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Abstract
Several studies have shown that gingivitis is common in children and adolescents. Introduction of orthodontic devices may exacerbate the gingival inflammation. Orthodontically induced gingival hyperplasia in adolescents, its etiology, and treatment alternatives are discussed. Three instances in which laser therapy was used are described.

Laser treatment of orthodontically induced gingival hyperplasia

One of the more difficult tasks during orthodontic therapy for adolescents is maintenance of adequate oral hygiene. In a study of 1,433 British schoolchildren, James found that 72 percent of 13-year-old girls had gingivitis.[1] According to Finn, 80 to 90 percent of children, 11 to 17 years old, have gingivitis.[2] In 1954, McIntosh discovered periodontal pockets 3 mm or deeper in more than 70 percent of children, 6 to 11 years old.[3] Wentz and Pollack showed that two-thirds of adolescent Chicago schoolchildren have some degree of gingivitis.[4] These data indicate that periodontal disease among adolescents is the rule, rather than the exception. Presented here is a review of the literature concerning gingival problems associated with orthodontic treatment and the use of lasers in such treatment. The review is followed by three case reports in which lasers are used to treat gingival hyperplasia in orthodontic patients.

Review of the literature

When fixed orthodontic devices are placed in adolescents, the problems associated with periodontal disease worsen. Bowers et al. noted that fixed (orthodontic) appliances (bands, wires, etc.) harbor bacteria and thus can contribute significantly to inflammation.[5] Graber stated that orthodontic appliances are foreign bodies, and that the irritation caused by the appliances often produces inflammation, redness, swelling, and pain.[6] Goldman and Cohen reported that inadequate oral hygiene around properly constructed orthodontic appliances causes gingival inflammation.[7] Genco et al. found that gingival inflammation frequently increases during placement of fixed orthodontic appliances.[8]

Rigorous oral home care, followed by gingivectomy to remove hyperplastic tissue, has been the recommended treatment in cases of gingivitis among orthodontic patients. According to Finn, gingivectomy should be performed to treat gingival hyperplasia in pediatric periodontal patients.[2] Genco et al. advocate gingivectomy to treat hyperplastic gingival proliferation in general.[8] They claimed that removing the irritating factors does not return the gingiva to its normal physiologic architecture, and that the hyperplastic gingiva prevents access to the root surface, which inhibits thorough root planing. Graber also advocated scaling, removing debris from pockets, and removing fibrous proliferation surgically.[6] Gingivectomy traditionally has been performed with a scalpel. Electrosurgical treatment is difficult, if not impossible in many cases because of the proximity of the orthodontic appliance to the involved tissue. A cardinal contraindication of electrosurgical treatment is proximity to metal, because metal conducts electrosurgical current and can cause irreversible destruction and extreme pain. Goldman and Cohen warned against use of electrosurgery near metal, because metal that touches the electrode becomes an electrode, and can cause pulp death.[7] Rosenstiel et al. warned that the electrode must not touch metal because contact with metal for as little as 0.4 seconds has been shown to cause irreversible pulpal damage in dogs.[9] Grant et al.,[10] and Ramfjord and Ash also advised

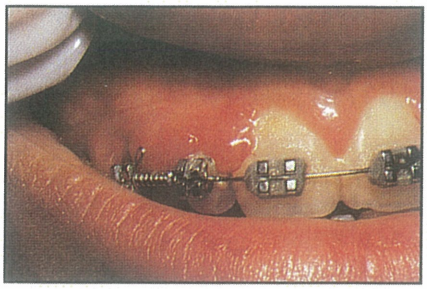

Fig. 1. The patient's home-care oral hygiene routine was poor (Case No. 1).

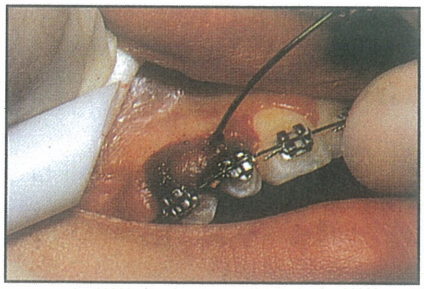

Fig. 2. Hemostasis and the view of the surgical field were excellent (Case No. 1).

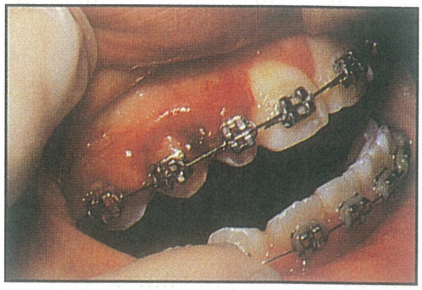

Fig. 3. Immediately after surgery, normal gingival architecture appeared under clotted blood (Case No. 1).

