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Lasers in pediatric dentistry

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Treating infants and young children is a rewarding experience, especially when we guide parents and children down the path of prevention and interception of oral disease. The American Academy of Pediatric Dentistry recommends that a child's first visit to the dentist occur no later than 6 months after the first teeth erupt, or around a child's first birthday [1]. During the initial visit, the pediatric dentist can assess medical histories, educate parents on healthy oral practices (eg, brushing, flossing, diet, oral habits, and fluoride), evaluate a child's risk of developing oral problems, and, when appropriate, determine necessary preventive or interceptive actions. Oral examinations by 1 year of age allow for earlier recognition and treatment of soft-tissue pathologies and anomalies, such as tongue-ties, that appear at birth.

For over 50 years, communities in the United States have been fluoridated, resulting in a significant reduction in dental caries [2]. As a result, pediatric dentistry has evolved into conservative treatment of incipient caries; moreover, sealants, preventive resin restorations, and tooth-colored composites represent a significant portion of the pediatric dental practice. This article discusses the use of lasers for conservative treatment of hard and soft tissues of the oral cavity.

Historical look at children's dental care

The "old school" of dental and pediatric medical knowledge recommended that children visit the dentist initially at 3 to 5 years of age or when they would be most cooperative. This notion prevented the dentist from intercepting repairable oral problems and, at times, resulted in the unnecessary loss of carious teeth [3]. Early tooth loss caused by decay can result in failure to thrive, impaired speech development, absence from and inability to concentrate in school, and reduced self-esteem [3]. Current

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thinking states that preventive dental care for children must begin earlier, must go beyond traditional caries management, and must incorporate developmental milestones and functional considerations so that their individual risk for oral conditions is addressed [4]. Guidance of the eruption and development of the primary and permanent dentition is an integral part of treating children and contributes to the development of a permanent dentition that is a harmonious, functional, and esthetically acceptable occlusion. Soft-tissue procedures that once were rejected because they necessitated general anesthesia can be safely and quickly treated with lasers in the dental office. Clinical experience indicates that restorative treatment in most children can be accomplished with little or no local anesthetic agents and their associated concerns, such as lip or tongue biting, which often occur when the child is numb [5,6]. Postoperative problems, such as dehydration when a child refuses adequate fluid intake after treatment, can be avoided.

Two early attempts at removing dental caries without the drill and local anesthetic agents failed primarily due to cost, materials, or equipment. Although used in the 1950s, large air-abrasion units such as the Airdent (S.S. White, formerly of Staten Island, New York) and a chemo-mechanical device called Caridex, developed at Tufts University, failed to gain acceptance in the mid-1980s [7]. Air abrasion resurfaced again in the early 1990s and did well initially as a bridge between the conventional high-speed handpiece and US Food and Drug Administration (FDA) clearance of an erbium:YAG laser.

Laser technology allows the dentist to perform microdentistry, removing only diseased dental tissue and preserving the remaining healthy tooth structure. Dental disease can be diagnosed early by using digital dental radiography, laser-assisted diagnosis of dental decay, or magnification such as dental loupes or a dental operating microscope.

Lasers for pediatric patients

Many different lasers are useful in pediatric dentistry. There are lasers for diagnosing dental disease such as the Diagnodent (Kavo, Lake Zurich, Illinois) [8]. This laser analyzes the emitted fluorescence on the tooth's occlusal surface, which correlates with the degree of demineralization in the tooth, and, when quantified, indicates the relative amount of caries present. Argon lasers are available for curing composite restorations and soft-tissue surgical procedures [9]. CO_2 lasers are used for surgical treatment of large soft-tissue lesions where coagulation, vaporization, and precision in tissue cutting is required [10], but due to potential patient movement and cooperation is not the author's laser of choice for treatment of children. Instruments such as the pulsed Nd:YAG at 1064 nm and the continuous wave or gated pulsed diode work at wave lengths that cut soft tissue but are not effective on hard tissues. These lasers are good for treatments involving pigmented soft tissue and are absorbed by hemoglobin in blood and therefore are effective hemostatic devices [11].

With the development and introduction of the erbium family of lasers, the pediatric dentist has a safe and efficient laser to treat hard and soft tissue of the oral cavity. The erbium laser's shallow depth of tissue penetration, high affinity for water, lack of thermal damage, and minimal reflective property make it ideal laser for pediatric dentistry. There are two wavelengths, Er,Cr:YSGG at 2790 nm and Er:YAG at 2940 nm, that are similarly effective in treating soft-tissue and hard-tissue lesions [12,13].

Hard-tissue procedures are performed in noncontact using water spray on the tissue. The water spray may or may not be used for soft-tissue surgery; most treatments are in both noncontact and contact with the tissue. Aphthous ulcers and herpetic lesions are always noncontact. The benefits of treating patients with the erbium family of lasers include the bactericidal effects [14], which can sterilize the area, and the numbing or analgesic effect on the target tissues, similar to the Nd:YAG devices [15,16].

Lasers are more precise and show less thermal necrosis of adjacent tissue than electrosurgical devices. Fig. 1A shows a histologic study comparing soft-tissue incisions in vitro performed with an erbium:YAG laser in contact and noncontact mode to an electrosurgical knife. At 3 days, the healing is remarkably different (Fig. 1B).

This article focuses on the rationale for treatment of procedures using lasers [17] on infants and children. Clinical experience has shown there are many benefits to treating children with lasers over conventional methods: reduction in chair time for similar restorative procedures; elimination of the high-speed drill with its associated vibrations, smell, and fear factor; and reduction or elimination of local anesthetics, suturing, pain medication, and antibiotics [18,19].

