Training and Use of Lasers in Postgraduate Orthodontic Programs in the United States and Canada


Abstract: This study was designed to determine if orthodontic residents are being trained to use lasers in the postgraduate orthodontic residency programs of the United States and Canada. An anonymous electronic survey was sent to the program director/chair of each of the seventy orthodontic residency programs, and thirty-seven (53 percent) of the programs responded. Of these thirty-seven programs, twenty-eight (76 percent) reported providing patient treatment with lasers in the orthodontic graduate program, eight (22 percent) said they do not provide treatment in the orthodontic graduate program, and one program (3 percent) reported providing laser training but not using lasers on patients. Gingivectomy and canine exposure were reported as the most common procedures that residents perform with a laser, while debonding of orthodontic brackets was the least common procedure performed with a laser. A diode laser was the most common type of laser used. Of the eight programs (22 percent) not offering laser training, four indicated having no plans to begin using lasers or training on their use. The other four indicated that they have plans to incorporate laser use in the future.

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Since the first medical procedure using a laser to remove a retinal tumor was performed in 1962,¹ the medical community has found creative ways to incorporate laser use into daily practice. The practice of dentistry has been changed by laser use as well, and many procedures are now performed using a variety of types of lasers.² For years, lasers have been used for various soft tissue procedures including gingivectomy, frenectomy, and biopsies.³ More recent case reports show implant uncovering is being performed with lasers.⁴ With implant dentistry, some have claimed laser use to be state of the art as compared to conventional techniques⁵ although this claim is not supported by the literature. Lasers have been used as an adjunct to endodontic procedures⁶ and for cleaning, shaping, and disinfecting root canal systems.⁷ They have the advantage of better control of bleeding, which is important in a number of procedures in restorative dentistry such as capturing the margins of crown preparations and obtaining isolation during placement of deep gingival restorations.⁸

No literature studies have shown to what degree orthodontic residencies have adopted the use of lasers in their clinical and didactic training of residents, even though lasers are being used in orthodontics for a variety of procedures including gingivectomy, frenectomy, operculectomy, papilla flattening, uncovering temporary anchorage devices, ablation of aphthous ulcerations, and exposure of impacted teeth.⁹ They are useful for tissue revision and moisture control during the placement of orthodontic brackets with moisture-sensitive adhesive near the gingiva. Many of these procedures enhance the esthetic result of orthodontic treatment and can make treatment easier. Residents who have been well trained with lasers should be better able to identify appropriate situations for laser use, avoid inappropriate use, and provide better patient care.

A recent survey found that 28 percent of orthodontists, periodontists, and general dentists surveyed said they used a soft tissue laser.¹⁰ Although this percentage is low, it does indicate a presence of lasers in dentistry, so training institutions should provide proper education with these modalities. Practitioners properly trained in the use of lasers can protect patients from harm by misuse.
The objective of this study was to determine if North American orthodontic residency programs are training future orthodontists to use lasers. This is an important part of dental education because many graduates may choose to use lasers to enhance their orthodontic practice, and a residency-based training enables them to learn the appropriate type of laser to use, which clinical conditions indicate laser use, and how to perform laser procedures most effectively.

**Methods**

After obtaining approval from the Institutional Review Board at A.T. Still University, we created an electronic survey to evaluate the extent to which lasers are currently being included in the training programs for orthodontic residents in North America. SurveyMonkey (www.surveymonkey.com) was used to facilitate the anonymous survey, and a link to it was e-mailed to all seventy orthodontic residency programs in the United States and Canada, along with a request that either the program director or department chair complete it. A phone call reminder and three separate e-mail reminders were sent to all of the programs that had not yet responded before the survey closing date.