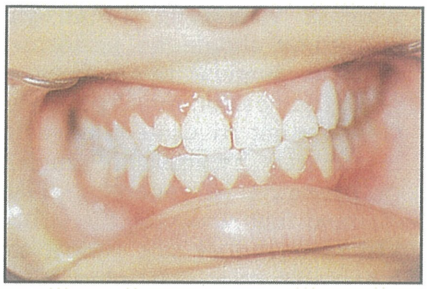

Fig. 4. Slight gingival inflammation was ascribed to a relapse in the patient's oral home care (Case No. 1).

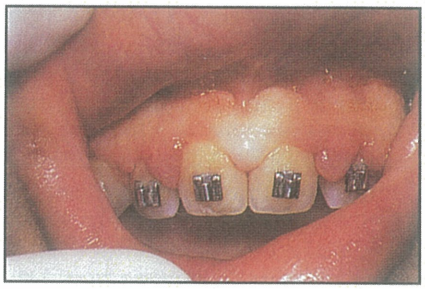

Fig. 5. The patient had hyperplastic gingiva in the anterior maxillary and mandibular regions, secondary to placement of full-mouth, banded orthodontic appliances (Case No. 2).

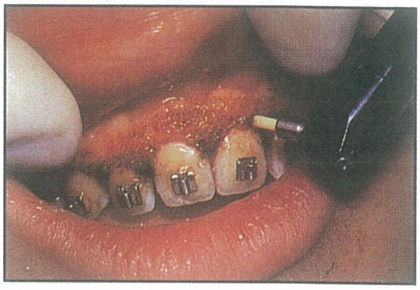

Fig. 6. A 20 W continuous wave CO_2 laser was used to ablate the hypertrophied tissue (Case No. 2).

against using electrosurgery for gingivectomy.[11]

As an alternative to using a scalpel or electrosurgery, carbon dioxide (CO_2) and neodymium:yttrium aluminum garnet (Nd:YAG) lasers can be used to treat gingival hyperplasia in orthodontic patients. Use of lasers for such treatment has the following advantages:

(1) superior hemostasis, which leads to better visualization of the surgical field;

(2) less postoperative discomfort, which decreases or eliminates the need for postoperative medication;

(3) better acceptance by patients; and

(4) superior esthetic results (gingival architecture), owing to the laser's ability to remove tissue in microscopically thin layers, allowing the surgeon better precision in sculpting the gingival tissue.

Lasers have been used for gingivectomy/gingivoplasty for some time. Pick et al. used a CO_2 laser to remove Dilantin (phenytoin)-induced hyperplasia in 12 patients.[12] They reported that blood loss was less than 5 ml, which compares favorably with blood loss from a blade. None of the 12 patients had hemorrhaging or postoperative problems. There was no damage to surrounding hard or soft tissue. Tissue healing was unremarkable, and postoperative discomfort was described as "very little."

Hylton described a CO_2 laser gingivectomy technique in a patient with Sturge-Weber syndrome.[13] Hylton noted greater precision than with an electrosurgical unit, with good hemorrhage control. Two weeks postoperatively, he noted that healing and epithelialization appeared to be well advanced. White et al. described using a free-running Nd:YAG laser for 70 soft-tissue surgical procedures, including gingivectomy and gingivoplasty.[14] They noted less bleeding than in comparative scalpel procedures, little need for anesthesia, and no discernible effects to the soft tissue, adjacent teeth, or bone. Other benefits of laser surgery discussed by the above authors include decreased posttreatment bacteremia at the surgical site, greatly decreased postoperative pain, less need for analgesics, and better acceptance of the procedure among patients.

The difference between gingival hyperplasia and gingival hypertrophy merits a brief discussion at this point. Gingival hypertrophy denotes an increase in the size of the cells within the tissue. The hallmark of gingival hypertrophy is edema. Gingival hypertrophy generally can be treated with thorough scaling and root planing.

Fig. 7. An immediately postoperative view: the patient did not require postoperative instructions or medications (Case No. 2).

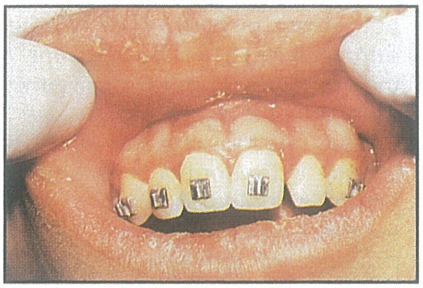

Fig. 8. The maxillary anterior tissue appeared to be normal 1 week postoperatively (Case No. 2).