Laser soft-tissue treatments

Diagnosis and rationale for treatment of ankyloglossia

There is no consensus, nor are there many current studies or recommendations on what constitutes abnormal lingual attachments, which can lead to the diagnosis and treatment of ankyloglossia [20]. Traditional teaching has been that the tongue-tie is of little relevance, has no adverse sequelae, and can be ignored. The reality is that a tongue-tie, by interfering with tongue mobility, can exert a harmful effect on many facets of life [21,22]. Ankyloglossia is a relatively common finding in the newborn population and represents a significant proportion of breast-feeding problems. Ankyloglossia can be diagnosed in 3.2% of pediatric patients. The abnormal attachment of the lingual frenum is one of the most misdiagnosed

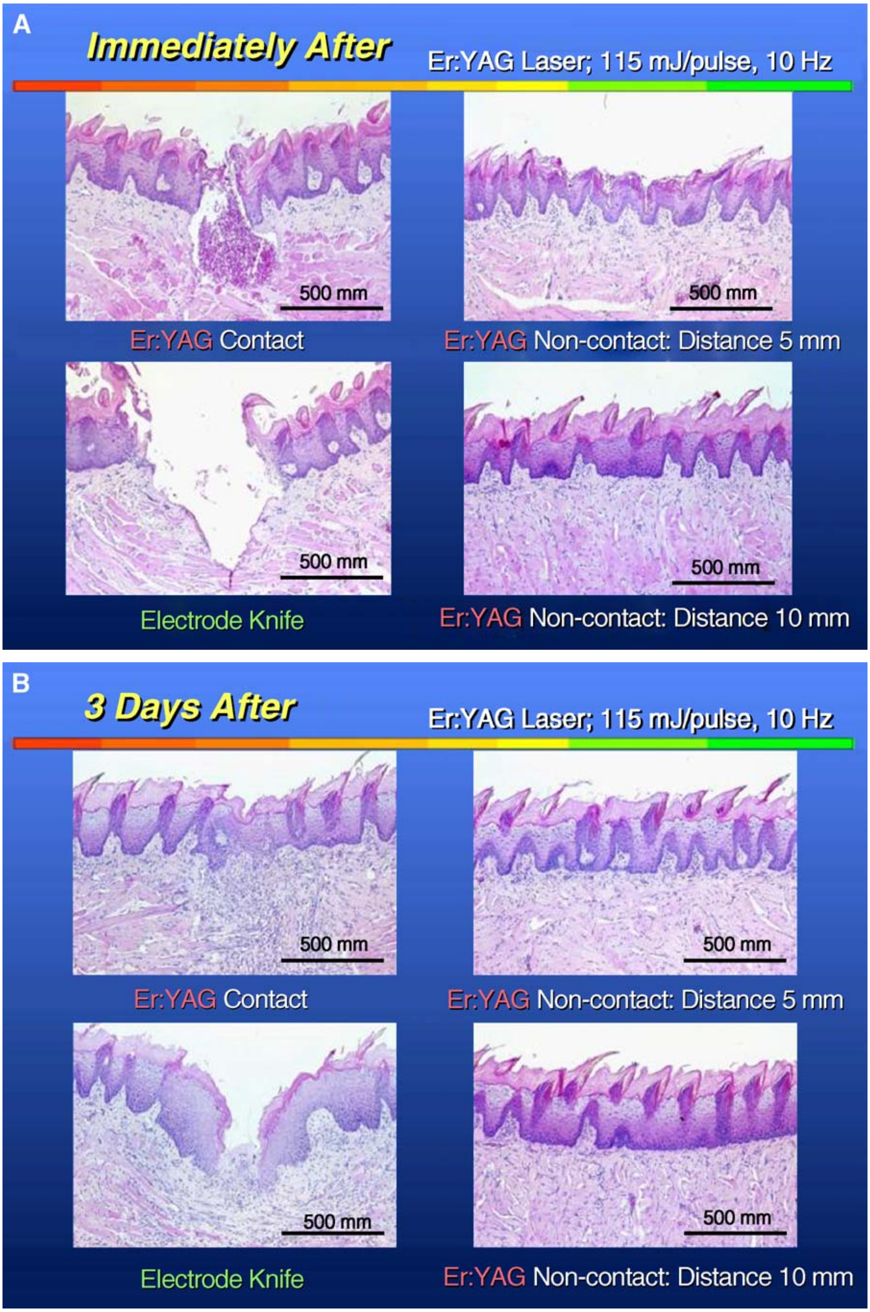

Fig. 1. (*A*) Comparison healing using an erbium laser and an electrosurgical device. (*B*) Note the difference in healing over a 3-day period. (Courtesy of Dr. A. Aoki, Tokyo, Japan.)

