Use of an Er:YAG Laser for Pulpotomies in Vital and Nonvital Primary Teeth

Lawrence Kotlow, DDS, Albany, New York

J Laser Dent 2008;16(2):75-79

SYNOPSIS

A protocol for performing a primary tooth pulpotomy utilizing an Er:YAG laser is described. Radiographic histories of several clinical cases are also shown.

ABSTRACT

Pulp therapy for vital and nonvital primary teeth usually involves the use of chemical agents, such as formocresol, or electrocautery. This article reviews the results of using the Er:YAG laser to achieve similar results. Clinical and radiographic evidence indicates that using the Er:YAG laser results in safe, successful treatment of pulpotomies in primary teeth, similar to the successful treatment of other modalities.

Key Words: amoxicillin; dental pulp exposure; electrocautery; formocresol; radiography, dental; root canal irrigants; zinc oxide-eugenol cement

INTRODUCTION

Primary teeth that have the pulp tissue exposed due to caries, mechanical removal of carious tissue, or as a preventive procedure on severely abraded teeth require the completion of a pulpotomy. The American Academy of Pediatric Dentistry defines a pulpotomy[1] as when the coronal pulp is amputated, and the remaining vital radicular pulp tissue surface is treated with a medicament such as formocresol[2-3] or ferric sulfate[4] or with electrocautery[5] to preserve the radicular pulp's health. Mineral trioxide aggregate (MTA)[6] has also been used as pulp dressing agent for pulp therapy treatment. A pulpectomy[1] is defined as a root canal procedure for pulp tissue that is irreversibly infected or necrotic due to caries or trauma. The objective of either procedure is to maintain the tooth or teeth involved – functionally and painlessly – without pathology until the primary tooth normally exfoliates upon eruption of the underlying permanent tooth or until the tooth is adequately developed for the root canal completion.

Lasers are an effective alternative for treating pulps with the additional the benefits of providing pulp therapy without the need to introduce chemicals into children's systems. It has been demonstrated that small amounts of formocresol may be absorbed and distributed throughout the child's body within minutes of its use at the pulpotomy site.[7]

Pulpotomy is one of the clinical indications for use of the Er:YAG laser (2940 nm), which is useful in treating both vital and nonvital primary teeth where a pulpotomy is required to maintain the primary tooth until it is ready to exfoliate.[8-10] In addition, successful treatment can delay the need to extract a nonvital primary tooth until a space maintainer can be inserted.

CLINICAL CASE SUMMARIES

This report presents a series of clinical cases of treating primary teeth, using the Er:YAG laser for pulpotomies in primary teeth.

PRETREATMENT

The teeth included in this report were performed on children who had medical histories completed by their parents which the indicated the children were healthy. Pulpotomies in the report are selected examples of more than 4,000 pulp treatments necessitated by traumatic injuries, mechanical or caries exposure, or in teeth determined to be nonvital due to caries or trauma. Cases represent examples of teeth treated with an Er:YAG laser in 2002 or later, with follow-up radiographs extending from 2 months to 5 years post-treatment. In anterior pulp therapy cases, the pulp therapy treatment was completed on children as young as 8 months of age. These cases represented children suffering from nursing bottle dental caries or who had traumatized the upper anterior teeth which resulted in the teeth becoming nonvital. In the posterior teeth, children had treatment as early as 16 months on first primary molar teeth and as early as 24 months for second primary molar teeth which had erupted prior to the normal eruption time of 36 months.

Radiographic Documentation

Examples in this report were chosen from those cases where the child was able to accept the taking of dental radiographs prior to beginning the treatment.

TREATMENT

A. Treatment Objectives

Provide successful pulp therapy using the Er:YAG laser as an alternative to chemical or electrosurgical methods.

B. Laser Operating Parameters

Either of two Er:YAG lasers were used for treatment: The DELight® or VersaWave® (HOYA ConBio, Fremont, Calif.) or the PowerLase® AT (Fotona d.d., Ljubljana, Slovenia, distributed in the United States by Lares Research, Chico, Calif.).