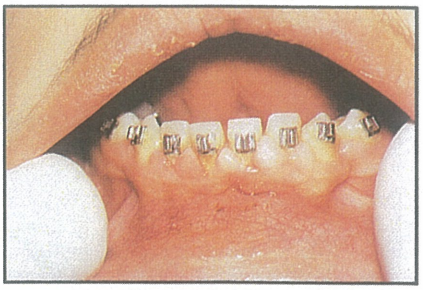

Fig. 9. In an infiltration technique 2 weeks postoperatively, 2 cartridges of lidocaine with epinephrine 1:100,000 were administered to the mandibular anterior gingiva (Case No 2).

Fig. 10. The same laser technique (described for Fig. 6) was used to remove the tissue in the mandibular arch (Case No. 2).

Fig. 11. The maxillary tissue appeared normal 3 weeks postoperatively. The mandibular tissue was healing uneventfully 1 week postoperatively (Case No. 2).

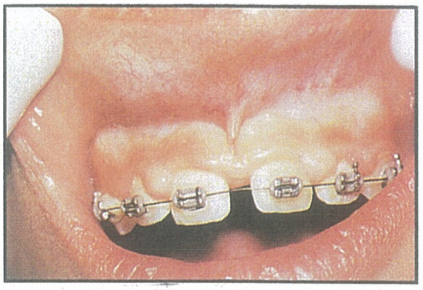

Fig. 12. At the surgical appointment, the patient's gingival tissue tone was better, with a fibrotic appearance (Case No. 3).

Following this initial therapy, the edema usually resolves, and the tissue shrinks to a healthier level. Surgery usually is not indicated in treatment of hypertrophy because violation of the biological width may result.

Gingival hyperplasia denotes an increase in the number of cells. The tissue is fibrotic, rather than edematous. Scaling and root planing does not decrease the number of cells. Surgical intervention is indicated routinely for reducing hyperplastic tissue. Invasion of the biological width is not a problem as long as the attachment apparatus is not violated, which would cause a tissue rebound.

In all three cases presented here, the primary diagnosis was gingival hyperplasia secondary to orthodontic therapy. Due to the patients' lack of adequate oral hygiene, there was concomitant gingival hypertrophy. In all three cases, it should be noted that the hypertrophy was treated first with scaling, root planing, and oral hygiene procedures. After this treatment, the authors intervened surgically to treat the hyperplasia. An average of two weeks (an arbitrary period due to the patients' and doctors' schedules) passed between the completion of initial therapy and excision.

Case reports

Case report No. 1—A 12-year-old girl, with full-banded orthodontic appliances on both arches, sought examination and prophylaxis at the behest of her orthodontist. The medical history was noncontributory. The soft tissue of the maxillary arch was inflamed, hyperemic, and friable. The tissue, which had hypertrophied to the extent that part of the orthodontic appliance was covered by inflamed gingiva, bled easily upon probing. It appeared that the patient's home-care oral hygiene routine was poor. After thorough scaling, root planing, and prophylaxis were performed, detailed home-care instruction was given. Two weeks later, it was noted that home care procedures had improved considerably, but the gingival condition had not changed.

Gingivectomy was recommended. Three methods—by electrosurgery, scalpel, and laser—were discussed with the patient and her family. Electrosurgery was contraindicated because of the proximity of the orthodontic appliance to the gingiva. Scalpel surgery was contraindicated due to the hyperemia. Tibbets stated unequivocally that gingivectomy by scalpel is contraindicated in case of hyperemic, edematous tissue.[15] It was believed that adequate hemostasis would be too difficult to obtain to perform the procedure properly. Laser gingivectomy was indicated because the laser, as it incises or excises tissue, cauterizes and induces coagulation. Pick advocates laser gingivectomy due to the laser's ability to cauterize and coagulate blood vessels as large as 0.5 mm in diameter.[12] It was believed that laser surgery would be

Fig. 13. The tissue was ablated slowly around the gingival third of the maxillary anterior teeth until normal gingival architecture was reestablished (Case No. 3).

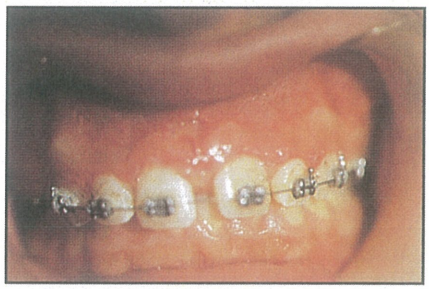

Fig. 14. The maxillary tissue appeared healthy 5 days postoperatively (Case No. 3).

a neater, cleaner procedure. The view of the surgical field should be better during laser surgery than during scalpel surgery because of the laser's hemostatic property.

