

## Ossiculoplasty: a UK survey

G DHANASEKAR, H K KHAN, N MALIK, F WILSON, V V RAUT

### Abstract

The aim of this study was to assess and quantify the current surgical practice of ossiculoplasty among British otolaryngology consultants, using a postal questionnaire. Ossiculoplasty is not a very common procedure. It is only performed by otologists with a special interest in ossiculoplasty. Among the 280 respondents (response rate 51.9 per cent), only 179 (63.9 per cent) performed ossiculoplasty. The majority of the consultants (86.5 per cent) used artificial prostheses, and 63.7 per cent used patients' own ossicles (autografts). Most of the consultants (77.6 per cent) performed ossiculoplasty with primary tympanoplasty surgery rather than with primary cholesteatoma surgery (46.3 per cent). The majority of the consultants (50.8 per cent) performed less than 10 ossiculoplasties per year.

This is the first survey on ossiculoplasty surgery in the United Kingdom.

**Key words:** Ear Ossicles; Otolgic Surgical Procedures; Questionnaires; Great Britain

### Introduction

In the last several decades, we have seen a variety of materials used to reconstruct the sound-conducting mechanism of the middle ear. From the USA, Emmet,<sup>1</sup> in 1989, briefly reviewed the history of otological implants and surveyed several otologists in an attempt to determine the most commonly used reconstructive materials at that time. Many reconstructive materials have come and gone since then. However, current practice in the UK has never been assessed, prompting this survey to ascertain and evaluate the current practice of ossiculoplasty amongst UK otolaryngologists.

The only previous, similar ossiculoplasty survey was conducted by Goldenberg and Emmet<sup>2</sup> in the USA in 2001.

### Materials and methods

A postal questionnaire (Appendix 1) on ossiculoplasty surgery was sent to 539 consultant members of the British Association of Otolaryngologists & Head and Neck Surgeons. The questionnaire contained 31 questions enquiring about the consultant, the indication and timing of surgery (including the types of prosthesis used), operative technique, and post-operative care. Replies were collected over a 12-week period.

### Results

The response rate in our study was 51.9 per cent (280/539). Of the 280 respondents, only 179 (63.9 per cent) performed ossiculoplasty; 135/280 (48.2 per cent) performed revision ossiculoplasty. The following results are based only on the 179 respondents who performed ossiculoplasty.

Twenty-seven (15 per cent) respondents would refer patients for a hearing aid or bone-anchored hearing aid. The otolaryngologists who did perform ossiculoplasty often used a variety of materials (case-dependent) during surgery: 114 (63.7 per cent) used patients' own ossicles (i.e. autografts); 58 (32.4 per cent) used cartilage; 61 (34.1 per cent) used cartilage and bone; 30 (16.7 per cent) used bone alone; and 155 (86.5 per cent) used artificial prostheses. Of respondents performing ossiculoplasty, 55.8 per cent (100/179) used hydroxyapatite prostheses, while 18.4 per cent (33/179) used hydroxyapatite with titanium prosthesis. Only 10 per cent (18/179) of the consultants in our survey used titanium-only prostheses.

One hundred and thirty-nine (77.6 per cent) respondents performed ossiculoplasty with primary tympanoplasty surgery; only 83 (46.3 per cent) performed ossiculoplasty with primary cholesteatoma surgery.

The majority of respondents (166, 92.7 per cent) performed ossiculoplasty under a general anaesthetic.

From the Department of Otolaryngology/Head & Neck Surgery, New Cross Hospital, Wolverhampton, UK.

This paper was presented at the joint ENT UK, Royal Society of Medicine and Scottish Otolaryngology Society Summer Meeting, Royal College of Surgeons, Edinburgh, Scotland, UK, 7–8 September 2005.

Accepted for publication: 21 March 2006.

