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Soft-Tissue Lasers and Procedures

A Peer-Reviewed Publication
Written by Raymond J. Voller, DMD, MAGD

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Educational Objectives

The overall goal of this article is to provide dental professionals with information on soft-tissue laser procedures. Upon completion of this course, the participant will be able to do the following:

1. List the wavelengths of the different types of dental lasers that are available
2. List the soft-tissue procedures that can be performed using a soft-tissue laser
3. List and discuss the relative advantages and disadvantages of lasers, scalpels and electrosurgery units
4. List and discuss the considerations involved in deciding whether to purchase a laser and specific attributes of lasers.

Abstract

Dental lasers are used for multiple dental procedures, including soft-tissue procedures. Soft-tissue lasers are available at varying wavelengths and powers and can be used for procedures that would otherwise be performed using a scalpel, or possibly an electrosurgical unit. Soft-tissue lasers enable safe and effective removal of soft tissue when used properly, and contribute to the efficiency and marketability of the dental office.

Introduction

Lasers for use in dentistry have been generally available for approximately two decades, with the first investigation of a dental laser having occurred more than forty years ago.^{1,2} The first laser using helium was created in 1960, and the first diode laser, which had a wavelength of 850 nm, was developed in 1962.³ Laser technology is currently routinely used in dentistry for many types of procedures, including hard-tissue procedures, soft-tissue procedures and the identification of carious lesions, as well as in relation to orthodontic therapy, periodontal and endodontic procedures.^{1,4-8} Recently, dental lasers have been investigated for the treatment of bisphosphonate-induced osteonecrosis, and research is being conducted on the influence of laser therapy on the rate of orthodontic tooth movement.^{9,10} The specific procedures that can be performed depend on the type of laser and its wavelength. The focus of this article is on the use of lasers for oral soft-tissue procedures.

Soft-tissue Dental Lasers

Soft-tissue procedures are currently performed using one of several types of FDA-cleared laser devices. The soft-tissue lasers available are carbon dioxide lasers, Nd:YAG lasers, argon lasers, H:YAG lasers, Er,Cr:YSGG lasers and diode lasers; they differ in what is used to produce the energy, the wavelength of the light emitted from the laser, and whether the energy is supplied in a continuous or pulsed manner.

The Technology Behind Lasers

The main factor involved in the absorption, scattering, reflection or transmission of the light energy emitted from a laser is its wavelength. In turn, the wavelength dictates the potential uses of specific lasers. By using an active element to excite atoms to emit photons, a very focused beam of light with a specific wavelength can be produced from the laser.¹¹ The wavelength determines the depth of penetration of the emitted light into hard or soft tissues, with shallower penetration resulting in superficial effects and deeper penetration resulting in effects throughout the area of tissue penetrated. The absorption of the light results in the production of heat, and depending on the temperature change and tissue, the end result may be superficial (such as charring) or deeper, such as vaporization or the melting of enamel and subsequent recrystallization¹² (which can also increase acid resistance).¹³ As a result of these fundamental laser physics, lasers of different wavelengths are used for different types of procedures. For soft-tissue procedures,¹⁴ carbon dioxide lasers have the highest wavelength, at around 10,600 nm, while Nd:YAG, Er:YAG and Er,Cr:YSGG lasers operate in wavelengths of 1,064 nm, 2,950 nm and 2,780 nm, respectively.¹² Diode lasers typically operate with a wavelength in the 810–980 nm range.¹⁵ The lowest-wavelength lasers used for soft-tissue procedures in dentistry are the argon lasers, with a wavelength of 457–502 nm.¹² At a wavelength of 810 nm, the diode laser gently removes targeted soft tissue without impacting neighboring tissue. Clinically, the author has found it possible to effortlessly remove undesired tissue, such as granulation tissue, precisely and accurately. At low power levels, tissue removal at very precise tolerances can be achieved, often requiring magnification to view the procedure. This type of accuracy is highly suited to sulcular troughing, in which the primary goal is to expose a margin for impressions and to achieve a functional and esthetic result.