In order to make the survey as easy as possible to complete, the software was programmed to automatically direct respondents to only pertinent questions and shorten the survey to a maximum of fourteen questions. A flowchart of this process is shown in Figure 1. The respondents who indicated having clinical use of lasers in their program were directed to Section A, which asked pertinent questions about laser use, and then to Section B, which asked questions about didactic training and clinical use. Those who indicated not using lasers clinically were directed to Section C, which asked questions about the availability for use and implementation.
were directed straight to Section B. Respondents who reported not using lasers in their program were directed only to Section C, which asked questions about potential plans for their use and barriers to implementation in their programs. The survey was comprised of multiple-choice questions with space for additional comments and an open-response comment section at the end. The data were collected and analyzed using SurveyMonkey and Microsoft Excel. (For the survey and number of responses to each question, contact the corresponding author.)

Results

We received thirty-seven responses from the seventy orthodontic programs, for a response rate of 53 percent. Not all questions were required to be answered by all recipients, as outlined in Figure 1. In addition, seven respondents completed some but not all questions.

Laser Training in Programs

Of a total of seventy orthodontic programs, twenty-eight (40 percent) provide patient treatment with and training about lasers, one program (1 percent) provides training about lasers but does not use them, eight programs (11 percent) do not provide training and do not use lasers, and thirty-three programs (47 percent) did not respond to the survey (Figure 2). To understand regional trends, the constituencies were divided into two regions, separated roughly by the Mississippi River. The Great Lakes Association of Orthodontists (GLAO), Southern Association of Orthodontists (SAO), Middle Atlantic Society of Orthodontists (MASO), and Northeastern Society of Orthodontists (NESO) were grouped into an Eastern Region. The Pacific Coast Society of Orthodontists (PCSO), Midwestern Society of Orthodontists (MSO), Rocky Mountain Society of Orthodontists (RMSO), and Southwestern Society of Orthodontists (SWSO) were grouped into a Western Region. Twenty of twenty-five respondents in the Eastern Region reported using lasers, while eight of twelve in the Western Region reported using lasers. A chi-square test was performed, and the difference between laser use in the Eastern Region and Western Region was not significant (p>0.05). Since the study was blinded, it was not possible to compare the programs in the United States to those in Canada because the constituent societies included both U.S. and Canadian programs in the same society.

The programs offering treatment with lasers were asked to indicate who provides the treatment...
and what types of treatment are provided. Of the twenty-four programs responding to this question, twenty-three (95 percent) reported that the orthodontic residents perform laser treatment, and twelve (50 percent) indicated that orthodontic faculty members also perform laser procedures. Some orthodontic programs reported that faculty members (six programs, 25 percent) and residents (five programs, 21 percent) from other departments at the same institution treat orthodontic patients with lasers. Two programs (10 percent) reported that they refer patients for laser procedures outside their institution.

Laser Procedures Performed by Residents

Programs were given the options of “gingivectomy,” “frenectomy,” “canine exposure,” and “debonding brackets” and were asked which procedures were performed with lasers and by whom. The options for persons performing the procedures were “orthodontic residents,” “orthodontic faculty members (with orthodontic residents observing),” “faculty members from a department other than the orthodontic graduate program (with orthodontic residents observing),” or “referrals outside the orthodontic clinic.” As shown in Figure 3, gingivectomy and canine exposure were the most common procedures in orthodontic residencies. Both of these procedures were most commonly performed by residents and were also performed by orthodontic and non-orthodontic faculty members with the residents observing.

Frenectomies with a laser were performed in fewer programs than laser gingivectomies, and more programs reported referring out of the orthodontic clinic for treatment. Open responses from this question indicated that programs also use lasers for removal of operculum and exposure of second molars.

Type of Lasers and Number of Procedures Performed

Orthodontic programs that reported using lasers were asked which types of lasers are used (Figure 4). The diode was the most common laser available for clinical use, with twenty programs reporting using a diode in the orthodontic clinic. CO₂ lasers were available for clinical use in three programs, and Er:YAG lasers were available in two programs. No programs reported the use of Nd:YAG or Argon lasers in the clinic, but two indicated having Nd:YAG lasers and

![Figure 3. Programs using lasers allow residents to perform various procedures with lasers](image-url)
reported more lecture time with six programs reporting three to five clock hours, four reporting three to ten hours, and one program reporting as much as eleven to twenty hours of laser training. The trend for hands-on training showed that fifteen of twenty-two (68 percent) programs responding to this question offered one to two hours of preclinical training with lasers (such as with pig mandibles) and five (23 percent) offered between three and five hours of hands-on preclinical training. One program (5 percent) offered eleven to twenty hours, and one program (5 percent) did not offer any hands-on training.