One hundred and fifty-six (87.1 per cent) respondents performed ossiculoplasty for unilateral conductive loss. Only a minority (36, 20.1 per cent) would offer or perform ossiculoplasty in the only hearing ear. One hundred and twenty-five (69.8 per cent) respondents performed bilateral ossiculoplasties and 70 (39.1 per cent) would wait for at least a year before operating on the second ear. Ninety-one (50.8 per cent) did less than 10 ossiculoplasties per year, whereas 59 (32.9 per cent) performed between 15 and 20 ossiculoplasties per year.

Post-operatively, 50 respondents (27.9 per cent) routinely used antibiotics. Almost all of the respondents (170, 94.9 per cent) restricted patients from swimming, and 139 (77.6 per cent) restricted patients from driving, flying or strenuous work post-operatively. Eighty-one (45.2 per cent) respondents would restrict all the above mentioned activities for four to six weeks post-operatively. Thirty-six (20.1 per cent) respondents followed up their patients for one year, 75 (41.8 per cent) followed up their patients for up to three years, and 37 (20.6 per cent) followed up their patients for five years.

**Discussion**

The reconstruction of the tympanic membrane and the sound-conducting mechanism of the middle ear is the contribution of tympanoplasty to the original efforts in the surgical treatment of chronic otitis media.<sup>3,4</sup> Many combinations of graft position,<sup>5</sup> ossicular interposition,<sup>6,7</sup> cartilage<sup>8,9</sup> or bone struts,<sup>10-12</sup> and various types of solid plastic or metal implants<sup>13-21</sup> have been used. Each technique is plagued with its own particular problems, including graft failure, implant extrusion, and persistent or recurrent conductive hearing loss.<sup>5-27</sup>

Amongst otologists, there are essentially two schools of thought with regard to reconstruction of the sound-conducting mechanism. One school believes that biocompatible implant materials are more substantial and less foreign than autograft or homograft human tissue that has been harvested, stored and processed before being used as implants. This belief is certainly borne out by our survey, in which 86.5 per cent (155/179) of respondents showed their preference for biocompatible implants. Certainly in the UK, homografts are not licensed for

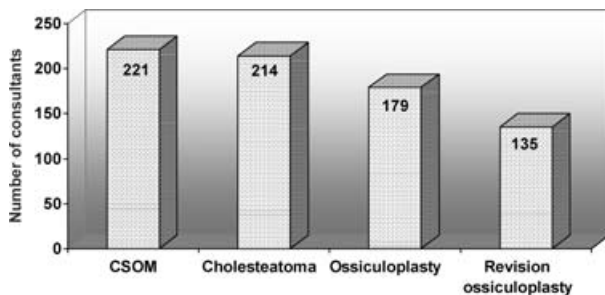


FIG. 1

Otological procedures performed by the 280 respondents.

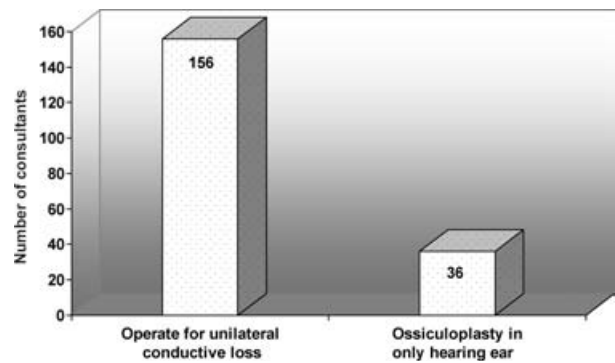


FIG. 2

Indications for ossiculoplasty (based on the 179 respondents who performed ossiculoplasty).

use. However, in Belgium, homografts are routinely used in middle-ear surgery. Plastic and metallic implants have been used in otolaryngological surgery for a long time. Shea<sup>28,29</sup> was the first to use polyethylene tubing to reconstruct the middle-ear sound-conducting mechanism in tympanoplasty.

