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Main Articles

Treatment of chronic otitis externa by KTP/532 laser

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Abstract
The traditional meatoplasty operations performed for chronic otitis externa, which has entered the 'fibrotic' phase, are often unsatisfactory because the results in terms of canal patency, hearing gain and patient satisfaction are variable. Although the use of laser in chronic ear surgery is well recognized, it has not been previously reported as a meatoplasty technique. Ten KTP laser meatoplasty operations were performed on eight patients with chronic otitis externa. This pilot study shows the technique to be effective, fast and with a high patient satisfaction rate in the short-term (mean follow-up period 9.3 months). The average increase in hearing thresholds was 24 dB HL. Significant patient benefit was obtained in at least six out of eight patients using the Belfast rule of thumb. The technique has many advantages over the traditional meatoplasty operations but the long-term results require evaluation.

Key words: Otitis externa; Laser surgery

Introduction

Chronic otitis externa is a condition of the external auditory meatus (EAM) which can result in stenosis when the underlying inflammatory process enters the chronic 'fibrotic' phase. Squamous epithelial hyperplasia and fibrosis results in stenosis of the external auditory meatus and apparent thickening of the tympanic membrane. A narrow EAM leading to poor ventilation is associated with chronic otitis externa, or recurrent acute otitis externa. The aim of surgical treatment is to correct any hearing disability and to create a wide, well aerated, dry, self-cleaning EAM which discourages further infection (Hunsaker, 1988).

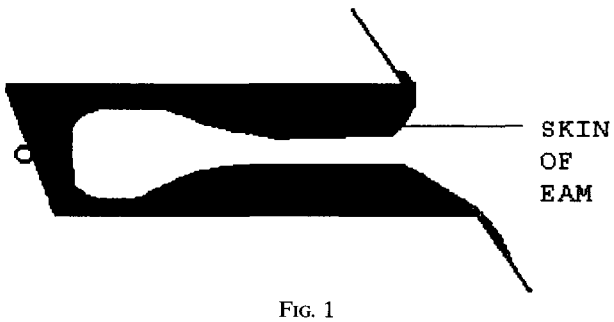

FIG. 1
Schematic diagram showing stenosis of the EAM and apparent thickening of the tympanic membrane due to the hyperplasia and fibrosis of the squamous epithelium.

Symptomatic patients with severe acquired stenosis of the EAM which is refractory to long-term medical therapy, are candidates for surgical treatment (Goodman and Middleton, 1984; Hunsaker, 1988). Various meatoplasty techniques have been described in the past, most of which involve excision with, or without, reconstruction with skin grafts or flaps (Beales and Crawford, 1966; Spector *et al.*, 1979; Tos and Bonding, 1979; Soliman *et al.*, 1980; Adkins and Osguthorpe, 1981; Paparella and Goycoolea, 1981; Goodman and Middleton, 1984; McDonald *et al.*, 1986; Tos and Balle, 1986; Bell, 1988; Hunsaker, 1988; Martin-Hirsch and Smelt, 1993; McCary *et al.*, 1995). Many of these traditional procedures are unsatisfactory as the long-term results are often variable, the hearing gain is minimal and the individual techniques are difficult to replicate. Furthermore, patient satisfaction has not been adequately assessed previously. Although the use of laser in chronic ear surgery is well known, it has not been previously reported as a meatoplasty technique (Parkin, 1990; Thedinger, 1990). The preliminary results of our experience with the KTP/532 laser meatoplasty technique are presented.

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Equipment and technique

The KTP laser is a twin crystal design generating a visible green light at 532 nm wavelength. A synthetic crystal of neodymium yttrium aluminium garnet (Nd: YAG) is photoactivated with an arc lamp to provide the initial stimulated emission of 1064 nm which is in the infrared portion of the spectrum. This beam is simultaneously passed through a second crystal, potassium titanyl phosphate (KTP), which converts some of the infrared light to visible light in the green portion of the spectrum. This process requires two photons of infrared light to produce one photon of green light. This conversion halves the wavelength (doubles the frequency), so the wavelength of the KTP beam (532 nm) is exactly half that of the Nd: YAG beam.