Table 1. Soft-tissue lasers and wavelengths

Carbon dioxide lasers	10,600 nm
Er:YAG lasers	2,950 nm
Er,Cr:YSGG lasers	2,780 nm
Nd:YAG lasers	1,064 nm
Diode lasers	810-980 nm
Argon lasers	457-502 nm

Laser Soft-tissue Procedures

Soft-tissue lasers can be used for gingival contouring, leveling, troughing, gingivectomy, other periodontal procedures, exposure of unerupted teeth, operculectomy, frenectomy, treatment of oral aphthous ulcers,¹⁶ soft-tissue incision, ablation and removal of soft-tissue lesions.^{4,5,17}

Figure 1. Frenectomy



Pre-treatment



Laser treatment



One week post-treatment

Gingival troughing and contouring are two of the most common soft-tissue procedures, frequently performed using a diode laser, and esthetic treatment can be enhanced with exquisitely managed gingival contouring using the laser. Adequate exposure of crown margins is an integral part of practicing restorative, reconstructive dentistry, and in those patients who have been treated by the author using the laser for gingival troughing, there is a noticeable reduction in post-treatment inflammation compared with the use of retraction cord. Concurrently, the operator can effectively remove

granulation tissue that may be present as a result of existing improperly positioned or contoured restorations. The health of the soft-tissue matrix around naturally shaped restorations can be readily enhanced by the biocidal effect of laser energy. This antimicrobial effect is an often-overlooked positive attribute of laser therapy. Laser gingival troughing also offers excellent hemostasis, and the removal of soft tissues such as fibromas or frenulae can be easily accomplished with minimal collateral damage, again with excellent hemostasis.

Figure 2. Treatment of an oral aphthous ulcer



Pre-treatment



Laser treatment



One day post-treatment

Lasers, electrosurgery and scalpels

Soft-tissue procedures can be performed using lasers, electrosurgery units and scalpels. Each of these devices has advantages and disadvantages. Scalpels have been the traditional instrument used, and dentists all learned how to use scalpels in dental school (which is not the case for lasers or electrosurgery). However, while tactile sensation is good, control and visibility can be awkward depending on the clinical site and amount of bleeding. In addition, local (and topical) anesthesia is almost always required, scalpels have no capacity for hemostasis and, depending on the procedure, sutures or a periodontal pack will be required. Scalpels are readily available and inexpensive, and the blades or the whole unit are single-use for infection control.

Lasers and electrosurgery units have some advantages over scalpels. Both lasers and electrosurgery units offer the ability to effectively and efficiently incise or remove soft tissue (once the learning curve is completed), and they provide excellent hemostasis. Lasers and electrosurgery units use a handpiece or pen-style holder to deliver the light or heat, which – together with hemostasis – provides for good visualization of the clinical site. While there is a burning flesh odor with lasers and electrosurgery, this can be mitigated using suction and is brief.¹⁸ Postoperative pain is reported to be less using a laser compared to using a scalpel and reduced inflammation has been observed.^{19,20,21} Due to the end-cutting characteristic of the laser tip, or minimal contact of an electrosurgery tip, there is reduced tactile sensation compared to use of a scalpel.

In comparing electrosurgery units and lasers, electrosurgery units have traditionally been substantially less expensive than lasers, although the introduction of moderately priced lasers and their versatility have diminished this factor as a consideration. Electrosurgery units are safe and effective when used correctly.²² The electrodes on electrosurgery units can be curved, which can be an advantage for clinical sites with difficult access, and cutting using the sides as well as the tip of the electrode can be achieved (which, depending on the access and site, could perhaps also be seen as a disadvantage). With respect to the learning curve referenced above for electrosurgery and laser units, in the case of lasers this includes learning to safeguard the eye health of the patient and operator staff by always wearing protective glasses when laser units are in use. Failure to do so has been reported to be one of the most common factors in injuries associated with laser use.²³ Provided that laser units are well maintained and safety protocols are consistently followed, however, this potential drawback is easily overcome.