Hydroxyapatite, a calcium bioceramic, has the same chemical composition as living bone. It is one of the biocompatible implants which have been successfully used since the 1970s. Grote,<sup>30,31</sup> Wehrs<sup>32,33</sup> and Goldenburg,<sup>34,35</sup> in various studies, have reported the long-term success of hydroxyapatite. In our survey, 55.8 per cent (100/179) of respondents used hydroxyapatite prostheses, while 18.4 per cent (33/179) used hydroxyapatite with titanium.

Titanium is another biocompatible implant which has been very popular among otologists for the last decade. According to Ho *et al.*,<sup>36</sup> titanium implants result in considerable hearing improvement compared with other materials. The extrusion rate seems quite low if a cartilage interposition graft is used. Its ease of handling, biocompatibility and sound-conducting properties improve its efficacy as an ossicular implant.<sup>36</sup> Krueger *et al.*<sup>37</sup> performed initial evaluation of the Kurz titanium prostheses and found low extrusion rates with

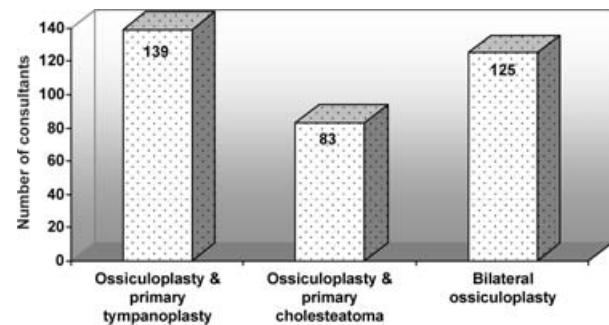


FIG. 3

Combination surgical procedures (based on the 179 respondents who performed ossiculoplasty).

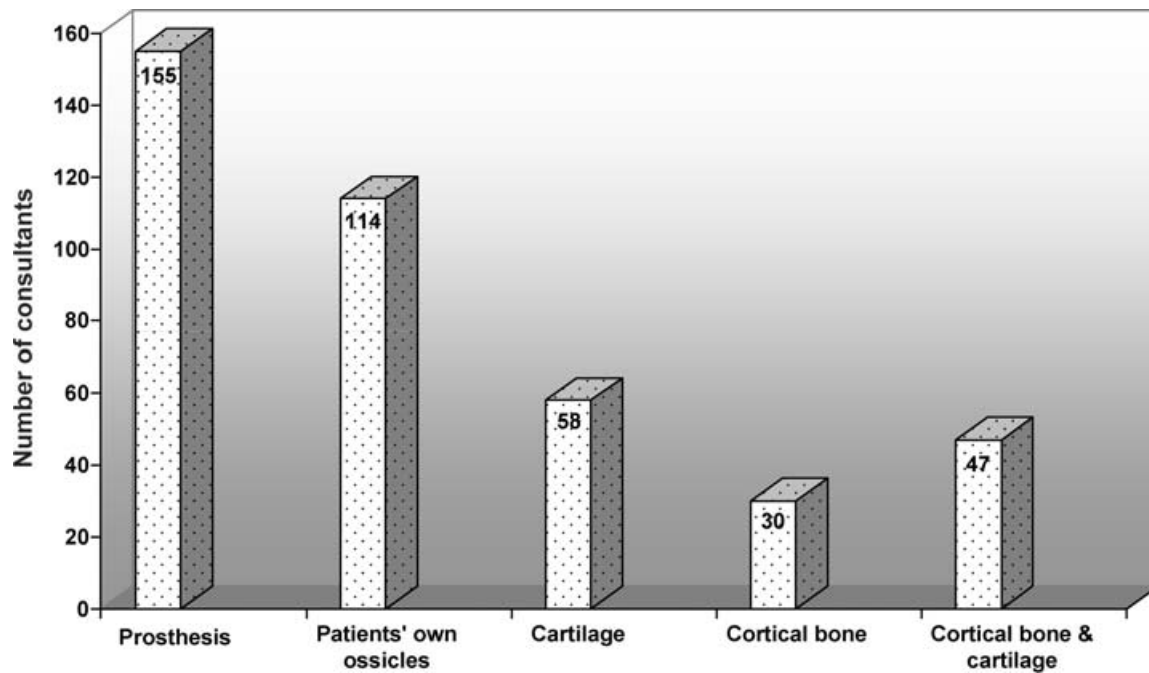


FIG. 4

Materials used in ossiculoplasty (based on the 179 respondents who performed ossiculoplasty).

