The Journal of Laryngology & Otology
April 2003, Vol. **117,** pp. 256–260

Retrospective case study of carbon dioxide laser stapedotomy with lens-based and mirror-based micromanipulators

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Abstract

Most clinical studies on carbon dioxide (CO_2) ($\lambda = 10.6$ mm) laser stapedotomy have been carried out with the laser guided by a conventional lens-based micromanipulator, with the attendant risks of correct aiming (HeNe) and surgical (CO_2) beam misalignment. Hence, engineering advances have attempted to improve laser targeting as well as the spot size focus. The development of the mirror-based micromanipulator was a response to this need but no data concerning its use in stapes surgery is available. We performed a retrospective case-series review of patients treated for otosclerosis between 1992 and 2000. Primary laser stapedotomy was performed in 218 consecutive patients. In the first 78 procedures, the aiming beam (HeNe, $\lambda = 632$ nm) and surgical beam (CO_2) were guided with a conventional lens-based micromanipulator whereas in the subsequent 140 procedures, they were guided by using a mirror-based micromanipulator. Hearing was tested at six and 12 months. The mean (SD) air-bone gap was 5 dB (4.5) and 4.5 dB (3.9). The mean closure was 15 dB (9.9) and 14.4 dB (9.4). The mean change in the high-tone bone-conduction level was 5.5 dB (7.3) and 7.8 dB (7.5). Overheating of the facial canal produced transient facial paralysis in one case and was due to misalignment of the beams with the lens-based micromanipulator. Use of the mirror-based micromanipulator obviated the need to verify alignment. The light-weight and superior optical yield of this system made it possible to reduce the number of impacts on the footplate by the integral restitution of the energy source. This study demonstrated that the CO_2 laser is an effective method for performing stapedotomy. In addition, microtrauma to the labyrinth is reduced by its ability to perform calibrated footplate fenestration without mechanical or vibrational injury to the inner ear. The optical reflection micromanipulator simplified beam alignment and enhanced surgical comfort.

Key words: Laser Surgery; Otosclerosis

Introduction

In otosclerosis surgery, a carbon dioxide (CO_2) ($\lambda = 10.6$ mm) laser is one of the lasers used to drill a hole through the stapes footplate safely (stapedectomy or stapedotomy). Advances have been made in the use of this CO_2 laser since it was first described by Lesinski in 1989.[1] Engineering advances have notably been made with respect to the precise optics between the laser source and the microscope. This has resulted in improved spot size focus[2] and the elimination of helium-neon (HeNe) ($\lambda = 632$ nm) and CO_2 beam misalignment. The development of a small, low-wattage CO_2 laser directly attached to the microscope (Unilase, I.L. Med, Walpole, MA, U.S.A.) has eliminated both the need for the optic arm and the resulting difficulties in beam alignment. It has also increased the precision of the focal point to 150 nm.[3] Unfortunately, this laser, which is directly attached to the microscope, is no longer produced and many otologists have been looking for a CO_2 laser with precision optics. The development of optical reflection systems (Unimax™ 2500, Reliant Technologies Inc., Foster City, CA, U.S.A.),[4] which replaces the conventional lens-based micromanipulators by a convex (divergent) and a concave (convergent) mirror, was a response to this technical challenge. As an additional advantage, this system can be fitted to an existing laser but, to our knowledge, no data have been published on its use in otology.

The purpose of this study was to analyse our experience with CO_2 laser stapedotomy and to review the improvements in stapes laser surgery, including the authors' personal experience with conventional lens-based and mirror-based micromanipulators.

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Accepted for publication: 9 December 2002.