When using a laser, local anesthesia may not be required for pain control and sutures/periodontal packs may also not be required.²⁴ This is a distinct advantage for all patients, including pediatric patients. Lasers enable soft-tissue procedures to be performed on infants and young children in cases that might otherwise require a general anesthetic. In

addition, swelling, discomfort and scarring are reduced.²⁴ A recent case study reported on the use of a diode laser for an upper labial frenectomy performed in a young orthodontic patient. Only topical anesthesia was required and the procedure took five minutes, complete hemostasis was achieved, and no suturing or periodontal pack was required. The clinical site healed uneventfully and optimally over a ten-day period.²⁵ It has been found that use of lasers results in less recession following troughing than traditional methods used for margin exposure.^{26,27} Lasers also have the ability to remove endotoxins and offer antimicrobial activity.

Table 2. Scalpels, lasers and electrosurgery

Scalpels
Traditional method learned
Good tactile sensation
No heat generation
Safe around implants
Inexpensive
Disposable blades/unit
Almost always requires local anesthesia
Requires use of sutures or periodontal pack
Electrosurgery unit
Care required around implants
Excellent hemostasis
Good visibility with pen-style holder
Curved electrodes aid visibility
Efficient and effective soft-tissue removal
Lasers
Excellent hemostasis
Good visibility with pen-style holder
Efficient and effective soft-tissue removal
Safe around implants
Typically requires no/topical anesthesia
No periodontal pack or suturing is required
Reduced post-operative pain
Reduced gingival recession following margin exposure
Reduced swelling and discomfort

Soft-tissue lasers can also be safely used in the peri-implant area,²⁸ while monopolar electrosurgery units should not be used due to the risk of heat-induced damage²⁹ and bipolar units require particularly careful use at these sites. One report cited damage to an intraoral prosthesis during

use of a bipolar electrosurgery unit to remove a basal cell carcinoma on the cheek – the prosthesis had functioned intraorally as an electrode during the procedure – and the author cautioned the reader to avoid similar damage to dental implants and other prostheses during use of these devices.³⁰

Soft-tissue Laser Cases

The first case below demonstrates the use of a diode laser (NV Microlaser™, Discus Dental, LLC) for gingival troughing during restorative treatment, the second case demonstrates gingival contouring in an orthodontic patient and the third case addresses the use of the diode laser for a gingivectomy.

Case 1. Gingival troughing

The patient, a middle-aged healthy male, had received bonded composites ten years earlier to restore his anterior worn and chipped teeth. Now the patient wanted a more esthetic solution, and a treatment plan was developed that included full-coverage Empress restorations on five upper anterior teeth. After a preoperative wax-up was performed to discuss with the patient and determine the optimal form for the new crowns, an appointment was made for preparations and impressions. After the preparations were completed, gingival troughing was performed using the diode laser set at continuous wave, 1.2 Watts, to expose the margins for impression taking that would enable the laboratory to properly prepare the ideal emergence profile. Following the troughing procedure, hydrogen peroxide (Super-Oxal) on a Microbrush was used to help clean the margins prior to taking the final impressions. Use of the laser enabled gentle and conservative exposure of the margins and also provided for excellent hemostasis. Preparation shades were taken, and provisional restorations were constructed with Luxatemp using a shrink-wrap procedure then cemented in place. At the seat appointment for the permanent restorations, the gingival margins were found to be healed and healthy. The final restorations were tried in, then bonded in place. The end result was a satisfied patient.