excellent hearing results, including good high frequency conduction. Good visualization and accurate placement are amongst the listed advantages of titanium prostheses. From Germany, the study of Maassen *et al.*<sup>38</sup> revealed that the titanium implant was significantly superior to other types in all measured aspects, based on the results of 383 of their 400 ossiculoplasties. Titanium is gradually gaining popularity in the UK, as reflected in our survey, with 10 per cent (18/179) of respondents using titanium prostheses.

The other school of thought believes that the middle ear should not be violated by nonliving material and that only human material – usually bone or cartilage – should be used to reconstruct the sound-conducting mechanism. In our survey, 114 (63.7 per cent) of respondents used patients' own ossicles (i.e. autografts), while 58 (32.4 per cent) used cartilage and 61 (34.1 per cent) used cartilage and bone. Only 30 (16.7 per cent) respondents used bone alone.

The three most popular alloplastic materials used in ossiculoplasty are plastipore, hydroxyapatite and titanium, as noted in a literature review by Yung assessing use of alloplastic materials in ossiculoplasty.<sup>39</sup> Certainly, in our survey, the most commonly used alloplastic materials were hydroxyapatite and titanium.

The majority of the UK consultants surveyed (156, 87.1 per cent) currently offered ossiculoplasty for unilateral conductive loss. The risk of operating on the sole remaining hearing ear, although present, is not the same as that in otosclerosis surgery. Hence, 20.1 per cent of respondents in our survey would offer or perform ossiculoplasty in the only hearing

ear. One hundred and twenty-five (69.8 per cent) performed bilateral ossiculoplasties.

A study by Vartiainen and Nuutinen<sup>40</sup> found that the best hearing results were obtained in ears with intact stapes, while cholesteatomatous ears showed poorer results than other ears with chronic pathology. These authors showed that autologous ossicle and cortical bone are suitable for ossicular reconstruction in chronic ears, especially when one-stage surgery is preferred. Interestingly, in our survey, 139 (77.6 per cent) respondents performed ossiculoplasty with primary tympanoplasty surgery, whereas 83 (46.3 per cent) performed ossiculoplasty with primary cholesteatoma surgery. There seems to be a growing trend towards a one-stage procedure, even in cholesteatomatous ears.

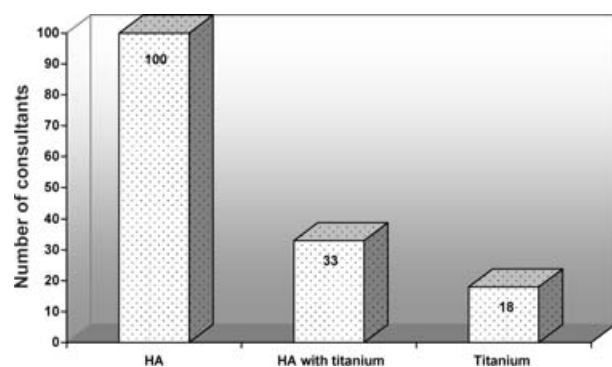


FIG. 5

Types of prosthesis used in ossiculoplasty (based on the 179 respondents who performed ossiculoplasty). HA = hydroxyapatite.