TABLE I
PURE-TONE THRESHOLDS BEFORE AND AFTER PRIMARY CO_2 LASER STAPEDOTOMY IN DECIBELS OF HEARING LOSS*

	0.25 kHz	0.5 kHz	1 kHz	2 kHz	3 kHz calculated	4 kHz	8kHz
Pre-operative (n = 218)							
Bone conduction (SD)	13.3 (9.5)	26.1 (11)	27.7 (12.4)	34.5 (14.7)	32.9 (16.5)	31.3 (18.3)	
Air conduction (SD)	56.4 (14.5)	54.4 (14.2)	53 (15.1)	46.9 (17.4)	47 (20)	47 (22.5)	52 (24.7)
6 months (n = 218)							
Bone conduction (SD)	10.6 (8.8)	19.9 (10.3)	21.3 (11.1)	26.6 (15.4)	27.8 (17.1)	28.9 (18.9)	
Air conduction (SD)	27.8 (11)	26.5 (11.7)	27.5 (12.7)	29.4 (15.7)	32 (17.9)	34.6 (20.1)	49.5 (25.5)
12 months (n = 93)							
Bone conduction (SD)	11.9 (9.6)	19.2 (10.1)	20.5 (10.6)	25.6 (14.5)	26.7 (16)	27.8 (17.4)	
Air conduction (SD)	28.3 (13.1)	24.7 (12.2)	25.5 (11.7)	28.5 (15.3)	31.4 (17)	34.2 (18.7)	51.1 (25.3)

*Level 2 of the Committee on Hearing and Equilibrium guidelines
SD = standard deviation

Patients and methods

Patients

We reviewed retrospectively the clinical records of all procedures for otosclerosis performed between 1992 and 2000 at the Tours University Hospitals. A total of 381 procedures were performed: 101 stapedectomies and 280 stapedotomies. Using the stapedotomy group, we selected 218 consecutive CO_2 laser stapedotomies for the study and excluded the 62 stapedotomies performed by traditional fenestration techniques. Thus, 200 patients (140 females, 60 males) comprised the study group (18 patients (12 females and six males) had undergone bilateral procedures). One hundred and five interventions involved the right ear and 113 the left ear. The mean age at surgery was 46 years (range: between 13 and 85 years. Twenty-four per cent (48/200) of the patients had a history of familial otosclerosis. Pre-operative audiograms (Table I) showed a mean air conduction threshold of 50 dB (SD: 15) and a mean bone conduction threshold of 30 dB (SD: 12), corresponding to a mean pre-operative air-bone gap (ABG) of 20 dB (SD: 9). Tinnitus was associated with the conduction deafness in 36 per cent (79/218) of the patients and three per cent (seven out of 218) complained of dizziness.

Procedures

At the time of the survey 195 of the 280 CO_2 laser stapedotomies had been performed by the senior otologists already familiar with otosclerosis without laser. The remaining cases were the first stapedotomies performed by the junior otologist. Following local povidone-iodine (without antibiotics) preparation, local anaesthesia was given, supplemented with midazolam (0.03/kg) sedation, when possible. This allowed patients to report any vertigo when the footplate was opened and when the piston was introduced. It also allowed us to determine whether hearing had improved after replacement of the tympanomeatal flap.

Surgical technique

The surgical approach was through the auditory canal with an endaural slit incision. Laser stapedotomy and crurotomy, in the super-pulse (SP) and continuous wave (CW) modes respectively, were performed by using the CO_2 laser (30 W, 200 msec pulse duration, MD25, SSI, Inc., Nashville, TN, U.S.A.) installed on the surgical microscope. In the SP mode, the micropulse had a width of 100 msec with a peak power of 200 W. Two distinct surgical techniques were employed according to the type of micromanipulator adapted to the microscope. Initially, the CO_2 laser was coupled to a lens-based micromanipulator (Microdot manipulator, 250 nm diameter spot, SSI, Inc., Nashville, TN, U.S.A.) mounted on a surgical microscope with a 250-mm objective lens. In the second technique, the CO_2 laser was coupled to a mirror-based micromanipulator (Unimax 2500 Microspot Micromanipulator, 150 nm diameter spot, Reliant Technologies Inc., Foster City, CA, U.S.A.) mounted on a surgical microscope with a 300-mm objective lens.

Using the first technique, we performed 78 consecutive 0.6 mm calibrated stapedotomies. The surgical steps were those described by Fisch.[5] Prior to each surgical procedure, the alignment of the CO_2 and HeNe beams was checked meticulously. We then created the fenestra in the footplate (SP mode). Once stapedotomy was accomplished, the Teflon™ piston was gently withdrawn from its base and placed in the cavity above the footplate. After positioning the tip of the piston in the footplate opening, the loop was crimped along the long process of the incus. Next, the incostapedial joint was disarticulated with a lenticular scalpel and the stapedius muscle sectioned with the CO_2 laser (3 W, CW mode). We removed the stapes arch by performing a CO_2 laser crurotomy (3 W, CW mode). When access to the anterior crus was difficult, it was fractured (after posterior laser crurotomy) by tipping it towards the promontory with a 45° microhook.