Fig. 2. Infant before treatment.

and overlooked congenital abnormalities observed in children. The author has examined over 350 children and has developed a list of diagnostic criteria that can be useful in treating and evaluating the lingual frenum [20]. When determining the need to revise the frenum in infants and children, the following guidelines are suggested:

- The lingual attachment should not create a diastema (gap) between the lower front teeth.
- The lingual attachment should not cause excessive force on the lower front teeth causing them to tip backward.
- The lingual attachment should not cause severe blanching of the gum tissue behind the lower front teeth abrasion to the underside of the tongue.
- The lingual attachment should not prevent a normal swallowing pattern. The tongue should be able to lick the lips, touch the roof of

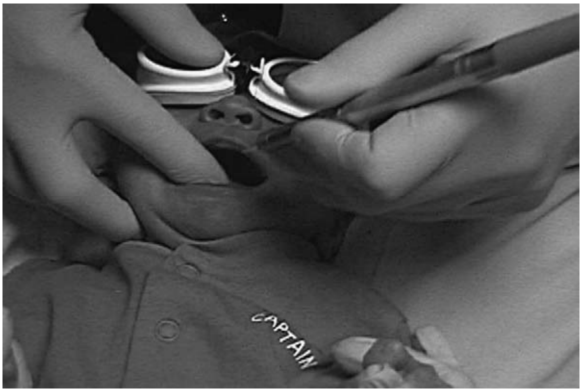

Fig. 3. Goggles in place; laser treatment begins.

Fig. 4. Pre-operative view.

the mouth, and allow for normal cleansing of the tooth surfaces. Eating and speech should not be affected.

Treatment of a tongue-tie revision in neonates with lasers does not require sedation or local anesthetic (Fig. 2). Laser settings are Er:YAG 30 hz, 50 mj, no water; Er,Cr:YSGG 20 hz,1 watt, no water. Small safety goggles are used for eye protection (Fig. 3). In most cases, 8 mm of freedom is adequate to allow for normal nursing, although additional revision may be required in the future. After treatment is completed, children can begin nursing, and nursing mothers report immediate relief of pain, extended nursing intervals, and improved infant sleep duration (Figs. 4 and 5).

Based on the distance of the insertion of the lingual frenum to the tip of the tongue, the clinician could classify tongue-ties thus: class I (12–16 mm, mild), class II (8–12 mm, moderate), class III (4–8 mm, severe), and class IV (0–4 mm, complete). Fig. 6 shows the normal movement of the tongue, and Fig. 7 shows a complete restriction.

Fig. 5. Treatment complete, tongue released.

Fig. 6. Normal tongue movement.

Older children and adults are prepared in the usual manner using a local anesthesia of operator choice and no water spray: Er:YAG 30 hz and 50 mj; Er,Cr:YSGG 20 hz, 50 mj. The tongue is stabilized with a hemostat (Fig. 8) or W. Lorenz holder (Fig. 9), and the frenum is revised. If the frenum is fibrous, it can be cut by grasping the tip of the tongue for stabilization. If the frenum is more closely attached, the hemostat is placed close to the underside of the tongue, and the laser tip is moved slowly down the hemostat until the revision is completed. It is important to avoid the glands on the floor of the mouth. A suture can be placed at the junction of the frenum and end of the cut to prevent reattachment (Fig. 10). Healing progresses uneventfully (Fig. 11). Revising the tongue may assist in correcting many speech abnormalities.

Diagnosis and treatment of the maxillary frenum in infants and in the mixed dentition

Infant oral examinations may disclose a maxillary frenum attachment inserting into the alveolar ridge and, in severe cases, may extend between the central incisors inserting into the palate. The frenum may contribute to the

Fig. 7. Complete restriction of movement.

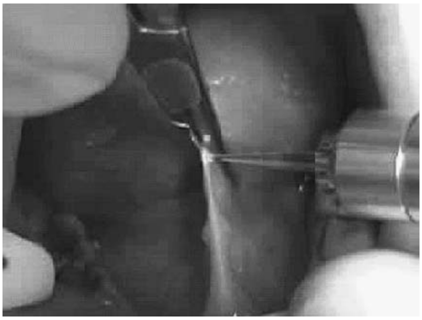

Fig. 8. Tongue grasped with hemostat. Laser excision begins.

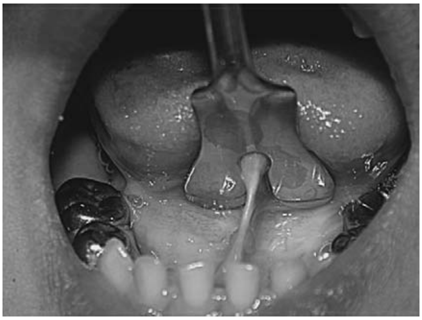

Fig. 9. Lorenz instrument used for stabilization.

Fig. 10. Suture placed.

development of a diastema between the central incisors and may cause the lip to get caught between the central incisors, cause the failure of traumatic injuries to the area to heal, and interfere with adequate oral hygiene. In the newborn, a tight maxillary frenum may interfere with proper latching to the breast and create difficulty with breast-feeding [22]. These problems could be diagnosed and corrected with little discomfort to the infant or young child in the dental office. The following are classifications the author has developed for evaluating maxillary frenum attachments that can aid in determining

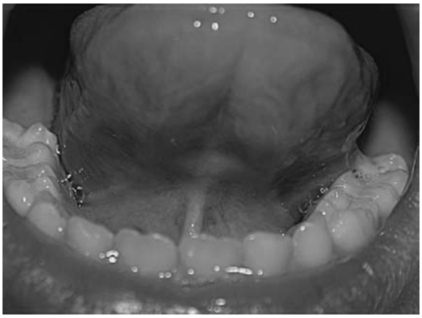

Fig. 11. Example of 1-week healing.

Fig. 12. Normal.

Fig. 13. Insertion above teeth.

when revision may be of benefit for the child. Figs. 12 through 15 show the differences of the insertions of the anterior muscle attachment, from a normal position (Fig. 12) to the attachment on the palatal tissue (Fig. 15).

