. It will be shown that crown lengthening with a dental laser can be a viable alternative to conventional surgery, for there are noticeable differences regarding postoperative complaints, and predictable and stable aesthetic results can be achieved this way.

Literature review

In the past, the conventional approach has been clearly and scientifically proved by sound studies, and there was a lack of technological advancements and the absence of new studies and evidence-based laser dentistry. The conventional techniques used were based on the severity or importance of the gummy smile. The correction of gummy smile was based on minor correction by bony crown lengthening of the smile line for the hard- and soft-tissue removal of the procedure. Advanced gummy smile correction cases were usually referred for orthognathic surgery, as described in the literature.[1–4] Today, supplementary techniques for gummy smile reduction, such as botulinum toxin and hyaluronic acid fillers of the upper lip, are also viable options for treating patients seeking cosmetic treatment.[5,6] Also, in some cases, lip repositioning can be advised in order to hide the excessive gingival display in the aesthetic zone.[7,8]

Materials and methods

Study population

The cases reported on in this article were part of a clinically comparative prospective cross-over study. Ethical approval was obtained from the ethical research committee of the Lebanese Dental Association of Beirut in Lebanon, and the patients signed a detailed consent form before undergoing the surgical procedure.

Description of the intervention

All surgeries were carried out by the same practitioner. The crown lengthening procedure was divided into two parts: performed from the midline of the maxillary central incisors to the second premolar area on one side using the conventional surgery technique and from the midline of the maxillary central incisors to the other second premolar area using the laser technique. The side for each technique in each patient was random selected. The patients were female, aged between 22 and 25, and perfectly healthy according to their medical histories. Moreover, they were non-smokers who rarely drank alcohol. Also, they had no allergies to any commonly used medications and took no daily medication prior to the treatment. Their family medical histories did not reveal any serious medical problems or anomalies. Most of the patients maintained remarkable oral hygiene.

Ahead of treatment, panoramic radiographs of the patients were taken. A detailed intra- and extra-oral examination was also done, including VELscope assessment (LED Dental) to check for oral precancerous lesions, and the findings were perfectly healthy intra-oral conditions of the cheeks, soft palate and tongue. Detailed probing was performed for every patient, from the distal part of the first right premolar to the distal part of the second left premolar. There were three points of probing for each buccal side of each tooth (distal, middle and mesial). The aim of the probing was to check the reattachment of the periodontal ligament after one month and compare it between the two techniques that were used. Measurements of the gingival surface for swelling assessment was done using the CEREC Bluecam digital scanner (Dentsply Sirona), comparing the 3D images before the surgery and after the first, second and third clinical assessment after the procedures (Fig. 1).

The laser technique

The following preoperative photographs were taken: a sagittal or frontal photograph perpendicular to the incisal edges of the maxillary central incisors and in the plane of the midline of the maxillary central incisors (Fig. 2), a lateral pho-

Fig. 1: Pre-op CAD/CAM photograph for swelling measurement. **Fig. 2:** Pre-op frontal view. **Fig. 3:** Pre-op right lateral view. **Fig. 4:** Pre-op left lateral view. **Fig. 5:** Pre-op occlusal view. **Fig. 6:** Laser soft-tissue removal.

tograph perpendicular to the buccal surface of the right canine (Fig. 3), a lateral photograph perpendicular to the buccal surface of the left canine (Fig. 4), and an oblique occlusal photograph at approximately 45° to the midline of the maxillary central incisors (Fig. 5). Detailed probing of the periodontal pockets was carried out, and the biological width of the ten maxillary teeth was measured and noted.

By means of the Er,Cr:YSGG laser, the patient's new gingival margin was drawn on to the gingival margin, starting from the distal area of the second premolar of one side to the distal area of the second premolar of the other side. The laser, operating at a wavelength of 2,780 nm, was set to 1 W, 0 % water, 0 % air, H mode (150 µs) and 50 pps, for dehydrating the marginal gingiva in order to limit the expected future gingival line.