In the 140 consecutive 0.6 mm calibrated stapedotomies performed by using the second technique, it was unnecessary to check the alignment of the beams. Consequently the surgical steps became more conventional, i.e. laser crurotomy (CW mode) and removal of the stapes arch preceded CO_2 laser stapedotomy (SP mode).

We did not systematically seal the stapedotomy fenestration with fat plugs. After packing the canal, the tympanomeatal flap was replaced before closing the endural incision.

TABLE II
SUMMARY OF HEARING RESULTS AFTER PRIMARY CO_2 LASER STAPEDOTOMY IN DECIBELS OF HEARING LOSS*

	6 months n = 218			12 months n = 93		
	Mean	Standard deviation	Range	Mean	Standard deviation	Range
Post-operative air-bone gap (dB)	5	4.5	0–33.1	4.5	3.9	0–18.1
Closure of air-bone gap (dB)	15	9.9	–16.3–49.4	14.4	9.4	–8.1–45.6
Change in high-tone bone conduction level (dB)	5.5	7.3	–13.3–26.7	7.8	7.5	–11.7–30
Change in Speech Reception Threshold (dB)	20.6	14.4	–50–70	23.4	15.6	–25–85

*Level 1 of the Committee on Hearing and Equilibrium guidelines

Post-operative evaluation

Hearing results and post-operative symptoms were analysed by using the Level 1 and 2 1995 AAO-HNS Committee on hearing guidelines.[6] The two surgical techniques were compared for surgical comfort and complications.

Results

Post-CO_2 laser stapedotomy evaluations were obtained in all the 218 consecutive patients at six months, and in 93 patients at 12 months. Laser stapedotomy was technically successful in all patients except one, who had a footplate fracture during crurotomy which required a posterior stapedectomy. The mean duration of surgery, measured between incision and closure, was 69 minutes (SD: 29) and no significant difference was found between the two techniques. The mean duration of surgery was 93 minutes (SD: 18) for the junior surgeon. There were no cases of tympanic membrane perforation, severe post-operative labyrinthization, or permanent facial paralysis. One patient had transient facial paresis caused by overheating of the facial canal due to a technical error, but completely recovered after three weeks. Two patients complained of post-operative dizziness. In one of the cases, the dizziness was present before stapedotomy and in the other, it resolved spontaneously after three months. In six patients (three per cent), osseous canal curettage traumatized the chorda tympani and produced prolonged, unilateral dysgeusia. The rate of tinnitus decreased from 36 to 17 per cent (37/218) and disappeared in 82 per cent (65/79) of the affected patients. In nine per cent (12/139) of the patients, tinnitus first appeared following surgery.

Hearing results are shown in Tables I, II and III. The conventional bins construction for ABG was 0–10 dB: 91 per cent and 91 per cent, 11–20 dB: eight and nine per cent, 21–30 dB: 0.5 per cent and 0 per cent, >30 dB: 0.5 per cent and 0 per cent respectively at six and 12 months. Good results, considered to be an ABG within 15 dB, were obtained in 96 per cent (210/218) of the patients at six months and in 97 per cent (90/93) of the patients after 12 months. Speech reception thresholds improved: 20.6 dB (SD: 14.4) at six months and 23.4 dB (SD: 15.6) at 12 months.

With the first technique using a conventional lens-based micromanipulator, beam alignment had to be checked; this added several minutes to the operating time. Even then, despite meticulous alignment, the HeNe and CO_2 beams could still diverge. This made the laser targeting procedure more difficult, stressful and dangerous. In one case, misalignment during footplate opening caused overheating in the facial canal. In contrast, with the second technique using the mirror-based micromanipulator, alignment does not require checking. The lightweight and superior optical yield of the two mirrors micromanipulator made it possible to reduce the amount of impact on the footplate thanks to the integral restitution of the energy source. This device made surgery easier.

Discussion

Laser stapedotomy was developed by Perkins in the United States.[7] In his 1980 report on 11 successful laser stapedotomies, he described the rosette stapedotomy technique to isolate a footplate disk which is then resected with a hook (taking care not to let it fall into the vestibule). Associated with laser crurotomy, this procedure was intended to eliminate the risk of a floating footplate, footplate fracture, or mobilization. Other enthusiastic reports on this technique soon followed[8] using an argon laser which, at the time, was the only medical laser (widely used in Ophthalmology) with sufficient precision to be used in this delicate surgery.