The author suggests that optimal results occur when this procedure is completed between 8 and 18 months of age. In infants, no sedation is usually required. The patient is prepared in the usual manner with appropriate laser

Fig. 14. Insertion between teeth.

Fig. 15. Insertion on palate.

Fig. 16. Initial incision.

safety glasses, and a small amount of a local anesthetic is placed into the frenum area. The lasers settings are the same for ankyloglossia: Er:YAG 30 hz, 50 mj; Er,Cr:YSGG 20 hz, 50 mj, both with no water. The laser energy is directed at the insertion of the frenum and the area between the two front teeth (Fig. 16). Sutures are not required. The postoperative course is usually uneventful, frequently requiring no more than one dose of nonprescription pain medication such as ibuprofen (Figs. 17 and 18).

Fig. 17. Twenty-four hours postoperative.

In the mixed dentition, in addition to soft tissue-revision, the procedure may require the lasing of bone between the two maxillary central incisors. In that case, the erbium lasers are an ideal choice of instrument, and a water spray must be used. In the author's experience, the optimal time to revise the frenum, if it is not done in the early primary dentition, is when the two central incisors have erupted about 2 to 3 mm (Figs. 19 and 20). Afterward, the eruption of the lateral incisors assists in closing the diastema once the frenum tissue is ablated. There is no adverse scar formation from this procedure, and it can be completed before initiation of orthodontics. If the diastema is the only problem, orthodontics may not be required (Fig. 21).

Frenum areas in other areas of the mouth are treated similarly, and other wavelengths may be used. Fig. 22 shows and Nd:YAG laser (1064 nm) used with a setting of 100 hz, 20 mj, 2 watts for the ablation of the soft tissue (Fig. 23). Fig. 24 shows the 2-week postoperative healing.

Exposure of teeth for orthodontic care

A variety of wavelengths can remove soft tissue to uncover permanent teeth for orthodontic guidance, but only the erbium lasers can remove soft

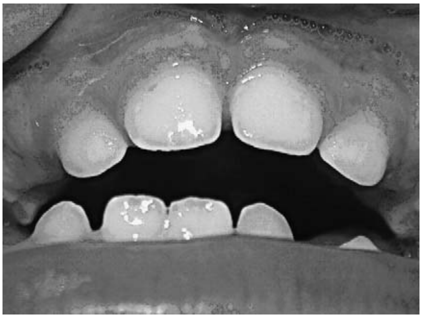

Fig. 18. Six months postoperative.

Fig. 19. Pre-operative.

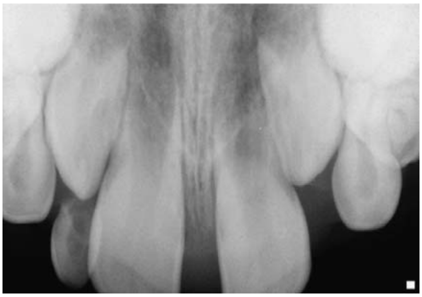

Fig. 20. Pre-operative radiograph.

Fig. 21. Six months post-operative.

tissue and bone. When only soft tissue requires removal, this procedure can often be completed without the need for local anesthesia, and a topical anesthetic, such as EMLA [23] should be applied (Fig. 25). Suggested settings are Er:YAG 30 hz, 45 mj; Er,Cr:YSGG 20 hz, 70 mj; both in contact and noncontact mode (Figs. 26 and 27). When using the erbium instruments, care must always be taken when near enamel to prevent etching; therefore, as the enamel is exposed the laser tip must be held parallel to the surface of the tooth (Fig. 28). When using the Nd:YAG or

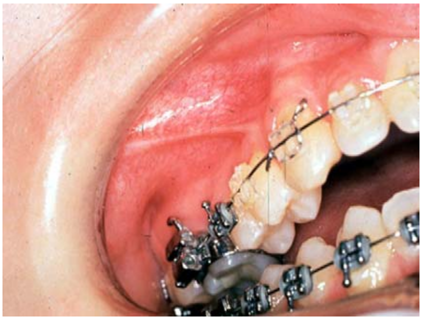

Fig. 22. Pre-operative.

Fig. 23. Laser ablation.

Fig. 24. Two-week postoperative. (Courtesy of Donald J. Coluzzi, DDS, Redwood City, CA.)

diode for this procedure, there is no danger of etching or injuring the enamel because the wavelength of these lasers does not interact with tooth structure. Figs. 29 and 30 show a similar tooth exposure using a diode (830 nm) with a setting of 1 watt, continuous wave. Fig. 31 shows the healing and band placement 10 days later.

Fig. 25. Topical anesthetic placed.

Gingival recontouring and gingivectomies in orthodontic patients; Dilantin hyperplasia and crown lengthening in caries preparations

In instances where gingival tissue has become hypertrophied due to medications such as Dilantin or instances where poor oral care occurs while the patient is wearing orthodontic appliances, the laser can be used to reshape or remove excessive tissue growth [24]. When restoring teeth where caries extend below the gingival tissue, lasers can remove the gingival tissue to allow placement of a restoration without concerns for bleeding. Most of these procedures can be completed without local anesthesia and with little or no postoperative discomfort. Different laser instruments can be used. The erbium settings are 20 to 30 hz and 55 to 80 mj, with no water spray. Fig. 32 shows typical hyperplastic tissue present during orthodontic treatment and removal with an erbium laser; Fig. 33 shows the 1-week postoperative healing. An argon laser (514 nm) may also be used with a setting of 1 watt, continuous wave for tissue removal. Figs. 34 through 39 demonstrate the use of this wavelength for the reshaping of gingival tissue.