1. DELight and VersaWave Settings

- Wavelength: 2940 nm
- Repetition rate: 30 Hz
- Energy per pulse: 55 mJ
- Water spray: 20 cc per minute
- Delivery system: Flexible fiber
- Emission mode: Free-running pulsed
- Tip size: 600-µm 80-degree quartz tip
- Pulse duration: 300 microseconds
- Average power: 1.65 Watts
- Total time per treatment: 15 seconds repeated three times

2: PowerLase AT Setting

- Wavelength: 2940 nm
- Repetition rate: 80 Hz
- Energy per pulse: 20 mJ
- Water spray set to 6
- Air set to 3
- Delivery system: Articulated arm
- Emission mode: Free-running pulsed
- Tip size: 800-µm sapphire tip in 90-degree handpiece
- Pulse duration: SP or 300 microseconds
- Average power: 1.60 Watts
- Total time per treatment: 15 seconds repeated three times

In all but one of the following cases, HOYA ConBio's DELight or VersaWave Er:YAG laser was used to perform the pulpotomy. Case #5 used the PowerLase AT Er:YAG laser.

C. Treatment Delivery Sequence

For all children appropriate laser safety glasses were placed on the child, either goggles for infants and young children, or regular safety glasses. Appropriate glasses were worn by all auxiliary personal and operating dentists. All procedures were completed through a dental operating microscope fitted with the appropriate 2970-nm laser filters. All required office safety protocols were followed.

Where patient cooperation was adequate, either rubber dam, Isolite™ tooth isolation (Isolite Systems, Santa Barbara, Calif.), or

Case #1: Traumatic injury to tooth #E, nonvital pulpotomy, patient age 3 years old at initial treatment

Pretreatment	Post-Treatment
	
Figure 1: Pretreatment, January 2, 2003	Figure 2: Post-treatment, May 12, 2006

Case #2: Dental caries in tooth #K, patient age 5 years at initial treatment

Pretreatment	Post-Treatment
	
Figure 3: Pretreatment, December 30, 2003	Figure 4: Post-treatment, July 5, 2006

Case #3: Dental caries in tooth #A, patient age 4 years at initial treatment

Pretreatment	Post-Treatment

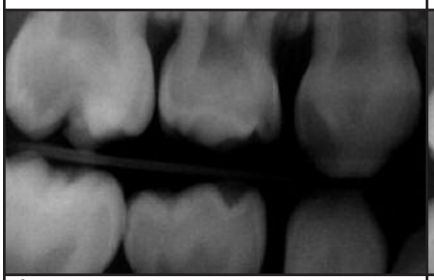
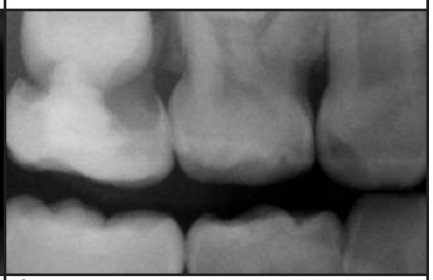
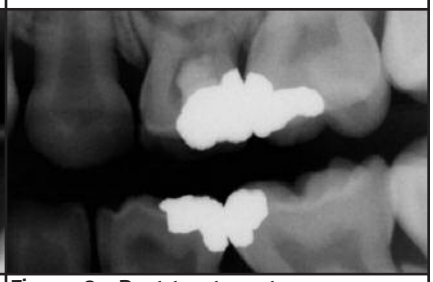
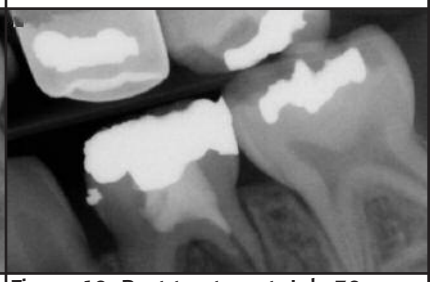

	

Figure 5: Pretreatment, January 9, 2003	Figure 6: Post-treatment, June 11, 2007

Case #4: Dental caries in tooth #I, patient age 4.5 years at initial treatment

Pretreatment	Post-Treatment
	
Figure 7: Pretreatment, October 30, 2002	Figure 8: Post-treatment, June 1, 2006

Case #5: Nonvital tooth with infection present, patient age 4 years, 250 mg amoxicillin prescribed three times a day for 10 days

Pretreatment	Post-Treatment
	
Figure 9: Pretreatment, May 21, 2007	Figure 10: Post-treatment, July 30, 2007. New bone growth and asymptomatic tooth 2 months post-treatment

Case #6: Dental caries in tooth #T, patient age 4.5 years at initial treatment

Pretreatment	Post-Treatment
	
Figure 11: Pretreatment, January 9, 2003	Figure 12: Post-treatment, June 11, 2007. Note root resorption of mesial root. Tooth remains stable and without any clinical signs of pathology

simple tooth isolation using cotton rolls were used for the procedure. Depending on the child's age, level of cooperation, and condition of the tooth, local anesthesia was usually required for vital teeth. There are instances when using the laser that children did allow for the use of the laser without the need for local anesthesia.