Figure 3. Upper anterior teeth before treatment



Figure 4. Gingival troughing with diode laser



Figure 5. Use of Super-Oxal with Microbrush



Figure 6. Exposed margins following gingival troughing



Figure 7. Provisional restorations seated



Figure 8. Gingival tissue at seat appointment



Figure 9. Final bonded Empress restorations



Case 2. Removal of bunched gingival tissue interproximally

This case illustrates use of the diode laser to recontour and resect hyperplastic gingival tissues, secondary to orthodontic treatment. A young lady presented with a median diastema that she did not like and wanted to have treated and closed. On examination, it was found that in addition to the diastema there was a one-tooth-width arch discrepancy, with spacing evident primarily, but not exclusively, in the anterior dentition. After discussion with the patient, it was decided to treat this case orthodontically to close the median diastema and simultaneously create space for a third bicuspid to avoid exacerbating an existing tongue posture and constricted airway. In any orthodontic case, good oral hygiene and a healthy periodontium are essential. One of the potential problems that can be encountered during orthodontic treatment is the bunching of interproximal tissue during space closure, such that the tissue mimics gingival hyperplasia. In this particular case, the patient's oral hygiene and compliance were suboptimal, exacerbating the problem. The interproximal tissue and pseudopocket that resulted increased the retention of plaque and also made it more difficult for the patient to perform oral hygiene in that area. As orthodontic treatment progressed, the interproximal tissue bunched further together from the o-chain elastomers. As a result, gingival recontouring was indicated prior to completion of orthodontic treatment. Following the use of topical local anesthesia, the Discus diode laser, set at 1.4 Watts continuous wave, was used to make the initial incisions. The author has found that keeping the wattage low, yet high enough to cut and coagulate soft tissue, results in the least discomfort, with pain control achieved using no anesthesia or just topical anesthesia. When the "char" was created, the patient reported no discomfort. Following the desired laser "incisions" to remove the excess tissue and the creation of a balanced height-to-width ratio, the patient was then dismissed after the replacement of the orthodontic wires secured with a new elastomeric o-chain. The one-week postoperative clinical image illustrates healed, well-contoured gingival tissues, even given the difficult access for oral hygiene and the patient's suboptimal home care. A similar technique can be used to recontour gingival tissue that has discrepancies within one tooth or across several teeth, as well as to expose sufficient length of crown to place a bracket and elastomeric chains.

Figure 10. Median diastema prior to orthodontic therapy



Figure 11. Anterior view of teeth orthodontically moved mesially



Figure 12. Initial lasing of the tissues and the creation of an initial "char"



Figure 13. Gingival tissues immediately postoperatively



Figure 14. One-week postoperative view with the wire and elastomeric o-chain in place.



Notice the amount of healing that has taken place even with suboptimal oral hygiene.

Case 3. Minor gingivectomy

In this case, the patient was undergoing treatment for a porcelain inlay in an endodontically treated tooth (tooth #12). The patient lost the provisional restoration and did not return until the seat appointment, as she did not experience any pain. On examination it was found that the gingival tissue had overgrown the margins of the restoration, and a minor gingivectomy was required to expose the margins. This was easily achieved in less than one minute, together with hemostasis, using the diode laser on continuous wave. Following this, Super-Oxal was used to clean the area of any residual debris and the restoration was seated.

Figure 15. Overgrown gingival area



Figure 16. Use of the diode laser



Figure 17. Preparation margins after laser use



Figure 18. Final restoration



Considering Technology Adoption

Each time new technology is introduced, today's dental practitioner must decide whether or not to embrace it. Considerations in making this decision include the effectiveness and safety of the new technology compared to existing technology and, from a financial perspective, the return on investment. Not all new technologies live up to their promise, with the result that clinical performance may not be improved or that efficiency remains the same or decreases. Such technologies may end up being dust collectors and "stands" for other more useful technologies that actually do work in our hands, and the practitioner may have unwittingly been an early adopter for an obsolete technology. The treatment we provide using newly acquired technology should not

only work in our hands to provide improved patient care in the short term, but it must also help patients and our laboratories in the long term. Financial considerations may dictate not only whether or not to acquire technology, but also the right time to acquire it – when will the price be at a reasonable level for the investment to provide a return?