Of the twenty-two programs that use lasers and responded to the question about certification, nine (41 percent) responded that residents are certified in laser use by the end of their residency. Of these, four obtained certification from the Academy of Laser Dentistry, three from the academic institution itself, and one from a continuing education provider. The last institution did not specify the source of certifica-

![Figure 4. Availability of different types of lasers for clinical and research use](image)

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Discussion

In an effort to be current with the latest technology and innovation, residency programs may actively seek to provide laser instruction. An American Dental Association (ADA) survey reported that 31 percent of adults consider it “very important” for a dental practice to have a laser and 30 percent consider it “important.” The patient’s perception of treatment and overall satisfaction with orthodontic treatment has been shown to differ from the orthodontist’s perception. Many times, the public still perceives conventional treatment to be outdated although the evidence base is not present to support that a newer modality would be better than conventional treatment. This perception is what may drive practices to offer newer modalities that are not yet proven to be superior to traditional methods. The practitioner must also be very careful to ensure that the newer modality is at least as good as conventional methods and avoid substandard treatment.

Kravitz and Kusnoto stated that the diode and the erbium lasers are the two most popular types of
lasers used in dentistry. This differs slightly from the results of our survey, which found the most common lasers present in residency program clinics to be the diode and CO₂ lasers (Figure 4). Much of the popularity of the diode laser is probably attributed to its low cost and ease of use as compared to other types of lasers. Although improvements have been made in design, CO₂ lasers have long tubular arms that can take up space and be intimidating to patients. They also cost considerably more than diode lasers. Erbium lasers are used in dentistry for hard tissue procedures, so a reasonable explanation for their lack of popularity in orthodontic programs may be because soft tissue procedures are more common in orthodontics.

This study brought to light the fact that the amount and level of experience and training residents get with lasers vary considerably from program to program. Our findings were that some programs offer residents extensive training of up to twenty hours and one program offers more than twenty-one laser procedures performed by the residents during their training. Other programs offer no laser training at all. The data also suggest that most residents with laser experience have had preclinical hands-on training and graduate having completed at least three to five laser procedures (Figure 5).

A recent survey found that 26 percent of orthodontists use a laser in their office. The results of our survey show that some programs are preparing residents with the training that will enable them to join the minority of orthodontists who offer laser treatment in their practice. Other programs are at least offering an exposure to the technology, but additional education would be required to obtain proficiency.

Residency programs should consider including lasers in resident training because when the students become practitioners, they will likely need to use them in their practice for the convenience and benefit of their patients. For example, a simple gingivectomy to facilitate better bracket placement can be accomplished quickly with a laser in the orthodontic office, whereas a referral to another office for such a simple procedure would require unnecessary time and expense for the patient. Formal residency training is an ideal environment in which to provide practitioners with proper training about which type of procedures are most appropriate to be performed with a laser and which should be referred to other practitioners for treatment. For example, if a laser gingivectomy is performed when crown lengthening should have been done, the result will not be successful. The logical time for orthodontists to learn these skills and their limitations is while in residency, where proper instruction can occur.

Most institutions that responded to our survey do not offer a specific laser certification. Perhaps this is because few states and provinces require certification in the licensure process for laser use. There were not enough programs that offered certification to conclude that any certain entity is regarded as more reputable than others. Four programs, however, did report certification from the Academy of Laser Dentistry.

