A Comparison of Postoperative Pain Parameters Between CO_2 Laser and Scalpel Biopsies

Robert A. Strauss[a], Gary Jones[b], Dorothy E. Wojtkowski[c]

[a] *Professor of Surgery, Director, Residency Training Program, Department of Oral and Maxillofacial Surgery, Virginia Commonwealth University Medical Center, Richmond, VA, USA.*
[b] *Dentist in private practice, Pinehurst Oral Maxillofacial Surgery, Pinehurst, NC, USA.*
[c] *Resident, Department of Oral and Maxillofacial Surgery, Virginia Commonwealth University Medical Center, Richmond, VA, USA.*

Purpose: Laser surgery has been shown to exhibit several advantages over scalpel surgery for many procedures. Some of these advantages include hemostasis, decreased scarring, and the ability to perform certain procedures without anesthesia. It has been postulated that laser surgery results in less postoperative pain. However, this can be a difficult parameter to measure. This study sought to determine if there was a difference between the frequency and intensity of pain following scalpel biopsy when compared to biopsy performed with a CO_2 laser.

Materials and Methods: Forty patients requiring biopsy of either intraoral or facial lesions were selected for this study. Twenty patients underwent biopsy using a scalpel and 20 had similar biopsies performed with a continuous-wave CO_2 laser. Following biopsy, patients were discharged with a postoperative course survey. Patients were asked to measure their pain on a standard 100-mm visual analog scale two times per day for seven days. Patients were also asked to describe the frequency of their pain during that time period. Analysis was then performed to compare pain parameters between the scalpel and laser biopsy groups.

Results: Multivariate analysis of variance revealed no statistically significant difference in frequency and intensity of pain or temporal distribution of pain with laser biopsy vs scalpel biopsy.

Conclusions: CO_2 laser biopsy and scalpel biopsy techniques result in equivalent amount, frequency, and duration of postoperative pain.

Keywords: pain, excisional biopsy, CO_2 laser, scalpel, dentistry.

J Oral Laser Applications 2006; 8: 39-42. *Submitted for publication: 24.08.05; accepted for publication: 22.11.05.*

The CO_2 laser has been available for medical use for over thirty years and as instrumentation has improved, these lasers have become more common in both general and dental specialty offices. Early lasers were limiting due to their cumbersome delivery systems and innate difficulty in providing consistent depth of treatment without clinically significant damage to healthy tissues.[1] With the advent of hollow wave-guide lasers, many early problems have been solved.

Lasers enable transmission of high energy light to a specific site. The resultant effect of such light within tissues can be chemical, mechanical, or thermal. Most medical procedures use the thermal effects of lasers to manipulate tissues.[2] The CO_2 laser transmits energy at

10,600 nm, which falls in the infrared spectrum and is absorbed predominantly by water. Body tissues are high in water content and therefore the CO_2 laser can target intracellular water, allowing for precision cutting or surface ablation.[3-5] Other laser wavelengths are more specific for vascular, pigmented, or deeper tissue lesions.[3,6]

The CO_2 laser has been the most commonly used soft tissue laser in both medicine and dentistry. Its ability to vaporize tissue, make incisions, and provide intraoperative hemostasis makes it an ideal instrument for biopsy procedures. Lateral thermal damage for the CO_2 laser is approximately 500 microns or less.[4,7,8] Because lateral damage is so small, very exacting use of the laser may be performed without destroying nearby normal tissue. It should be noted that lateral thermal effects may be a potential disadvantage of the laser. A "thermal artifact" essentially "cooks" tissue and can affect the ability of the pathologist to read biopsy tissue margins. The surgeon should take this into account when doing laser surgery, and can minimize thermal artifacts by selecting appropriate laser power, time, and spot size.

Studies have shown that CO_2 laser wounds demonstrate delays in inflammation, collagen production, and tensile strength in early stages of healing when compared to scalpel wounds.[9] However, in late-stage healing, wound strength and epithelialization between the two incisions are nearly equivalent and laser wounds tend to heal with less scar contracture.[9,10] Thus, laser wounds eventually heal with less scarring than conventional blade incisions, inflict minimal damage on nearby normal tissue, and have comparable long-term wound strength.