In the case of lasers, they have been proven over time to be a safe and effective technology for numerous intra-oral procedures. The initial cost of lasers following their introduction was, for most practitioners, prohibitive. Since then, newer and more versatile models have been introduced with increased applicability for the practitioner and a significantly lower acquisition cost. A further consideration in determining whether to acquire a laser is marketing and patient acceptance. New technology gives an office a state-of-the-art appearance, and for some patients this is an important factor. The author does not go through a single day of practice without hearing a patient mention how up-to-date the office appears. Patient acceptance of laser therapy has been found to be high, including in pediatric patients, with one study of pediatric patients finding that acceptance of laser treatment for hard- and soft-tissue procedures combined was 75%.³¹

Finally, if a decision is made to acquire laser technology, the practitioner must determine which procedures the laser would be used for and from there select the laser. Recently introduced lasers have smaller footprints, reducing the need for space in the dental office, and can be placed on the countertop (SoftLase Pro[®], Discus Dental, LLC; Odyssey[®] Navigator[™], Ivoclar). Truly portable wireless lasers in the form of a pen have also recently been introduced (NV Microlaser[™], Discus Dental, LLC). LED readouts are also used, and a further consideration here is versatility for use with both left- and right-handed operators. Wireless technology also seems to help sell in today's market, and practitioners are already accustomed to using foot pedals. This feature eliminates one more item that can clutter the dental operatory. Considerations in the final choice include cost, size of the unit, versatility, ease of use and support from the manufacturer.

Summary

Careful consideration must be given to the decision as to whether or not to incorporate a laser, and to the benefits of specific lasers and their place in your practice. The use of lasers in dentistry has contributed to an increase in patient comfort and office efficiency, as well as offered safe and effective treatment. Soft-tissue procedures such as gingival troughing and gingivectomies can be achieved in less time with lower patient discomfort than when using more traditional techniques.

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Author Profile



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Dr. Voller graduated from the University of Pittsburgh School of Dental Medicine in 1980, and also holds a Mastership in the Academy of General Dentistry. He practices general, esthetic, reconstructive dentistry and orthodontics and is the owner of VollerDentistry, LLC with offices in Kittanning, PA and Pittsburgh, PA. Dr. Voller has earned his Fellowships in the Academy of Comprehensive Esthetics and the Academy of Dentistry International. He is a member of the Academy of Cosmetic Dentistry and the American Dental Association, as well as their constituent societies. Dr. Voller lectures nationwide and has published numerous articles on reconstructive dentistry and orthodontics. Dr. Voller can be reached at drvoller@comcast.net.

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Questions

- Lasers for use in dentistry have been generally available for approximately _____.
 - a decade
 - two decades
 - four decades
 - none of the above
- The first diode laser had a wavelength of 950 nm and was developed in 1972.
 - True
 - False
- The amount of ultra-violet light emitted from a laser is the main determinant of how the light energy is absorbed.
 - True
 - False
- The absorption of light from lasers results in the production of heat, and it is the thermal effects as a result of the _____ that determine whether the end result is superficial or deep.
 - degree of absorption
 - degree of reflection
 - degree of specificity
 - degree of sensitivity
- For soft-tissue procedures, _____ lasers have the highest wavelength.
 - Nd:YAG
 - argon
 - carbon dioxide
 - Er:YAG
- The lowest-wavelength lasers used for soft-tissue procedures in dentistry are the diode lasers.
 - True
 - False
- At low power levels, tissue removal at very precise tolerances can be achieved using a laser.
 - True
 - False
- Soft-tissue lasers can be used for _____.
 - gingival troughing
 - operculectomy
 - exposure of unerupted teeth
 - all of the above
- Laser gingival troughing offers excellent hemostasis.
 - True
 - False
- Soft-tissue procedures can be performed using _____.
 - scalpels
 - electrosurgery units
 - lasers
 - all of the above
- Tactile sensation, control and visibility are all poor using a scalpel.
 - True
 - False
- Scalpels are _____.
 - inexpensive
 - a soft-tissue cutting tool that was learned in dental school by all dentists
 - readily available
 - all of the above
- Lasers and electrosurgery units offer the ability to effectively and efficiently incise or remove soft tissue, and provide excellent hemostasis.
 - True
 - False
- Good visualization can be obtained using a laser or electrosurgery unit due to _____.
 - their pen-style holders
 - the good hemostasis that is obtained when using them
 - the cleared area after using them
 - a and b
- Healing has been found to be quicker using a laser than using a scalpel.
 - True
 - False
- Postoperative pain is reported to be less compared to using a scalpel and reduced inflammation has been observed with use of a laser.
 - True
 - False
- Electrosurgery units and lasers are both safe and effective when used correctly.
 - True
 - False
- The electrodes on electrosurgery units _____.
 - can be curved
 - offer less tactile sensation than a scalpel
 - can cut soft-tissue using the tip and the sides of the electrodes
 - all of the above
- Protective glasses must be worn to safeguard eye health when using a laser.
 - True
 - False
- Sutures or a periodontal pack are usually required when using a laser.
 - True
 - False
- Local anesthesia is rarely required when using a scalpel.
 - True
 - False
- _____ can safely be used around implants.
 - Monopolar or bipolar electrosurgery units
 - Scalpels
 - Soft-tissue lasers
 - b and c
- According to this article, keeping the wattage low, yet high enough to cut and coagulate soft tissue, _____.
 - results in the fastest procedure
 - results in the least discomfort
 - results in the least charring
 - all of the above
- A consideration in deciding whether to adopt new technology is _____.
 - the effectiveness of the new technology compared to existing technology
 - the safety of the new technology compared to existing technology
 - the return on investment
 - all of the above
- Treatment provided using newly acquired technology should not only work in our hands to provide improved patient care in the short term, but it must also help patients and our laboratories in the long term.
 - True
 - False
- Financial considerations may dictate whether and when to acquire technology.
 - True
 - False
- New technology gives an office a state-of-the-art appearance.
 - True
 - False
- In one study of pediatric patients, it was found that acceptance of laser treatment for hard- and soft-tissue procedures combined was _____.
 - 55%
 - 65%
 - 75%
 - 85%
- A consideration in determining which laser to acquire is _____.
 - the procedures it would be used for in the office and the space required
 - its ability to be used by right- and left-handed operators
 - incorporated features such as wireless technology
 - all of the above
- The use of lasers in dentistry has contributed to an increase in patient comfort and office efficiency.
 - True
 - False

