CO\textsubscript{2} Laser Myringoplasty Using A Hand Held Fiber

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ABSTRACT

We performed laser myringoplasty to treat retraction pockets of the tympanic membrane (TM) using the OmniGuide\textsuperscript{®} hand held CO\textsubscript{2} laser. Similar laser myringoplasty techniques have been described for both the line of sight CO\textsubscript{2} and KTP lasers. We report the efficacy of the hand held CO\textsubscript{2} laser for treatment of retraction pockets. 19 patients, and a total of 24 ears, were treated using this technique.

Hand held CO\textsubscript{2} laser myringoplasty produces hearing improvement. The laser fiber allows for controlled delivery of energy to the TM with improved accuracy. Ears with effusions experience the greatest hearing improvement. Patients with membrane adherence not amenable to valsalva may be at greater risk for suboptimal hearing results.

INTRODUCTION

Tympanic membrane atelectasis is a chronic otologic condition resulting from Eustachian tube dysfunction (ETD). One complication of ETD is deformation of the tympanic membrane with loss of middle ear space, i.e., TM atelectasis. It is generally accepted that retraction pockets in the atelectric drum are caused by negative middle ear pressure. This may result in atrophy of the membrane, erosion of the ossicles, hearing loss, and the development of cholesteatoma\textsuperscript{1}.

A range of modalities have been used to treat membrane atelectasis, however current treatments are often unsatisfactory or too invasive. An effective yet minimally invasive treatment for severe atelectasis is desired. Several authors have utilized lasers in the treatment of tympanic membrane retraction pockets.\textsuperscript{2,3} Laser energy changes the conformation of the membrane and produces a stronger tympanic membrane, in turn minimizing further membrane deformation. CO\textsubscript{2} laser energy is ideal for use in otologic surgery because of its precision and predictable absorption in tissue. Recent advances in thin film technology have overcome traditional delivery limitations and led to the development of a flexible fiber through which CO\textsubscript{2} laser light can be guided.\textsuperscript{4} As a result the user may direct the CO\textsubscript{2} energy towards membrane retraction pockets with greater accuracy. In this study we show that hand held CO\textsubscript{2} laser myringoplasty is a safe and reliable method for treatment of tympanic membrane retraction pockets. We also address additional factors that influence hearing improvement.

METHODS

19 patients, 24 ears total, with TM atelectasis were selected for laser myringoplasty. Preoperative audiograms were performed on all patients. All procedures were performed in the operating room under general anesthesia. The area of atelectasis was examined using the operating microscope. First, an effort was made to elevate the membrane adherent to middle ear structures. In most cases, anesthetized gas “ballooned” out the retraction pocket. If this did not occur, saline was injected into the middle ear space under pressure (hydro-dissection) to release the adherent portion. If unsuccessful, a small myringotomy was made adjacent to the pocket and the TM was mechanically elevated off of the ossicles. CO\textsubscript{2} laser energy was then delivered at 2 watts, 0.1 second pulses to the TM. A myringotomy tube was then placed. Postoperative audiograms were performed at a minimum of 4 weeks after surgery. Hearing results and adverse events were recorded via a review of clinic encounter notes.

RESULTS

Laser myringoplasty was performed on 19 patients (13 male, 6 female), and a total of 24 ears. Ages ranged from 5-74, (mean 39 years). All patients had pre- and post-operative audiograms available for review. Air-bone gaps (ABG) were calculated for pure tones at 0.5, 1, 2 and 3 kHz. The average preoperative ABG for the 24 ears was 13.9 dB. The average postoperative ABG was 8.5 dB (P=0.02). The twenty ears with no effusion experienced average ABG closure from 12.1 to 7.8 dB. The four ears with effusion had average ABG closure from 22.7 to 7.00 dB. Ears were also classified on the degree of membrane adherence to middle ear structures. The 9 ears requiring mechanical elevation experienced an ABG closure from 15.0 to 10.9 dB whereas the 15 ears that did not, had an average ABG closure from 13.0 to 7.15 dB.

CONCLUSIONS

• Hand held CO\textsubscript{2} Laser Myringoplasty is a successful minimally invasive treatment for TM atelectasis.
• The hand held CO\textsubscript{2} laser allows precise coagulation of tissue with minimal thermal damage to unaffected areas of the TM. The hand held design improves access to the TM and control of energy dispersed onto the tissue.
• Ears with effusions experienced the greatest improvement. Effusion and non-effusion groups resulted in similar hearing which supports the supposition that laser myringoplasty produces immediate hearing improvement.
• The extent of membrane adherence should be considered. Significant differences were seen between TMs that were and were not successfully elevated.