However, Portmann[9] then Gantz[10] expressed some reservations about this technique. While recognizing its advantages for creating the fenestra and vaporizing the muscle and the posterior branch of the stapes without mechanical or vibrational injury to the inner ear, they nonetheless noted its high cost and the associated risks of this laser. After his first 20 procedures, Portmann reported a labyrinthine syndrome of an 'intensity never before described' following classic procedures. After a series of stapedotomies in eight cats, Gantz also recognized the efficacy of the argon laser, although the procedure resulted in three perforations of the saccule in the axis of the footplate fenestra.

TABLE III
RATE OF POST-OPERATIVE RESIDUAL ABG IN PRIMARY CO_2 LASER STAPEDOTOMY

	0–10 dB	11–20 dB	21–30 dB	>30 dB
6 months n = 218	91%	8%	0.5%	0.5%
12 months n = 93	91%	9%	–	–

ABG = air-bone gap

Experimental studies in guinea pigs,[11] cats,[12] and on human temporal bone[1,3,13] demonstrated the safety of the CO_2 laser on labyrinthine structures, thereby reassuring those who feared that this laser would 'boil' the perilymph.

In 1989 and 1993, after surgical and experimental research with the CO_2 laser, Lesinski determined its safety parameters for stapedotomy and revision stapedectomy by comparing its optical and tissue characteristics with other lasers (argon and KTP-532). His experimental study evaluated the effect of footplate vaporization on the labyrinth fluids and the utricular, saccular and cochlear epithelia. The visible argon and KTP lasers have ideal optical properties for use in microsurgery[14–20] and are easily adapted to the accurate and manoeuvrable fibre-optic systems introduced in 1988 (Endo-Otoprobe, HGM Medical Laser Systems, Salt Lake City, UT, U.S.A.). However, their short wavelength makes them theoretically unsuitable for otosclerotic surgery.[3,10,13] Indeed, they are only partially absorbed by footplate structures, which require high energy levels for vaporization; thus the energy can penetrate into the perilymph and be absorbed by the pigmented tissues of the inner ear (blood vessels, neuroepithelium). Consequently, the use of these lasers in stapedotomy requires caution with low power settings (1 watt) 0.2-second pulses or less. In addition, since it is well established that a temperature greater than 40°C results in irreversible damage to the intracellular organs of the ciliated cells and vessels, these lasers should be used with care and low power settings in revision stapedectomy.

In contrast, the optical properties of the CO_2 laser are less favourable because this invisible laser must be aligned with a visible, inactive aiming beam (HeNe). With a spot size exceeding 1 mm, this laser was initially considered unsuitable for microsurgery until the development of precision micromanipulators that reduced it to 300 nm at a 250 mm focus and the advent of the Superpulse mode which limits thermal diffusion.[21] These advances now give the CO_2 laser ideal tissue characteristics: virtually complete absorption by the perilymph and stapes footplate during vaporization resulting in the absence of significant temperature elevations in the vestibule. The quality of the CO_2 laser is illustrated by Lesinski's measurements:[1] a temperature elevation of less than 0.3°C at the footplate/perilymph interface during stapedotomy and the absence of a greater than 0.5°C temperature increase in the open vestibule on direct application of the laser (2 W 0.1 sec pulse, SP mode) with a focal spot of 200 μm.

Since 1992, we, as numerous other otologists, have tried to reduce surgical trauma during stapedotomy.[22] Stapedotomy is performed using the Fisch technique which was described in 1980[5] and whose originality resides in its reversal of the classical steps of stapes surgery:[23,24] footplate fenestration and piston introduction precede extraction of the stapes arch in order to replace the length of time the labyrinth is open, thereby lowering the attendant risks of injury to the cochlea or ossicles. The prosthesis loop is crimped to an incus which is still attached to the stapes and therefore immobile, thereby minimizing the risk of incus dislocation or accidental protrusion of the piston into the vestibule. Despite this, several cases of footplate fracture have occurred. Some authors have recommended[25,26] using a diamond-charged microcutter (for gradual drilling-out of the footplate) but we feel that this solution still carries the risk of producing vibratory mechanical trauma to the footplate.