High-volume evacuation was used in all instances.

Analgesia (articaine 1:100,000 epinephrine) was used when appropriate.

D. Treatment Procedure

Access to the pulp chamber was achieved either through the use of high-speed dental handpiece, slow-speed dental handpiece, or the Er:YAG laser set to enamel ablation settings (DELight and VersaWave at 15 Hz / 120-400 mJ, or the PowerLase AT at 15-20 Hz / 125-300 mJ). Local anesthesia was used where indicated. Once the chamber was opened, the laser tip was placed into the chamber using the above settings for approximately 15 seconds. In most instances, this was repeated three times. If hemostasis was not achieved, the process was repeated one more time or until adequate hemostasis was achieved.

The chamber was then filled using zinc oxide eugenol cement and the appropriate restoration was placed.

E. Postoperative Instructions

Parents were instructed to call the office if any problems such as swelling or pain occurred.

FOLLOW-UP CARE

A. Assessment of Treatment Outcome

Children were seen at normal six-month preventive maintenance visits and appropriate clinical and radiographic evaluations were completed as needed.

B. Complications

In certain teeth radiographic evaluation revealed internal root resorption, however, the teeth remained clinically stable. The failure rate associated with the use of the laser appears to be similar to teeth treated using formocresol.

Case #7: Dental caries in tooth #T, patient age 6 years at initial treatment

Pretreatment	Post-Treatment	

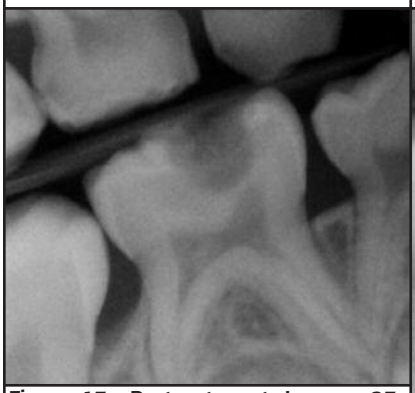



Figure 13: Pretreatment, January 23, 2003	Figure 14: Post-treatment, January 29, 2007	Figure 15: Post-treatment, August 16, 2007. Tooth about to exfoliate

Case #8: Dental caries in tooth #S, patient age 4.5 years at initial treatment

Pretreatment	Post-Treatment	

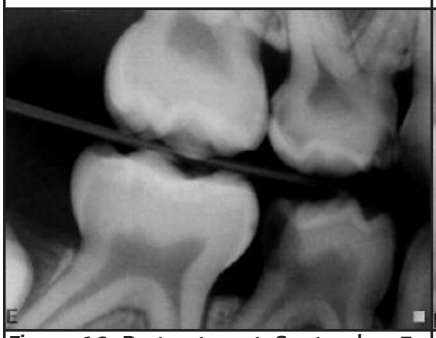
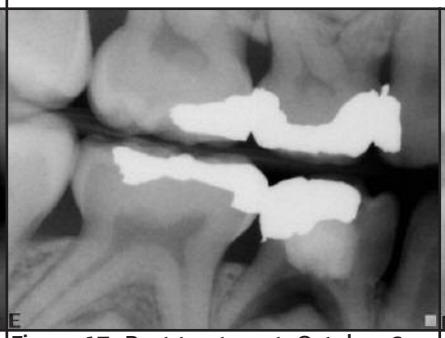
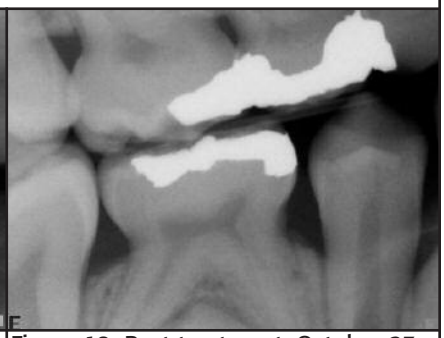

		

Figure 16: Pretreatment, September 3, 2002	Figure 17: Post-treatment, October 6, 2006. Tooth about to exfoliate	Figure 18: Post-treatment, October 23, 2007. Note the eruption of the permanent tooth in the correct position without any signs of infection

Conclusion

The clinical cases described include assessment up to 5 years postoperatively, and demonstrate the effectiveness of the Er:YAG laser for performing pulpotomies on primary teeth. Successful outcomes are evident both clinically and radiographically.

