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BRIEF COMMUNICATION

Pilot study on the diode laser in stapes surgery

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KEYWORDS
Stapes surgery;
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Abstract
Stapes surgery has a long history. While the results are good, there is a possibility of complications that can lead to a worsening of hearing. The objective of this study was to study hearing in patients undergoing surgery using 980Nm Diode laser in the immediate postoperative period. In no case was the bone threshold worse in the first audiometry control at 10 days of surgery. The use of a 980Nm Diode laser thus minimises the chance of stapes footplate fracture with risk of its drop in the labyrinth. A thick stapes can be operated on without the trauma produced by drilling it. By facilitating the surgical procedure, stapes surgery with a 980Nm Diode laser reduces the possibility of complications.

PALABRAS CLAVE
Cirugía estapedial;
Láser;
Láser diodo 980 Nm

Estudio piloto sobre el láser diodo en la cirugía estapedial

Resumen
La cirugía del estribo tiene una larga historia. Si bien los resultados son buenos, existe la posibilidad de complicaciones que pueden llevar a un empeoramiento de la audición. El propósito de este trabajo es estudiar la audición en pacientes operados con láser diodo 980 Nm en el postoperatorio inmediato. En ningún caso empeoró la vía ósea en el primer control audiométrico a los 10 días de la cirugía.
El uso de láser diodo 980 Nm minimiza la posibilidad de fractura platinar con el riesgo de caída de la misma en el vestíbulo. Permite intervenir una platina gruesa sin el trauma que produce el fresado de la misma. La cirugía del estribo con láser diodo 980 Nm reduce la posibilidad de complicaciones al facilitar el procedimiento quirúrgico.

Introduction

Stapedial surgery has a long history. While its results are good, as in any surgery there is the possibility of complications. Hearing may be deteriorated or even lost forever. There

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are factors that depend on the patient's circumstances, the surgeon's experience and other factors that are somewhat unforeseeable.[1]

Although the technique has not been modified for a long time, the attention to detail to minimise the trauma represented by opening the labyrinth has seen constant improvement by otology surgeons. All manoeuvres performed on the ossicular chain, and especially on the stapes and plate, require special care.

There are some particularly difficult cases that require manoeuvres likely to cause internal hearing damage.[2] For example, branches of the stirrup that do not fracture normally, plates that are not fixed well enough or that are thicker than usual, plates that are fixed but very thin, heavy bleeding, etc. Techniques and surgical instruments have therefore been developed to facilitate these manoeuvres with less risk of injury to the inner ear. In conventional techniques, when the plate is totally or partially removed, it is relatively frequent for the first audiometric control to note a decrease in bone conduction, especially at high frequencies; this loss may or may not improve with time.[1,3]

Different types of lasers have been used over time, including Argon, CO_2, Yag, diode 810 and others.[4-6] The currently available 980Nm diode laser may have certain advantages. A diode is an electronic laser consisting of 2 semiconductor materials with the size of a grain of sand. This technology makes it possible for this laser to be the smallest available. A microprocessor-controlled system regulates the flow of electrical current through the diode and generates the laser beam. This beam is transmitted through an optical system to an optical fibre, which is the medium through which light reaches the location requiring surgery.

Methods

The purpose of this work was to study hearing in patients, in the immediate postoperative period, who had undergone surgery with a Deka Smart 980Nm diode laser. We present 6 patients who were operated on with this type of laser.

First, one or more beams were fired to ensure the viability of plate drilling before any surgical manoeuvre was performed. The posterior branch of the stapes was then weakened with several shots using a 200 µ fibre. In all cases, we used 1 watt of power with a pulse duration of 0.2 s. The stapes muscle tendon was also sectioned using laser. Subsequently, the previously tested area was weakened and platinectomy was carried out at a right angle. To end the surgery, a polyethylene prosthesis was laid in place with a small tragal perichondrium layer.

To verify the safety of its use and to test the risk of labyrinthine damage, the preoperative bone conduction at 250-4,000 Hz frequencies were taken as references and compared after 10 days from the intervention.

Results

We present the clinical and audiometric characteristics of the 6 patients, the latter before surgery and at 10 post-operative (Table). In no case did bone conduction decrease; on the contrary, it improved, especially in the higher frequencies of 1,000-4,000 Hz (Figure).

Discussion

The indications for the use of laser in otology vary greatly.[3] The anatomical features of the ear allow the use of different types of lasers.[1,5,6] The CO_2 laser beams are absorbed by clear liquids, so they may damage the perilymph. Those of an Argon laser are absorbed by the blood, so they preserve inner ear fluids. The Er-Yag laser allows good bone ablation with scant perilymph penetration, but does not offer good haemostasis.