Our results, as well as those of other researchers, have shown that the laser technique for footplate fenestration has enhanced the safety of this surgical procedure. By creating a round stapedotomy at the chosen site without risk of footplate moblization, the laser has theoretically eliminated the danger of producing a floating footplate or a footplate fracture. Unfortunately, mobilization of the superstructure is still possible, especially when the anterior crus remains inaccessible to laser vaporization. In this not uncommon situation, traditional crurotomy still exposes the footplate to fracture, a complication we have encountered once. As a result, a conventional, posterior stapedectomy had to be carried out. In contrast, the reliability of this laser technique is supported by the documented reduction in injury to the labyrinth and the improvement in ABG closure; indeed, recently published data[3,15–19,27–31] demonstrated that closure to within 10 dB is achieved in more than 90 per cent of the cases.

Our experience confirms Lesinski's findings on the quality of the CO_2 laser. However, very little has been published on the use of CO_2 lasers for this indication, in contrast to the numerous reports on the use of visible lasers (argon and KTP) since Perkins' initial publication. Many otologists have questioned the efficacy of the CO_2 laser in otosclerotic surgery due to the micromanipulator, which requires straight aim from a distance, even though this drawback already existed with visible lasers before the advent of fibre-optics. This drawback can be overcome easily by choosing the access most familiar to otologists: the endaural route. By using a conventional lens-based micromanipulator to meticuously check the alignment of the two beams prior to each intervention, we have been able to minimize the risks of poor beam alignment. This adaptation appears reasonable since it diversifies the use of our CO_2 laser. We initially chose to use a power attenuator in order to define our own working and safety parameters for footplate fenestration. The results were as satisfactory as those obtained with more conventional instruments, but with the added obvious advantage of superior technical feasibility in terms of inner ear, vestibular or facial nerve injury.

The 140 consecutive stapedotomies we performed with these recently developed optical reflection micromanipulators confirms the ease of this surgical technique. Due to the continuous alignment of the two beams, the quality of the lighting, the laser energy delivered and the ease of use of the system, reservations about the use of the CO_2 laser in otosclerosis can be allayed.

Since fewer and fewer patients present with otosclerosis, it might be feared that younger surgeons will have less exposure to this kind of surgery. Hence the need for a safer technique that minimizes post-operative complications. The use of the CO_2 laser in stapes surgery is a perfect response to this need. The technique merits wider use, especially since it is the most widely used laser in the field of otolaryngology and can be used in other specialties as well.

Conclusion

Otosclerosis surgery with the CO_2 laser gives excellent results. Its use in stapedotomy and crurotomy has improved the Fisch technique by eliminating the risks of footplate fracture or mobilization. In addition, microtrauma to the labyrinth is reduced since calibrated footplate fenetration can be performed without mechanical or vibrational injury to the inner ear. The recent development of micromanipulators that simplify beam alignment and considerably enhance surgical comfort will certainly make use of this technique more widespread.

Acknowledgements

The authors are indebted to Jay Neumann, M.D., Otolaryngologist from Mobile, Alabama, and to Don Schwartz, M.D. from Tours, for their help in proofreading this paper.