The KTP laser lends itself ideally to the surgery of chronic ear disease. Firstly, the unit delivers the laser beam via a flexible optic fibre thus avoiding bulky articulated arms and improving access to the various parts of the ear. Secondly, as the pathology is often vascular and as haemoglobin has excellent absorption of the KTP's 532 nm wavelength, this makes it an efficient coagulator. Lastly, the aiming beam and the surgical beam are the same, providing superior target accuracy (Thedinger, 1990).

Under general anaesthesia with endotracheal intubation the patient is placed in the supine position. Full laser safety precautions are taken with all personnel using goggles for eye protection. The surgeon's eyes are protected while working through the operating microscope with an automatic eye safety filter. Two primary delivery devices are available: a micromanipulator which is attached to the undersurface of the microscope and a hand-held delivery device through which the optical fibres are threaded. A range of fibre diameters are available (0.2, 0.3, 0.4 and 0.6 mm), the authors recommend a 0.2 mm fibre as it produces a small precise spot size. The fibre is threaded through a Bellucci suction tube which obviates the need to clutter the small surgical field with a separate suction to aspirate the smoke. Accurate cleaving of the fibre is necessary to ensure a sharp spot and even power distribution in the delivered beam. A power setting of two watts is used to perform the meatoplasty with continuous exposure. The procedure is usually carried out in an antero-posterior direction and the stenosis is vaporized on a broad front, without creating narrow channels, so as to avoid perforation of the tympanic membrane. The tympanic membrane is identified anteriorly so as to avoid potential damage to underlying middle ear structures in cases of inadvertent perforation or absence of the ear drum. The level of the tympanic membrane is often indicated by small bubbles appearing in the operative field. At the end of the procedure a Terracortril ointment pack is inserted and the patient discharged on the same day. The pack is removed after two weeks in the outpatient department and the patients are reviewed at three-monthly intervals until a dry patent external meatus is obtained. In several cases the pack had to be reinserted for a further period of two weeks until re-epithelialization had occurred.

Patients and methods

Eight patients who underwent KTP laser meatoplasty for otitis externa, which had entered the chronic 'fibrotic' phase with severe stenosis, were prospectively entered into the study. The following information was collected pre- and post-operatively: symptom scores using a visual analogue scale (otorrhoea, otalgia, hearing impairment and sensation of blockage), otoscopic findings (mild stenosis of the EAM: 0–33 per cent occlusion, moderate stenosis: 34–66 per cent occlusion, severe stenosis: >66 per cent occlusion) and hearing thresholds averaged over the four frequencies, 0.5 kHz, 1 kHz, 2 kHz and 4 kHz (AC and BC). The operative details and post-operative management were also documented.

Results

Eight patients, seven men and one woman, underwent a total of 10 procedures (Table I). This included one patient who had bilateral meatoplasties (5 and 9, Table I) and one patient who required revision for moderate restenosis (1, Table I). The mean age at the time of surgery was 53.6 years (range 32–62 years) and the mean follow-up period was 9.3 months (range six to 15 months).

The average operating time was 10 minutes (range 5–17 minutes) and as familiarity with the instrumentation and technique increased the operating time was reduced. In seven out of nine ears otorrhoea was

TABLE I

SUMMARY OF DATA ON PATIENTS WHO UNDERWENT KTP/532 LASER MEATOPLASTY (AVERAGE HEARING THRESHOLD AT 0.5, 1, 2 AND 4 kHz)

Age/Sex (Years)		Follow-up period (Months)	Pre-op AC threshold (dB HL)	Post-op AC threshold (dB HL)	Hearing gain (dB HL)	Reduction in air bone gap (dB HL)
1.	48/M	15	45	27.5	17.5	12.5
(Includes 1 revision procedure)						
2.	61/M	15	85	45	40	40
3.	52/M	12	55	30	25	25
4.	53/M	9	75	55	20	15
5RE	32/M	9	47.5	27.5	20	15
6.	61/M	6	62.5	37.5	25	20
7.	60/F	6	45	25	20	15
8.	62/M	6	60	30	30	25
9LE	32/M	6	45	25	20	15
Average	53.6	9.3	57.8	33.6	24.2	20.3