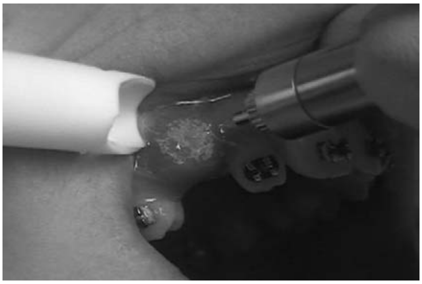

Fig. 26. Laser ablation.

Fig. 27. Tooth exposed.

Removal of lesions and biopsies

Lasers are excellent tools for removing soft-tissue lesions. All lesions removed should be sent to a pathology laboratory for diagnosis, and it is important to advise the pathologist that the tissue was excised with a laser. Lesion removal usually requires local anesthesia; however, treatments rarely require sutures. Bleeding is minimal, and there is little or no postoperative discomfort. Instruments such as argon, diode, and Nd:YAG are useful for pigmented and vascular lesions, whereas nonpigmented lesions are more effectively removed by an erbium or CO_2 laser due to those wavelength's absorption in the water of the lesions. Figs. 40 through 42 show the removal of a benign traumatic fibrous lesion on the lip using a diode at 1 watt, continuous wave. Figs. 43 through 45 show similar tissue on the tongue removed with an erbium laser in contact mode at 20 to 30 hz, 45 to 80 mj, no water.

Treatment of pericoronal problems in erupting teeth

It is not uncommon for children whose first permanent molars are erupting to develop discomfort, swelling, or infection in the tissue overlying the emerging tooth; teens and adults often experience this with other teeth.

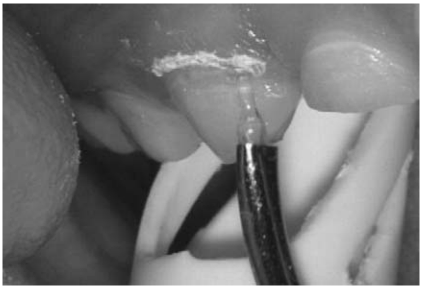

Fig. 28. Correct erbium laser placement, parallel to the tooth surface.

Fig. 29. Pre-operative.

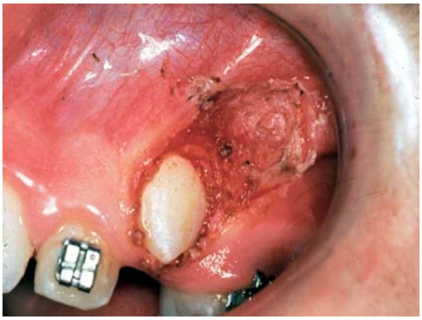

Fig. 30. Diode laser ablation complete.

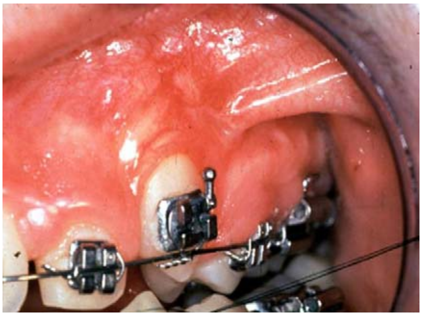

Fig. 31. Ten days postoperative. (Courtesy Donald J. Coluzzi, DDS, Redwood City, CA.)

Lasers can be used in a noncontact mode to ablate the involved tissue and expose the clinical crown of the involved tooth. In most instances the treatment with the laser can be completed without the use of local anesthesia. Erbium settings are 20–30 hz and 45 to 55 mj in a noncontact mode with no water (Fig. 46).

Fig. 32. Pre-operative.

Fig. 33. One week postoperative.

Fig. 34. Pre-operative with topical anesthetic.

Treatment of aphthous ulcers and herpetic lesions

One of the easiest and most appreciated procedures using lasers is treatment of single isolated aphthous ulcers or recurrent aphthous stomatitis [25,26]. The treatment involves low power settings, and the laser energy is directed at the target tissue in a noncontact fashion. A diode instrument is set at 0.4 watts, continuous; Nd:YAG is used at 20 hz, 50 mj; and erbium

Fig. 35. Argon laser beginning ablation.

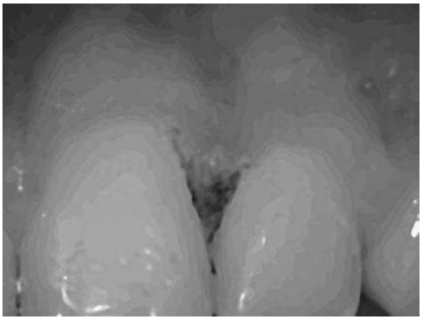

Fig. 36. Immediately postoperative.