A laser can be used in external ear canal surgery to treat vascular lesions, polyps, granulomas and exostosis

Table 1 Description of the clinical characteristics of the 6 patients (age, gender, ear intervened) and audiometric tests in decibels (dB) of bone (BC) and air (AC) conduction before surgery (PRE) and at 10 days postoperative (POST) at frequencies of 250-4,000 Hz

Patient	1	2	3	4	5	6
Age	58	49	37	61	40	52
Gender	M	F	M	F	F	F
Ear	R	R	L	R	R	L
BC PRE/ POST250	10-5	15-10	5-5	10-10	45-40	5-5
BC PRE/ POST500	10-5	25-20	15-15	30-30	45-45	15-10
BC PRE/ POST1000	15-5	45-15	20-15	25-20	55-50	20-15
BC PRE/ POST2000	15-5	55-40	15-10	30-25	65-45	35-20
BC PRE/ POST4000	15-10	45-35	10-10	25-20	65-50	20-15
AC PRE/ POST250	50-10	50-35	50-20	50-20	80-60	55-30
AC PRE/ POST500	65-10	55-25	50-20	55-30	75-65	60-35
AC PRE/ POST1000	55-15	75-50	40-15	55-25	85-60	50-35
AC PRE/ POST2000	55-15	85-55	30-15	60-30	80-60	50-30
AC PRE/ POST4000	45-15	80-75	40-10	60-30	85-75	40-35

F indicates female; L, left; M, male; R, right.

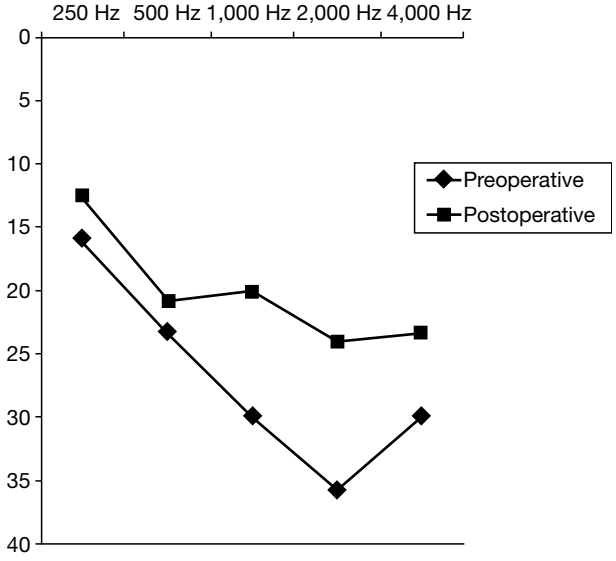

Figure Audiometric features of the bone conduction (BC) of the 6 patients, before surgery and 10 days postoperative. In no case did BC decrease; on the contrary, it improved, especially in the higher frequencies of 1,000-4,000 Hz.

and to reduce the mass of inoperable tumours. However, its use in stapedial surgery is what is most noteworthy.[7,8] The laser allows the vaporisation of the stapedial muscle tendon and its subsequent healing, as well as platinectomy. There is little bleeding and less risk of stapes mobilisation. In otoneurosurgery, it is used for mass reduction in cerebellopontine angle tumours.

The laser is very popular because it allows precise manoeuvres that minimise the risk of labyrinthine injuries. It is common to find a bone conduction loss, frequently transient, after standard stapedial surgery. The cause has not been established; among other possibilities, it is thought to be a vascular disorder or a direct surgical trauma.[1,2] There are no studies that describe changes in neurosensory impairment in the immediate postoperative period.

In this work, we studied in the immediate postoperative period (10 days) after stapedial surgery the sensorineural impact of using a 980nm diode laser. While we present few cases, it is possible to note the early improvement in bone conduction at 1,000-4,000 Hz frequencies. This could be due to the addition of a minor trauma on the inner ear and to factors affecting mechanical sound conduction, due to a more precise plate approach.

We also obtained other benefits with the use of diode laser. The 980nm diode laser, with its 200 µ fibre, can reach narrow areas of the tympanic cavity without impeding vision, making a more precise technique possible. Because this laser has a thinner fibre, it requires less energy to achieve the same effect. The laser promotes haemostasis by coagulating the vessels of the mucosa around the fenestra. It also minimises the likelihood of fracturing the plate, with the corresponding labyrinthine trauma.

Based on our experience, we can say that the 980 diode laser is not harmful and its use facilitates the surgical procedure, avoiding the risks inherent to incudostapedial manipulation.

The use of the diode laser has the advantage of being a less invasive method and makes mini-invasive surgery possible. The clinical benefits are rapid recovery, minimal bleeding and reduced postoperative care, resulting in a higher quality of patient care.

Conclusions

1. The use of the diode laser makes closer access to narrower areas possible without obstructing the view and reduces bleeding. It also minimises the chance of plate injury and the risk of its falling into the vestibule.
2. It is common to find a hearing decrease in bone conduction in the immediate postoperative period after standard stapedial surgery. This does not occur when using the diode laser and it is not uncommon to observe a remarkable recovery of the Carhart notch even in high-pitched tones during that first control.
3. Stapes surgery with diode laser consequently reduces the possibility of complications by facilitating the surgical procedure.

Conflict of interest

The authors declare no conflict of interest.

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