References

1 Lesinski SG, Palmer A. CO_2 laser for otosclerosis: safe energy parameters. *Laryngoscope* 1989;**99**(suppl 46):9–12
2 Ossoff RH, Werkhaven JA, Raif J, Abraham M. Advanced microspot microslad for the CO_2 laser. *Otolaryngol Head Neck Surg* 1991;**105**:411–4
3 Lesinski SG, Newrock R. Carbon dioxide lasers for otosclerosis. *Otolaryngol Clin North Am* 1993;**26**:417–41
4 Gottscalk MA. Surgical-laser micromanipulator eliminates lenses. *Design News* 1994;131–3
5 Fisch U. Stapedotomy versus stapedectomy. *Am J Otol* 1982;**4**:112–7
6 Guidelines for the evaluation and results of treatment of conductive hearing loss. *Otolaryngol Head Neck Surg* 1995;**113**:186–7
7 Perkins RC. Laser stapedotomy for otosclerosis. *Laryngoscope* 1980;**90**:228–40
8 McGee TM. Laser applications in ossicular surgery. *Otolaryngol Clin North Am* 1990;**23**:7–18
9 Portmann M. Traitement chirurgical de l'otospongiose, les différentes techniques et leur critique. *Acta Oto Rhino Laryngol Belgica* 1981;**35**:458–65
10 Gantz B, Jenkins HA, Kishimoto S, Fisch U. Argon laser stapedotomy. *Ann Otol Rhinol Laryngol* 1982;**91**:25–6
11 Thoma J, Mrowinski D, Kastenbauer ER. Experimental investigations on the suitability of the carbon dioxide laser for stapedotomy. *Ann Otol Rhinol Laryngol* 1986;**95**:126–31
12 Gardner G. CO_2 Laser stapedotomy. Is it practical? *Am J Otol* 1984;**5**:108–17
13 Lesinski SG, Palmer A. Laser for otosclerosis: CO_2 *vs.* Argon and KTP-532. *Laryngoscope* 1989;**99**(suppl 46):1–8
14 Bartels LJ. KTP laser stapedotomy: Is it safe? *Otolaryngol Head Neck Surg* 1990;**103**:685–92
15 Causse JB, Gherini S, Horn KL. Surgical treatment of stapes fixation by Argon laser stapedotomy with reconstruction of the annular ligament. *Otolaryngol Clin North Am* 1993;**26**:395–416
16 Gherini S, Horn KL, Bowman CA, Griffin G. Small fenestra stapedotomy using a fibreoptic hand-held Argon laser in obliterative otosclerosis. *Laryngoscope* 1990;**100**:1276–82
17 Gherini S, Horn KL, Causse JB, McArthur GR. Fibreoptic argon laser stapedotomy: Is it safe? *Am J Otol* 1993;**5**:283–9
18 Hodgson RS, Wilson DF. Argon laser stapedotomy. *Laryngoscope* 1990;**101**:230–3
19 Rauch SD, Bartley ML. Argon laser stapedectomy: comparison to traditional fenestration techniques. *Am J Otol* 1992;**5**:556–60
20 Silverstein H, Rosenberg S, Jones R. Small fenestra stapedotomies with and without KTP laser: a comparison. *Laryngoscope* 1989;**99**:485–8
21 Wong BJ, Neev J, Van Gemert MJ. Surface temperature distributions in carbon dioxide, Argon, with KTP (Nd:YAG) laser ablated otic capsule and calvarial bone. *Am J Otol* 1997;**6**:766–72
22 Lescanne E, Robier A, Soin C, Manceau A, Benlyazid A, Beutter P. Otosclerosis surgery: a series of 227 cases. Introduction of CO_2 laser. *Ann Otolaryngol Chir Cervicofac* 1999;**116**:28–36
23 Pedersen CB. The use of small fenestra technique with the Fisch piston in the surgical treatment of otosclerosis. *J Laryngol Otol* 1987;**101**:542–7
24 Conrad GJ. Collective stapedectomy, an approach to the numbers problem. *J Laryngol Otol* 1990;**104**:390–3
25 Causse JB, Causse JR, Parahy CH. Stapedotomy technique and results. *Am J Otol* 1985;**6**:68–71
26 Mangham CA. Reducing footplate complications in small fenestra microdrill stapedotomy. *Am J Otol* 1993;**14**:118–21
27 Molony TB. CO_2 laser stapedotomy. *J La State Med Soc* 1993;**145**:405–8
28 Buchman CA, Fucci MJ, Roberson JB Jr, De La Cruz A. Comparison of Argon and CO_2 laser stapedotomy in primary otosclerosis surgery. *Am J Otolaryngol* 2000;**21**:227–30
29 Antonelli PJ, Gianoli GJ, Lundy LB, LaRouere MJ, Kartush JM. Early post-laser stapedotomy hearing thresholds. *Am J Otol* 1998;**19**:443–6
30 Poe DS. Laser-assisted endoscopic stapedectomy: a prospective study. *Laryngoscope* 2000;**110**:1–37
31 Sedwick JD, Louden CL, Shelton C. Stapedectomy *vs* stapedotomy. Do you really need a laser? *Arch Otolaryngol Head Neck Surg* 1997;**123**:177–80

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Dr E. Lescanne takes responsibility for the integrity of the content of the paper.
Competing interests: None declared