Fig. 37. Pre-operative.

lasers are used at minimum hz with 30 to 40 mj. The involved area is lased in 15- to 30-second intervals, no local anesthesia is used, and the procedure is repeated three or four times until the patient reports relief. The tissue may appear drier at the end of the treatment, without much change in color. It is important to make sure everyone has glasses, masks, and barriers and that high-speed suction is in use because the vaporized plume may contain

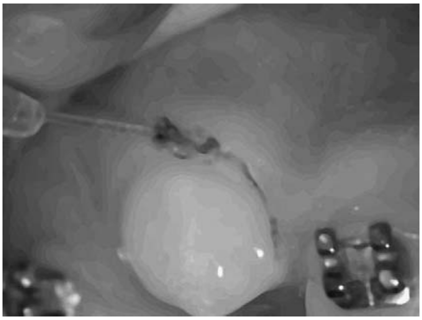

Fig. 38. Argon laser beginning ablation.

infective tissue fragments. In most cases, one office treatment ablates the lesion, and the patient experiences immediate comfort. In herpes labialis, using the laser when the prodromal signs first appear has a palliative effect on the area and may prevent the development of a full herpes lesion from developing. Fig. 47 demonstrates the use of an erbium laser in noncontact treatment.

Pulp therapy in primary teeth

Conventional materials for the treatment of pulps in primary teeth involve the use of mummifying materials such as formocresol or using electrosurgery to clean the pulp chamber. Studies have shown that laser instruments can produce favorable results [27,28]. The author has treated more than 150 primary teeth over 2 years using the erbium laser with results equal to or better than with conventional formocresol. In vital teeth, the laser set at 20 to 30 hz, 50 to 70 mj cleans the pulp chamber in 10 to 20 seconds. The laser seems to provide adequate hemostasis and allows some

Fig. 39. Immediately postoperative (Courtesy of Glenn van As, DMD, North Vancouver, British Columbia.)

Fig. 40. Pre-operative.

vital tissue to remain at the apex. In nonvital teeth, the laser's success rates seem equal to conventional pulpotomy procedures. If a fistula is present, the same settings are used to incise it, but the success rate falls significantly. In a pilot study at the University of Texas at San Antonio, unpublished data seems to substantiate the author's conclusions [29]. Two cases are shown: Fig. 48 is a 7-month post-treatment radiograph, and Fig. 49 is an 18-month postoperative radiograph; both show successful laser pulp therapy.

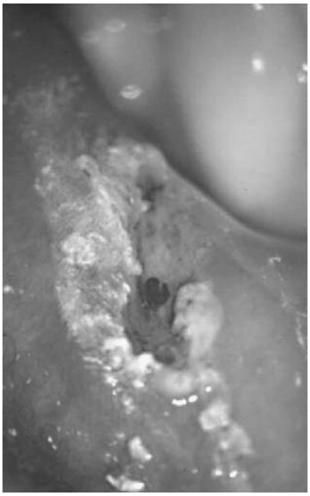

Fig. 41. Diode laser ablation complete.

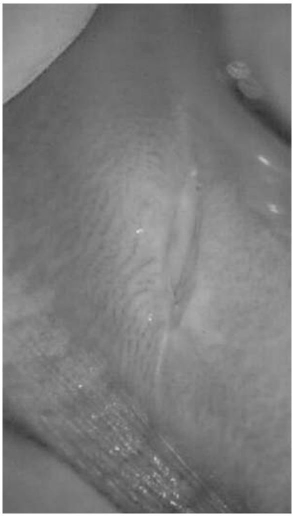

Fig. 42. One week postoperative. (Courtesy of Glenn vanAs, DMD, North Vancouver, British Columbia.)

Hard-tissue interaction

The effectiveness of using a laser for the removal of caries is safe and well documented in the dental literature. The Nd:YAG laser [30] is indicated for use in superficial pigmented caries removal; however, the erbium family of lasers are the lasers of choice and most efficient for deep enamel, dentin, and caries removal [31–36].

Lasers prevent the micro-fractures seen with conventional drills and in most instances do not require local anesthesia to prepare the teeth for restorations [37]. When using erbium lasers to remove dental caries,

Fig. 43. Preoperative.

Fig. 44. Immediately postoperative.

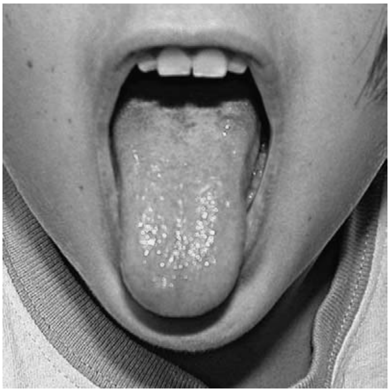

Fig. 45. Six days postoperative.

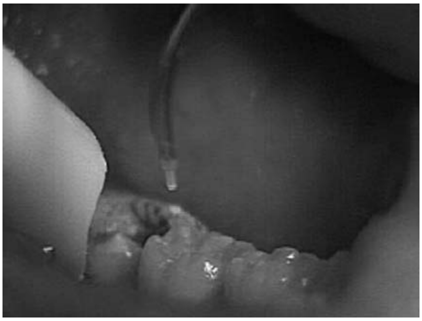

Fig. 46. Erbium laser ablation beginning in noncontact mode.

Fig. 47. Erbium laser in noncontact mode.

successful patient comfort depends on many operator variables and on the patient's experiences with previous dental treatment. The most important principle is to use the lowest setting possible to complete the treatment—more power does not mean better treatment. The laser's ability to remove hard tissue depends on such factors as the water and fluoride content of the target tissue; the laser settings, including energy, pulses per second, and water spray pattern; the tip material, shape, and diameter; and the proper suctioning technique to remove the water and ablated particles.

In keeping with recommended infection control and Occupational Safety and Health Administration (OSHA) requirements, isolation of the quadrants being treated can be accomplished by placing a #3 or #7 winged rubber dam clamp gently on the gingival tissue. A small amount of topical maybe used. Because the clamp is not placed subgingivally, the patient usually does not require local anesthesia (Fig. 50). Another method of isolation is a soft mouth prop with built-in suction and fiber optic lighting (Isolite, Santa Barbara, California) that allows treatment of the upper and lower arches simultaneously (Figs. 51 and 52).