After drawing of the future gingival line, 2–3 mm of soft tissue was removed using the Er,Cr:YSGG laser, operating at a wavelength of 2,780 nm and set at 4.5 W, 50 % air, 30 % water, H mode (150 µs) and 50 pps, in non-contact mode with a Z6 tip perpendicular to the gingival surface. There was a distance of 2 mm between the Z6 tip and the gingiva. After removing a few gingival layers and before achieving complete ablation of the gingiva, the tip was redirected and the second phase of the soft-tissue removal began with a tip direction parallel to the tooth surface with the same settings in non-contact mode and at a distance of 2 mm from the gingival margin in order to eliminate the amount of gingiva that was to be removed layer by layer (Fig. 6).

In the following step, hard tissue was removed in order to obtain a stable final result regarding the future gingival line. The Z tip was marked at 2 mm from the working side with a fluorescent marker. The surgical procedure was performed using the Er,Cr:YSGG laser, operating at a wavelength of 2,780 nm and set at 4.5 W, 50 % air, 70 % water, H mode (150 µs) and 35 pps, in non-contact mode, with a painting movement at a rate of approximately 60 seconds per tooth with the Z6 tip parallel to the buccal wall of the tooth. The working part of the tip was inside the sulcus and the previous sulcular depths of each distal, middle and mesial point of the buccal sulcus of each tooth were known. The objective was to restore the depth of the sulcus by removing the alveolar bone with painting movements to the point of x –1 mm of the selected marker, where x was defined as the preoperative sulcular depth. The bony crown lengthening was stopped at –1 mm, since the Er,Cr:YSGG laser, operating at the described settings, has a working distance of 1 mm ahead of the working tip of the Z6 tip, and the painting movement aims to maintain the polished surface of the remaining alveolar bone as much as possible.

The conventional surgery technique

The incision of the soft tissue was done with a #15 blade, starting with a 1 cm incision parallel to the midline of the maxillary central incisors, proceeding perpendicular to the surface of the alveolar bone and redefining the new gingival line with another incision going mesial from


Fig. 7


Fig. 8


Fig. 9


Fig. 10


Fig. 11


Fig. 12


Fig. 13

Fig. 7: Scalpel alignment of the future gingival line in the conventional surgery site. **Fig. 8:** Soft-tissue removal in the conventional surgery site. **Fig. 9:** Full-thickness flap and retraction of the periosteal membrane. **Fig. 10:** Suturing and final photograph immediately after surgery. **Fig. 11:** Clinical situation three days after surgery. **Fig. 12:** Clinical situation seven days after surgery. **Fig. 13:** Clinical situation one month after surgery and after placement of the veneers.

the central incisor to the distal wall of the second premolar of the same side and always parallel to the previous limit of the gingival margin of the sulcus (Fig. 7). The soft tissue defined by the previous incision was removed (Fig. 8), a full-thickness mucoperiosteal flap was performed (Fig. 9), and bony crown lengthening or alveolar bone removal was performed with a round diamond bur. The amount of removed bone should be equivalent to the amount of removed gingival tissue in each tooth. This should be defined ahead of surgery with probing of the sulcus and aesthetic assessment when planning the future gingival line of the patient. Suturing was done using 4/0 resorbable silk sutures (Fig. 10).[9–13]

After the surgery, we prescribed an antibiotic (Augmentin, 625 mg; one tablet twice a day for seven days), a non-steroidal anti-inflammatory drug (ibuprofen, 400 mg; one tablet twice a day for three days) and an analgesic (paracetamol, 500 mg; two tablets twice a day for one day). Clinical assessment was performed on a daily basis for three days (Fig. 11) after the procedure, a fourth clinical assessment after one week, on the same day as the sutures were removed (Fig. 12), and a final reassessment after one month (Fig. 13) in order to recheck and compare the reattachment of the periodontal ligament.