AUTHOR BIOGRAPHY

Dr. Lawrence Kotlow maintains a private practice in pediatric dentistry and has been providing lectures and discussion concerning the use of Er:YAG lasers in pediatric dentistry for more than 7 years. He is a graduate of SUNY Buffalo Dental School and is a Board Certified specialist in pediatric dentistry. He received his pediatric training at the Children's Hospital in Cincinnati, Ohio. He has Advanced Proficiency in the Er:YAG laser and Standard Proficiency in the diode and Nd:YAG lasers from the Academy of Laser Dentistry. He contributed the chapter on erbium laser and pediatric dentistry for the October 2004 Dental Clinics of North America and has published more than 25 articles concerning pediatric dentistry and laser dentistry as well as lectured internationally. He has served on the board of directors for the Academy of Laser Dentistry.

Dr. Kotlow may be contacted by e-mail at lkotlow@aol.com.

Disclosure: *Dr. Kotlow has presented educational seminars on pediatric dentistry and lasers for Hoya ConBio.*

He consults and provides professional guidance in development of products for many laser- and technology-associated manufacturers such as Isolite, Schick, and Lares Research and various laser safety glass manufacturers. For his professional speaking engagements or product input he receives an honorarium or new products to evaluate.

REFERENCES

1. American Academy of Pediatric Dentistry Clinical Affairs Committee – Pulp Therapy Subcommittee; American Academy of Pediatric Dentistry Council on Clinical Affairs. Pediatric Dentistry Reference Manual: Guideline on pulp therapy for primary and young permanent teeth. *Pediatr Dent* 2006-2007;28(7):144-148.
2. Camp JH, Barrett EJ, Pulver F. Pediatric endodontics: Endodontic treatment for the primary and young, permanent dentition. Chapter 23 in: Cohen S. Burns RC, editors. *Pathways of the Pulp.* 8th ed. St. Louis, Mo.: Mosby, Inc., 2002:797-844.
3. Farooq NS, Coll JA, Kuwabara A. Shelton P. Success rates of formocresol pulpotomy and indirect pulp therapy in the treatment of deep dentinal caries in primary teeth. *Pediatr Dent* 2000;22(4):278-286.
4. Smith NL, Seale NS, Nunn ME. Ferric sulfate pulpotomy in primary molars: A retrospective study. *Pediatr Dent* 2000:22(3):192-199.
5. Dean JA, Mack RB, Fulkerson BT, Sanders BJ. Comparison of electrosurgical and formocresol pulpotomy procedures in children. *Int J Paediatr Dent* 2002;12(3):177-182.
6. Eidelman E, Holan G, Fuks AB. Mineral trioxide aggregate vs. formocresol in pulpotomized primary molars: A preliminary report. *Pediatr Dent* 2001;23(1):15-18.
7. Pashley EL, Myers DR, Pashley DH, Whitford GM. Systemic distribution of 14C-formaldehyde from formocresol-treated pulpotomy sites. *J Dent Res* 1980;59(3):602-608.
8. Kimura Y, Yonaga K, Yokoyama K, Watanabe H, Wang X, Matsumoto K. Histopathological changes in dental pulp irradiated by Er:YAG laser: A preliminary report on laser pulpotomy. *J Clin Laser Med Surg* 2003;21(6):345-350.
9. Liu J-F, Chen L-R, Chao S-Y. Laser pulpotomy of primary teeth. *Pediatr Dent* 1999;21(2):128-129.
10. Church A, Henson T. Recall evaluation of primary pulp therapy using a dental laser. [Poster.] American Academy of Pediatric Dentistry 60th Annual Session, May 23-27, 2007, San Antonio, Texas.