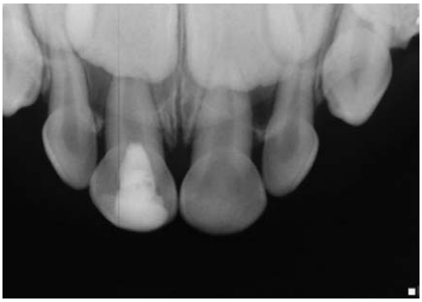

Fig. 48. Seven months post-treatment.

Fig. 49. Eighteen months post-treatment.

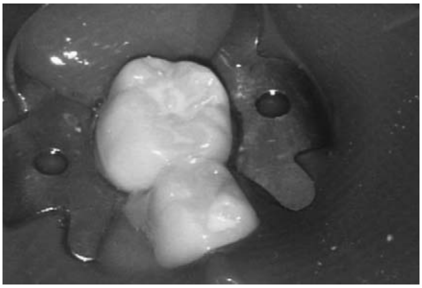

Fig. 50. Clamp and nonlatex dam placed.

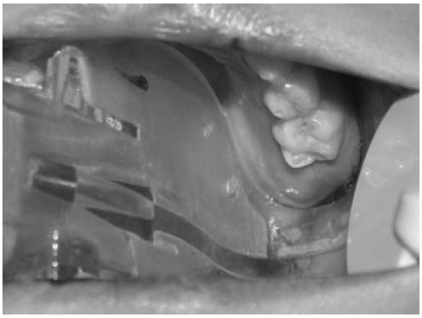

Fig. 51. Isolation of upper quadrant.

Visualization of procedures

Although laser treatment can be completed by the dentist with direct vision, it may be advantageous to treat patients using magnification [38]. Dental loupes provide a fixed magnification; the dental surgical microscope

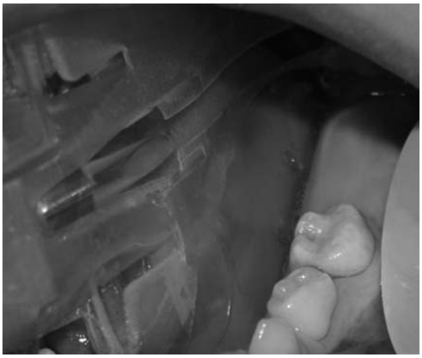

Fig. 52. Simultaneous isolation of lower quadrant.

provides variable magnification powers and better operating posture. Magnification allows the dentist to see precisely what the laser is ablating. In the author's experience, children adjust well to the microscope (Fig. 53), sit still, and have no aversion to its use [39].

Removal of amalgam and other direct restorations

It is not recommended that any laser be used for the direct removal of failing amalgam restorations. If caries ablation requires removal of an existing amalgam, the laser tip should be directed at the surrounding enamel to produce a small trough. Hand instruments can then be used to lift out the metal, and the preparation can be completed (Figs. 54–56). Lasers can be used to remove defective composite and glass ionomer restorations.

Fig. 53. Dental operating microscope used for visualization of procedure.

Fig. 54. Laser troughing around old amalgam.

Fig. 55. Amalgam is removed with hand instrument.

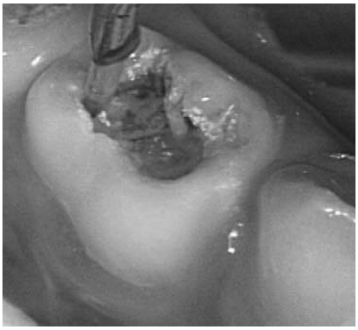

Fig. 56. Laser preparation resumes.

Sealant placement

Sealants have been available since 1955 [40], and yet their placement remains underused. Up to 70% of all molars develop occlusal surface caries within 3 years of the tooth's eruption [41].

The laser allows the dentist to clean, sterilize, and clearly visualize the enamel grooves. Furthermore, studies have shown that the erbium-etched enamel has similar properties to acid-etched enamel [42–44]. The laser requires water to remove caries and etch teeth; however, in instances where very young children may react negatively to the water spray, the practitioner may shut off the water and, using energies of approximately 30 mj, carefully etch the tooth. It is important to continuously move the laser tip around the pit and fissures to avoid injuring the tooth being etched. Fig. 57 shows teeth properly etched with the laser. Conventional sealant placement, including additional acid conditioning, can follow.

Caries removal and tooth preparation

The erbium family of lasers may be used for the treatment of any class of caries. If the tooth has a high fluoride content, surface ablation may proceed slowly because of the minimal water content. In those cases, a high-speed turbine may be used to remove the enamel. The tip of the laser should be held perpendicular to the cutting surface to maximize cutting efficiency. Once the enamel is removed, the energy settings must be reduced because dentin and caries have more water content than enamel and cut more easily. The clinician must adjust the laser parameters so that tooth structure removal proceeds conservatively, efficiently, and comfortably. The erbium family has the ability to reduce the bacterial population of the target tissue [14] and often produces an analgesic effect on that tissue [15,16]. If necessary, a slow-speed handpiece can be used to complete deep caries removal without the need for additional local anesthesia. Although the laser can often eliminate the need for conventional caries removal, there is no reason avoid a combination of conventional and laser tooth preparation if required. Typical average settings for the erbium family of lasers are total power of 6 watts for enamel removal, 4 watts for dentin preparation, and 2 watts for caries removal, all with water spray. The parameters should be

Fig. 57. Erbium laser etched enamel surfaces of deciduous molars.