Soft-Tissue Lasers and Procedures

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Educational Objectives

- List the wavelengths of the different types of dental lasers that are available
- List the soft-tissue procedures that can be performed using a soft-tissue laser
- List and discuss the relative advantages and disadvantages of lasers, scalpels and electrosurgery units
- List and discuss the considerations involved in deciding whether to purchase a laser and specific attributes of lasers.

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Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

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4. How would you rate the objectives and educational methods?	5	4	3	2	1	0
5. How do you rate the author's grasp of the topic?	5	4	3	2	1	0
6. Please rate the instructor's effectiveness.	5	4	3	2	1	0
7. Was the overall administration of the course effective?	5	4	3	2	1	0
8. Do you feel that the references were adequate?		Yes		No		
9. Would you participate in a similar program on a different topic?		Yes		No		
10. If any of the continuing education questions were unclear or ambiguous, please list them.	_____					

11. Was there any subject matter you found confusing? Please describe.

12. What additional continuing dental education topics would you like to see?

If not taking online, mail completed answer sheet to
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P.O. Box 116, Chesterland, OH 44026
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| 3. (A) (B) (C) (D) | 18. (A) (B) (C) (D) |
| 4. (A) (B) (C) (D) | 19. (A) (B) (C) (D) |
| 5. (A) (B) (C) (D) | 20. (A) (B) (C) (D) |
| 6. (A) (B) (C) (D) | 21. (A) (B) (C) (D) |
| 7. (A) (B) (C) (D) | 22. (A) (B) (C) (D) |
| 8. (A) (B) (C) (D) | 23. (A) (B) (C) (D) |
| 9. (A) (B) (C) (D) | 24. (A) (B) (C) (D) |
| 10. (A) (B) (C) (D) | 25. (A) (B) (C) (D) |
| 11. (A) (B) (C) (D) | 26. (A) (B) (C) (D) |
| 12. (A) (B) (C) (D) | 27. (A) (B) (C) (D) |
| 13. (A) (B) (C) (D) | 28. (A) (B) (C) (D) |
| 14. (A) (B) (C) (D) | 29. (A) (B) (C) (D) |
| 15. (A) (B) (C) (D) | 30. (A) (B) (C) (D) |

AGD Code 135

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

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