In addition to its use as a "light scalpel", recent studies have proposed the use of the CO_2 laser at low energy levels for pain control of ulcerative lesions of the mouth.[11,12] Several studies have demonstrated significant clinical success in eliminating pain, decreasing healing time, and preventing recurrence of mucosal ulcerative lesions by irradiating wounds with 1 to 1.5 Watts of laser energy for 5 s without any need for local anesthetic prior to treatment.[11,12]

The purpose of this study was to determine if the clinical benefits of the CO_2 laser for surgical biopsy could translate into subjective improvements in patient pain perception. Specifically, a difference was sought between the frequency and intensity of pain following scalpel biopsy when compared to biopsies performed with the CO_2 laser.

MATERIALS AND METHODS

Forty patients who required biopsy of lesions involving the oral cavity and or the face were alternately divided into 2 groups of 20. Each group consisted of 12 males and 8 females. The first group underwent biopsy using a conventional stainless steel scalpel while the second group had CO_2 laser biopsies. Laser biopsies were performed with a continuous-wave CO_2 Luxar Laser (Lumenis, Santa Clara, CA, USA) set at 6 Watts intermittent mode for outlining and 6 Watts continuous mode for excision. Both groups had local infiltration of 2% xylocaine with 1:100,000 epinephrine for preoperative anesthesia. Postoperatively, all patients were allowed to take over-the-counter pain medications ad lib (eg, aspirin, ibuprofen, acetaminophen) and no prescriptions were written for narcotic pain medications.

The group receiving scalpel biopsies had 11 from the buccal mucosa, 3 from the palate, 2 from the tongue, 2 from the gingiva, 1 from the retromolar trigone, and 1 from the face. For the laser group, the sites included 6 from the buccal mucosa, 2 from the palate, 5 from the tongue, 2 from the gingiva, 1 from the lip, and 4 extraorally. Standard elliptical excisional biopsies were performed on all lesions. All excisions were between 0.5 and 1 cm in length and were closed with 4-0 gut intraorally and 6-0 nylon extraorally.

After the biopsies were completed, patients were discharged with a postoperative survey covering a one-week period. The first entry was on the day of surgery and two entries per day were required for seven days. Patients were asked to record their level of discomfort on a standard visual analog scale (VAS) of 0 to 100 mm; 0 being no pain, and 100 being the worst pain imaginable. Patients returned to the clinic for a one week postoperative visit, at which time the surveys were collected. All 40 patients completed the survey.

RESULTS

Survey analysis was performed to evaluate differences in the time course, duration, and amount of perceived pain associated with scalpel vs CO_2 laser use. Initially, the average amount of pain experienced daily by each patient was determined. The range of pain scores was 0 to 85 for the scalpel group and 0 to 84 for the laser group. A three-way multivariate analysis of variance (MANOVA) was used to compare pain for different postoperative days, overall pain, peak pain day, and number of days of pain related to specific biopsy site, type, and gender.

The first comparison was made of the average of all VAS pain scores. Average pain value for scalpel biopsy was 10.64 ± 14.8 ($p > 0.5$). The average pain value for biopsies performed by laser was 9.9 ± 15.8 ($p > 0.5$). The next comparison was made between the average peak pain days. Scalpel biopsy patients experienced peak pain on day 1.6 ± 1.5 ($p = 0.25$) and laser biopsy patients on day 2.25 ± 2.0 ($p = 0.25$).

A comparison was also made of the total number of days in pain. Over the seven days surveyed, the scalpel group reported an average 4.3 ± 2.3 ($p > 0.5$) days in pain while the laser group reported an average 4.05 ± 2.8 ($p > 0.5$) days in pain.