Fig. 58. Pre-operative view of carious molar with failed sealant.

adjusted on each device using the manufacturer's guidelines. Fig. 58 shows a carious molar, Fig. 59 shows the caries removed, and Fig. 60 shows the final restoration. No local anesthesia was used.

When removing class II caries, the author recommends matrixing the adjacent tooth to prevent accidental etching of the enamel surface on the noncarious tooth (Figs. 61 and 62).

Combining soft- and hard-tissue treatments

There are a number of surgical procedures involving hard and soft dental tissues, such as apicoectomies and the removal of impacted teeth under bone. The erbium lasers are ideal for these surgeries, and a variety of tips, settings, and water sprays can be used [45]. Initial access may require settings of 20 to 30 hz, 50 to 60 mj, no water for soft tissue ablation, followed by the removal of underlying bone using 20 to 30 hz, 80 to 100 mj

Fig. 59. Caries removed with laser, no anesthesia used.

Fig. 60. Postoperative view showing tooth restored. (Courtesy of Glenn van As, DMD, North Vancouver, British Columbia.)

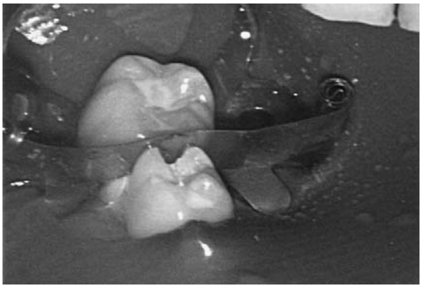

Fig. 61. Matrix inserted to protect the adjacent tooth surface.

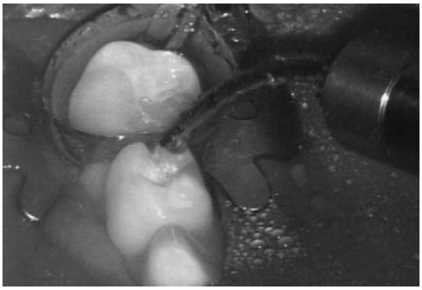

Fig. 62. After caries removal on the distal, the matrix can be removed.

with water, and then the sectioning of the impacted tooth with high power (6 watts). During surgery, the laser's water supply can be filled with sterile water. Figs. 63 through 68 show removal of an impacted lower second bicuspid using the erbium laser for each step of the procedure, except for placing sutures.

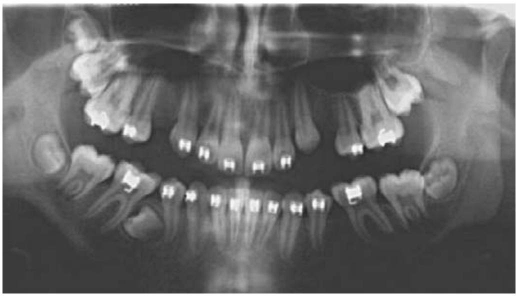

Fig. 63. Pre-operative panoramic film showing impacted lower second bicuspid.

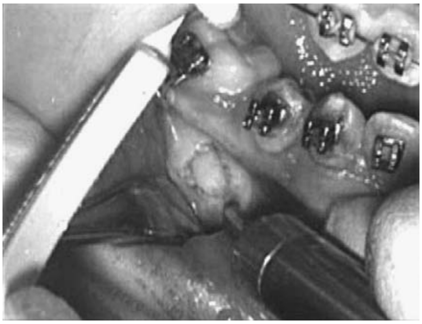

Fig. 64. Erbium laser ablating soft tissue to expose tooth.

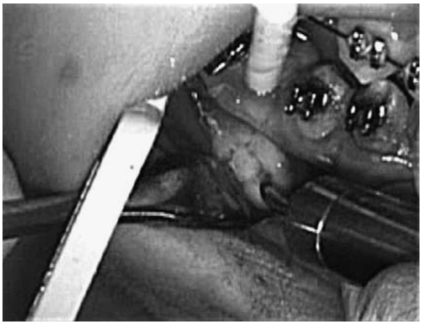

Fig. 65. After bone removal, laser used to section tooth.

Documentation of laser treatments

It is important to document in the patient's chart all treatment involving lasers after procedures are completed. Entries should include the laser used; the parameters, such as energy, pulses per second, power, time of exposure, and water spray; the tip or other accessories used; and the patient or parent's

Fig. 66. One week postoperative.

Fig. 67. Immediate postoperative radiograph.

Fig. 68. One year postoperative.

informed consent. If the operator has access to digital photography, photographs of soft-tissue treatments before and after care are recommended.

Summary

The pediatric dentist's mission is simple: provide optimal preventive, interceptive, and restorative dental care in a stress-free environment. Lasers such as the argon, diode, Nd: YAG, CO_2, and erbium have enabled dentists to reduce patient stress and fear during dental treatment. Lasers enable the dentist to provide children with minimally invasive dentistry for hard- and soft-tissue procedures with minimal discomfort, no pain during and after treatment, no injections, and little or no bleeding. Parents and children appreciate the elimination of needles, vibrations, and the smell of conventional dental care. Lasers represent a phenomenal change in dentistry, and in the future the laser may be just as commonplace as the dental handpiece in the dental office.

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