Results

On the third day, no significant difference was found between the conventional and laser surgery groups (p-value = 0.364; Wilcoxon test) according to the visual analogue scale. The fact that we can achieve with laser surgery in three days what we can achieve with conventional surgery in seven days regarding the swelling parameter is significative. In the first few days, redness of the tissue can occur. The tissue adjacent to the treated areas may feel tight. In the conventional surgery site, redness of the gingiva was present during the healing period. In the laser surgery site, however, gingival redness was close to negligible owing to the conservative, non-aggressive, selective removal of the soft and hard tissue. The reason for such gingival redness is the inflammatory process of the regeneration of the new epithelial and connective tissue cells. However, one week after the procedure, the two sites revealed similarities in terms of structure and bleeding, which were close to negligible.

The texture of the newly formed gingiva was approximately the same one week after the procedure for the two compared techniques. In the laser-treated site, the tissue had reattached normally, unlike in the conventional surgery site. This can play a very important role in the predictability of the results of the Er,Cr:YSGG laser, especially when it comes to the aesthetic zone and participants' desire for reduced gingival display while smiling. Laser treatment reduces the formation of scar tissue due to tissue damage related to cuts, burns and surgery. This therapy can reduce the formation of fibrous tissue by accelerating the healing process, improving the blood flow to the treated area. It must be noted that fast healing leads to less scar tissue formation.[14]

Discussion

The purpose of this study was to evaluate the Er,Cr:YSGG laser approach for crown lengthening of soft and hard tissue in the aesthetic zone with a view to the aesthetic outcome for patients with minor gummy smile. The results of the study show that laser-assisted crown lengthening in soft and hard tissue must be considered a viable alternative to conventional surgery owing to its numerous advantages. For instance, though the use of the Er,Cr:YSGG laser in flapless crown lengthening surgery, postoperative symptoms can be minimised, such as swelling and pain, which are due to the unnecessary retraction of the periosteal membrane, leading to inflammatory cells collecting for regeneration of the periosteum after surgery. Also, the mechanical removal of bone with conventional rotary burs can lead to heat damage to the bone, even if there is additional water cooling by the handpiece. The removed part of the bone will simultaneously have dead bone cells on top of the alveolar crestal bone and consequently additional inflammatory cells, which can lead to additional swelling and to delayed healing of the bone and gingiva.

In terms of healing, the use of an Er,Cr:YSGG laser for soft-tissue removal has tremendous advantages over the scalpel procedure. For one, the Er,Cr:YSGG laser does not lead to damage to the epithelial and connective tissue, as it removes layers of the gingiva by explosive evaporation; thus, this approach will not lead to inflammation and gingival bleeding is minimal. Retraction of the periosteal membrane and bone and gingival removal with conventional surgery require sutures, which can irritate the mucosa of the upper lip. Also, most of the patients complained about pain caused by the midline suture, similar to complaints after frenectomy of the upper labial frenulum.

Reattachment of the hemidesmosomes and regeneration of the periodontal ligament are also affected by the conventional surgery procedure. In the conventionally treated case, there was delayed reattachment and inconsistent probing pocket depths one month after the surgery. The Er,Cr:YSGG laser in the laser-assisted surgery, however, contributed to a sterile surface of both the cementum and the periodontal ligament, leading to better, quicker and smoother reattachment as a result. The deepest layers of the connective tissue and the epithelium were also positively affected by the use of the Er,Cr:YSGG laser, similar to a biostimulation effect. The layers of the gingiva appeared to be healthier, and the colour and texture were more suitable for the newly formed gingiva. The hygiene of the patients treated with conventional surgery was also affected: the participants complained about having noticeable discomfort while brushing the surgery site. The patients treated with the laser, however, did not feel any of this physical discomfort. Noticeable sensitivity of the teeth was also described by the participants treated conventionally, while the laser-treated patients did not feel such sensitivity either.

Conclusion

The use of an Er,Cr:YSGG laser for crown lengthening in soft and hard tissue achieves a similar aesthetic treatment outcome compared with conventional surgery. The postoperative symptoms of the conventional approach, such as pain, swelling and physical discomfort, can be minimised through the use of a dental laser. Also, the use of this laser is very helpful for correctly predicting treatment outcomes, and quicker reattachment of the periodontal ligament, specifically in the aesthetic zone, can be achieved as well.

Literature

about the author

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