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reduced after the operation while in two the symptom was unchanged. Less pain was experienced in seven out of nine ears while in two the pain was unchanged. All reported that the sensation of blockage was reduced although one described fluctuation in this symptom after the operation. All patients were pleased with the improvement in hearing and described the operation as worthwhile. All patients who underwent this procedure were classified as having severe stenosis (>66 per cent occlusion of the EAM). Post-operatively only the first patient in the series had moderate restenosis (33–66 per cent) at a six month follow-up which required revision, two had asymptomatic minor restenosis (0–33 per cent) at six months which had not progressed at 12 months and none had recurrent severe restenosis.

The average improvement in air conduction hearing thresholds was 24.2 dB HL (range 17.5–40 dB HL) while the average reduction in the air bone gap was of the order of 20 dB HL (range 12.5–40 dB HL) (Table I). Using the Belfast rule of thumb, whereby significant benefit is defined as an average post-operative air conduction (AC) threshold <30 dB HL or an interaural difference <15 dB HL over the speech frequencies (0.5, 1, 2 and 4 Khz), six out of eight patients fulfilled these requirements (Smyth and Patterson, 1985).

Two patients had a tympanic perforation both of which occurred early in the learning curve of this series. One healed rapidly but the other patient has a residual perforation 12 months post-operatively. Paradoxically he had significant hearing gain (3; Table I).

Discussion

Various meatoplasty and concho-meatoplasty techniques have been described including excision of subdermal external meatal structures (Hunsaker, 1988), excision of the stenosed segment and split skin grafting (Spector *et al.*, 1979; Tos and Bonding, 1979; Paparella and Goycoolea, 1981; McDonald *et al.*, 1986; Tos and Balle, 1986; McCary *et al.*, 1995), excision and reconstruction with a local random flap (Adkins and Osguthorpe, 1981; Bell, 1988; Martin-Hirsch and Smelt, 1993), and excision and stenting (Beales and Crawford, 1966; Soliman *et al.*, 1980). These are often difficult to replicate and the results in terms of improvement in patients, symptoms and hearing gain are variable.

Although the application of laser in tympano-mastoid surgery is well recognized, its use in the treatment of chronic otitis externa has not been reported previously (Parkin, 1990; Thedinger, 1990). The indications include division of the crura and formation of the stapedotomy in otosclerosis, division of middle-ear adhesions, excision of tympanosclerotic plaques, vaporization of granulation tissue and hyperplastic mucosa from the ossicles and to vaporize any residual tympano-mastoid mucosal disease in both canal wall up and canal wall down mastoidectomies.

The KTP/532 laser meatoplasty technique described above is relatively straightforward to perform, quick (average operating time 10 minutes), and is usually undertaken as a day-case procedure. In this study canal patency was significantly improved and the average increase in air conduction hearing thresholds was 24 dB which was maintained even in those patients who were followed up to 15 months and at least six out of eight patients had significant auditory benefit using the Belfast rule of thumb. The majority of patients also noted improvement of the other otological symptoms. The rationale for this procedure is that hyperplastic and fibrotic squamous epithelium is removed by the KTP laser until healthy dermis is encountered. Regeneration of the epithelium takes place from the deep to the superficial layers.

Occasionally it may be difficult to assess the level and thickness of the tympanic membrane increasing the likelihood of a tympanic perforation. The possibility of an absent tympanic membrane, although rare, should be borne in mind so as to prevent laser damage to the underlying middle ear structures. A pre-operative CT scan is helpful in identifying the underlying anatomy.

Tos and Balle (1986) reported that patients who underwent excision and split-skin grafting were more likely to restenose in the first six months post-operatively. This was based on a five-year follow-up which showed that hearing improvement was maintained and that no further progression of the stenosis had occurred.

We recognize the limitation of these results due to the short follow-up period (mean 9.3 months) and small number of cases. A prospective study is currently underway in this department to assess the long-term results.

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