The average pain on day one was compared as well. The scalpel group reported an average pain of 16.7 ± 23.4 ($p > 0.5$). The laser group reported an average pain of 12.8 ± 14.9 ($p > 0.5$). The final comparison made was average pain by gender. Females reported an average pain of 13.7 ± 19.6 ($p = 0.25$). Males reported an average pain of 8 ± 11.0 ($p = 0.25$).

DISCUSSION

In a previous survey by Smith et al in 1989, 676 randomly selected patients were asked to describe why they are afraid of dentists. Fifty-two percent answered "pain".[13,14] The next most common response was fear of the local anesthetic needle.[13] These two reasons continue to be problematic for those who fear dentists and dental specialists. New technologies such as lasers are beginning to change these attitudes. Using the laser preempts the need for the patient to "see the knife" and in some cases, topical anesthesia may be adequate to perform laser procedures.[11,12,15]

Some literature has claimed decreased pain with laser surgery.[16-18] It has been suggested that this may be due to sealing of nerve fibers; however, there is controversy regarding this theory. Pain is a difficult variable to measure. People have different pain thresholds, and extreme pain to one person may be mild to moderate pain for another. It is also reported that women have a greater fear of dentists than men and may report greater pain secondary to fear.[13] However, women may also feel it is socially more acceptable for them to admit pain, and their reporting may be more accurate than that of their male counterparts.

A retrospective study by Smith et al asked patients to describe their pain during and after dental-related laser procedures. The authors reported that postoperative pain was directly related to pain experienced during the procedure.[13] 91% of patients reported no pain or mild pain during the laser procedure while only 9% experienced moderate or strong pain. When compared to procedures performed using traditional techniques, patients in Smith's study reported significantly less pain during and after treatment with a laser than with a scalpel.

In contrast, other studies have claimed more postoperative pain comparing laser techniques to conventional dissections during tonsillar surgery,[19,20] and still others report no difference in postoperative pain following periodontal surgery or abdominal incisions.[21,22] Although all of these articles compare lasers to scalpels, to date none have specifically evaluated pain following laser biopsies routinely performed by dentists and dental specialists.

The aim of this study was to determine if there indeed was a difference in the frequency and intensity of postoperative pain following laser vs scalpel biopsy. No statistically significant difference in overall pain, peak pain day, or number of days of pain was found when comparing biopsy site, type, or gender. Several reasons could account for the results. First, the large range of reported pain (14 to 90) compared to the sample size created huge variation in pain scores. The large deviations from the mean also made it difficult to elucidate trends. Second, the many different biopsy sites led to variations in mean pain scores, and some sites tended to be inherently more painful than others. In addition, patients were allowed to take mild pain medication ad lib. Some patients may have been controlling their postoperative discomfort with analgesics and did not report postoperative pain while others may have not taken any pain medications and may have reported more pain. However, because both scalpel and laser groups were allowed over-the-counter pain medication use and no opioids were distributed, we felt this would not significantly affect our results. In contrast to previous studies by Smith et al, where many patients had no postoperative pain with laser treatment, this study demonstrated mild to moderate pain following biopsy in all patients. However, there was no statistical significance between laser and scalpel biopsy.

CONCLUSION

This study demonstrated no difference in pain parameters postoperatively between scalpel and laser biopsy technique.

1. The amount of pain was equivalent.
2. The frequency of pain was equivalent.
3. The duration of postoperative pain was equivalent.

Despite no difference in postoperative pain using lasers, other advantages of the laser are reason enough to use it when possible. Lasers can make procedures less stressful for the patient by eliminating the "knife" and aid the surgeon by providing excellent hemostasis. In addition, there is negligible damage to adjacent tissues and scaring can be minimized or eliminated.[22,23] Lasers will continue to be an excellent tool for dentists and dental specialists.