Informed consent for laser gingivectomy was obtained from the family. By an infiltration technique, 2 cartridges of lidocaine with epinephrine 1:100,000 were administered to the maxillary anterior surgical site. A free-running Nd:YAG laser (DLase 300, American Dental Technologies, Troy, MI), at a setting of 2.5 W of average power, delivered 20 pulses/second through a 320 µm fiberoptic handpiece. The tissue was excised thoroughly. During excision, the tissue bled slightly, then coagulated immediately. Hemostasis and the view of the surgical field were excellent (Fig. 2).

Immediately after surgery, normal gingival architecture appeared under clotted blood (Fig. 3). No periodontal dressing nor packing was required, and sutures were not needed. The patient was not given postoperative medication nor instructions, except to maintain her home-care regimen, then she was dismissed.

Two weeks postoperatively, after the orthodontist removed the patient's appliance, gingival architecture appeared normal, with no evidence of gingival hyperplasia. Slight gingival inflammation was ascribed to a relapse in the patient's oral home care (Fig. 4). The patient said that she had no postoperative discomfort, and that no medications were needed. Both patient and parent were pleased with the result.

Case report No. 2—A 14-year-old boy had hyperplastic gingiva in the anterior maxillary and mandibular regions, secondary to placement of full-mouth, banded orthodontic appliances (Fig. 5). The patient was a mouth-breather, which contributes to gingival hyperplasia. McDonald and Avery describe mouth-breathing adolescents who develop chronic hyperplastic gingivitis, often in the maxillary arch.[16] Goldman and Cohen report that as a result of mouth-breathing, the maxillary anterior segment desiccates, which leads to inflammatory disease.[7] After thorough scaling, root planing, and prophylaxis, the patient was scheduled for laser gingivectomy. In an infiltration technique, 2 cartridges of lidocaine with epinephrine 1:100,000 were administered to the maxillary anterior region. A 20 W continuous wave CO_2 laser (LX-20, Luxar Corp., Bothell, WA), at a setting of 4 W of continuous power delivered through an 800 µm ceramic tip, was used to ablate the hypertrophied tissue (Fig. 6). The patient was dismissed without postoperative in-structions nor medications (Fig. 7).

The maxillary anterior tissue appeared normal 1 week postoperatively (Fig. 8); 2 weeks postoperatively, 2 cartridges of lidocaine with epinephrine 1:100,000 were administered in an infiltration technique to the mandibular anterior gingiva (Fig. 9). The same laser technique was used to remove the tissue in the mandibular arch (Fig. 10). One week later (three weeks postoperatively for the maxillary arch), the maxillary tissue appeared normal. The mandibular tissue was healing uneventfully (Fig. 11). The patient never needed pain medications and was pleased with the result.

Case report No. 3—In a 14-year-old boy (a mouth-breather) with marked gingival hyperplasia secondary to full-mouth orthodontic brackets and arch wires, tissue tone was edematous, with bleeding during gentle probing. The hyperplastic tissue covered the gingival third of the patient's maxillary anterior teeth. The rest of the dental examination and the medical history were not significant. The patient was noncommunicative and withdrawn. The patient's mother suggested that his behavior resulted from his self-consciousness about his "gummy" smile and short teeth.

Laser gingivectomy was suggested. Informed consent was obtained from the patient's mother. Oral hygiene instructions were given, and chlorhexidine gluconate (Peridex, Procter & Gamble, Cincinnati) rinses, b.i.d. for 1 week before surgery, were prescribed.

At the surgical appointment, tissue tone was better, with a fibrotic appearance (Fig. 12). In an infiltration technique, 2 cartridges of lidocaine with epinephrine 1:100,000 were administered to the maxillary anterior sextant. A 20 W continuous wave CO_2 laser (LX-20, Luxar Corp.) was used at a setting of 4 W of continuous power, delivered through an 800 µm ceramic tip. The tissue was ablated slowly around the gingival third of the maxillary anterior teeth until normal gingival architecture was reestablished (Fig. 13). A maxillary anterior frenectomy was performed simultaneously, owing to a diastema between the maxillary central incisors. The frenum pull was excessive. No postoperative precautions nor medications were given, and the patient was dismissed.

By day 5 postoperatively, the patient and his mother were pleased with the result (Fig. 14). The patient's appearance had improved greatly, and he was more communicative and social. Healing was uneventful. No pain medications were needed. The patient was enthusiastic, and expressed the desire to make a career of laser science.

Summary

In the three case reports presented, gingival hyperplasia resulting from orthodontic treatment was treated with laser gingivectomy. The patients experienced no pain during or after the procedure, and no medications were needed. Blood loss was negligible during the procedures, and healing was uneventful. Laser gingivectomy compares favorably to conventional techniques (i.e., scalpel surgery or electrosurgery).

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