Two of the thirty-seven responding programs (8 percent) indicated the use of lasers for debonding brackets, suggesting that this is being performed in some residencies but the practice may not be common (Figure 3). Recent research has focused on this as a topic of interest in orthodontics. Diode, Nd:YAG, and CO₂ lasers have all been studied for use in debonding brackets, and Er:YAG lasers have been used for debonding resin after debonding brackets.

The data collected in our study indicate that didactic teaching parallels the types of procedures that are being performed clinically. For example, of all the programs offering laser training, almost all reported that didactic training about gingivectomy procedures and canine exposure are part of their curriculum, while not so many reported didactic instruction about laser frenectomy and very few reported didactic instruction about laser-assisted debonding of brackets. This same trend was mirrored in the responses about what types of procedures are actually being performed, with gingivectomy and canine exposure being reported by most programs, frenectomy by some, and laser debonding by few (Figure 3).

This survey did not specifically ask about low-level laser therapy (LLLT), but included open response sections that afforded the possibility of garnering these responses. The effects of LLLT have been studied since the late 1980s with regard to a variety of aspects of dentistry including wound healing, orthodontic post-adjustment pain, and relapse of rotated teeth. Recent studies in Turkey, Brazil, and India have shown accelerated tooth movement in humans when diode lasers were used to perform LLLT. The results of these studies could provide additional value to orthodontic practice by accelerating tooth movement in a way that reduces treatment time or improves patient comfort by reducing the pain associated with orthodontic treatment.
None of the responding programs in the United States and Canada made mention of LLLT being used in their residency programs. It may be that the use of LLLT in the United States and Canada is less common than in other countries such as Korea, Singapore, Brazil, India, and Turkey, where studies on LLLT have been performed. It is also possible that some of the programs that did not respond are using or investigating the use of LLLT.

One of the weaknesses of this survey was the response rate. With just over half of the programs responding, there could still be a great disparity between the results of those that responded and the results if every program responded. In order to avoid undue time constraints on program directors and chairs, the survey was created to be as short as possible, but this limits the depth of detail that could be obtained from the results. Many additional questions could have been created to collect information about each program and program director, such as age, training, or treatment philosophy. Each of these variables has the potential to be a confounding factor, influencing the practices of the program.

Another limitation of the study is selection bias, introduced because of the voluntary nature of the survey. Some respondents may have chosen not to participate simply because they do not use lasers, they do not believe lasers should be used for certain procedures like a frenectomy, or they have had unsuccessful experience with lasers in the past. Some conditions, such as a very fibrous frenectomy, may be better handled by a surgeon without a laser. This may explain why fewer programs reported performing laser frenectomy than gingivectomy. This selection bias may work the opposite way too. A program that does use lasers may be eager to share views on laser use and be more likely to respond. These programs may also be more likely to answer that more types of laser procedures are performed because of their enthusiasm for laser use. The results must be carefully considered so as to not mislead the reader to think that the collected responses truly represent the entire population sampled.

Conclusions

Postgraduate residency training programs are incorporating laser training and use in their curricula, preparing residents with additional skills that may enhance their practice of orthodontics. Of the programs that responded to this survey, most programs reported offering residents both didactic and hands-on training. We recommend that orthodontic residency programs seek to teach about lasers because a structured, academic environment gives residents the advantage of learning how to select the appropriate laser type for the correct procedure and to use lasers in ways that enhance orthodontic treatment.

Based on the results of this survey, residents choosing a training program and educators in training programs should consider the following points. First, of the seventy orthodontic residency programs in the United States and Canada, thirty-seven (53 percent) responded to this survey. Of these thirty-seven programs, twenty-eighth (76 percent) offer clinical laser training to orthodontic residents. This means that at least twenty-eight of the seventy programs (40 percent) offer laser training. Second, gingivectomy and canine exposure are the procedures for which most residencies provide training using lasers, followed by other procedures. Third, the most common laser used in orthodontic residencies is a diode laser, followed by the CO₂ laser. Fourth, most orthodontic residencies offering laser training provide residents at least three to five procedures per resident during the course of their residency.

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REFERENCES