REFERENCES

1. Nanni C. Complications of laser surgery. Dermatol Clin 1997; 15:521-534.
2. van Hillegersberg R. Fundamentals of laser surgery. Eur J Surg 1997;163:3-12.
3. Guttenberg, SA, Emery RW. Laser dermatopathology. Oral Maxillofacial Surg Clin N Am 2004;16:189-195.
4. Guttenberg, SA, Emery RW. Laser physics and tissue interaction. Oral Maxillofacial Surg Clin N Am 2004;16:143-147.
5. Wlodawsky, RN, Strauss RA. Intraoral laser surgery. Oral Maxillofacial Surg Clin N Am 2004;16:149-163.
6. Niamtu, J. The treatment of vascular and pigmented lesions in oral and maxillofacial surgery. Oral Maxillofacial Surg Clin N Am 2004;16:239-254.
7. Sanders, DL, Reinisch L. Wound healing and collagen thermal damage in 7.5 micosec pulsed CO_2 laser skin incisions. Lasers Surg Med 2000;26:22-32.
8. Liboon J, Funkhouswer W, Terris DJ. A comparison of mucosal incisions made by scalpel, CO_2 laser, electrocautery, and constant-voltage electrocautery. Otolaryngol Head Neck Surg 1997;116:379-385.
9. Hendrick DA, Meyers A. Wound healing after laser. Otolaryngol Clin North Am 1995;28:969-986.
10. Zeinoun T, Nammour S, Dourov N, Aftimos G, Luomamen M. Myofibroblasts in healing laser excision wounds. Lasers Surg Med 2001;28:74-79.
11. Elad S, Or R, Sapira MY, Haviv A, Galili D, Garfunkel AA et al. CO_2 laser in oral graft-versus host disease: a pilot study. Bone Marrow Transplantation 2003;32:1031-1034.
12. Sharon-Buller A, Sela M. CO_2 laser treatment of ulcerative lesions. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2004;97:332-334.
13. Smith TA, Thompson JA, Lee WE. Assessing patient pain during dental laser treatment. JADA 1993;124:90-95.
14. Heaton LJ, Smith TA, Raybould TP. Factors influencing use of dental services in rural and urban communities: considerations for practitioners in underserved areas. J Dent Educ 2004;68: 1081-1089.
15. Komori T, Yokoyama K, Takato T, Matsumato K. Case reports of epulis treated by CO_2 laser without anesthesia. J Clin Laser Med Surg 1996;14:189-191.
16. Strauss RA. Lasers in oral and maxillofacial surgery. Dent Clin North Am 2000;44:851-873.
17. Villarreal Renedo PM, Monje Gil F, Junquera Gutierrez LM, De Vicente Rodriguez JC, Morillo Sanchez AJ. Treatment of oral and oropharyngeal epidermoid carcinomas by means of CO_2 laser. Med Oral 2004;9:172-175.
18. Sinha UK, Gallagher LA. Effects of steel scalpel, ultrasonic scalpel, CO_2 laser, and monopolar and bipolar electrosurgery on wound healing in guinea pig oral mucosa. Laryngoscope 2003;113:228-236.
19. Kothari P, Patel S, Brown P, Obara L, O'Malley S. A Prospective double-blind randomized controlled trial comparing the suitability of KTP laser tonsillectomy with conventional dissection tonsillectomy for day case surgery. Clin Otolaryngol Allied Sci 2002; 27:369-373.
20. Saito T, Honda N, Saito H. Advantage and disadvantage of KTP-532 laser tonsillectomy compared with conventional method. Auris Nasus Larynx 1999;26:447-452.
21. Pearlman NW, Stiegmann GV, Vance V, et al. A prospective study of incisional time, blood loss, pain, and healing with carbon dioxide laser, scalpel, and electrosurgery. Arch Surg 1991;126:1018-1020.
22. Pick PM. Using lasers in clinical dental practice. JADA 1993; 124:37-47.
23. Miller M, Truhe T. Lasers in dentistry: an overview. JADA 1993; 124:32-35.

Contact address: Dr. Robert Strauss, Department of Oral and Maxillofacial Surgery, Virginia Commonwealth University Medical Center, 520 N. 12th St., Lyons Building, Room 238, PO Box 980566 Richmond, VA 23298, USA. Fax: +1-804-827-1040. e-mail: rastraus@vcu.edu