- **This study documented the current surgical practice of ossiculoplasty among British otolaryngology consultants, using a postal questionnaire**
- **Artificial prostheses were used in preference to autograft ossicles, with hydroxyapatite and titanium being the favoured materials**
- **The majority of those responding (50.8 per cent) undertook less than 10 ossiculoplasties per year**

## References

- 1 Emmett JR. Biocompatible implants in tympanoplasty. *Am J Otol* 1989;**10**:215–19
- 2 Goldenberg RA, Emmet JR. Current use of implants in middle ear surgery. *Otol Neurotol* 2001;**22**:145–52
- 3 Zollner I. Principles of plastic surgery of sound conducting apparatus. *J Laryngol Otol* 1955;**69**:637–52
- 4 Wullstein H. Theory and practice of tympanoplasty. *Laryngoscope* 1956;**66**:1076–93
- 5 Sheehy JL. Ossicular problems in tympanoplasty. *Arch Otolaryngol* 1965;**81**:115–22
- 6 House WF, Patterson ME, Linthicum FH. Incus homo-grafts in chronic ear surgery. *Arch Otolaryngol* 1966;**84**:148–53
- 7 Pulec JL, Sheehy JL. Tympanoplasty: ossicular chain reconstruction. *Laryngoscope* 1973;**83**:448–65
- 8 Jansen C. Cartilage tympanoplasty. *Laryngoscope* 1963;**73**:1288–302
- 9 Goodhill V. Tragal perichondrium and cartilage in tympanoplasty. *Arch Otolaryngol* 1973;**85**:480–91
- 10 Bauer M. Bone autograft for ossicular reconstruction. *Arch Otolaryngol* 1966;**83**:335–8
- 11 Austin DF. Ossicular reconstruction. *Otolaryngol Clin North Am* 1972;**5**:145–60
- 12 Austin DF. Ossicular reconstruction. *Arch Otolaryngol* 1971;**94**:525–35
- 13 Sheehy JL. Plastic sheeting in tympanoplasty. *Laryngoscope* 1973;**83**:1140–59
- 14 House WF, Sheehy JL. Functional restoration in tympanoplasty. *Arch Otolaryngol* 1963;**78**:98–101
- 15 Waltner JG. Dumbell tympanoplasty. *Arch Otolaryngol* 1966;**83**:339–42
- 16 Palva A, Karja J. Results with two or three-legged wire columellization in chronic ear surgery. *Ann Otol Rhinol Laryngol* 1971;**80**:760–5
- 17 Palva T, Palva A, Karja J. Ossicular reconstruction in chronic ear surgery. *Arch Otolaryngol* 1973;**98**:340–8
- 18 House HP. Polyethylene in middle ear surgery. *Arch Otolaryngol* 1960;**71**:926–31
- 19 Harrison WH, Shambaugh GE, Kaplan J, Derlacki EL. Prosthesis in the middle ear. *Arch Otolaryngol* 1959;**69**:661–6
- 20 Hayden GD. Results with polyethylene T-strut in the restoration of hearing. *Laryngoscope* 1961;**71**:504–11
- 21 Plester D. Problems in tympanoplasty. *Laryngol Otol* 1961;**75**:879–4
- 22 Jensen C. Methods of ossicular reconstruction. *Otolaryngol Clin North Am* 1972;**5**:97–109
- 23 Smyth DGL. Tympanic reconstruction. *Otolaryngol Clin North Am* 1972;**5**:111–25
- 24 Garcia-Ibanez L. Sonoverion in obliterative otosclerosis. *Arch Otolaryngol* 1965;**82**:340–5
- 25 Siedentop KH, Brown RC. Type III polyethylene columella tympanoplasty. *Arch Otolaryngol* 1966;**83**:56–5
- 26 Wolferman A. Reconstructive surgery of the middle ear. New York: Grune & Stratton, 1970:143–5
- 27 Harrison WH. Ossicular reconstruction. *Arch Otolaryngol* 1969;**96**:525–35
- 28 Shea JJ. Tympanoplasty in chronic right otitis media. *Memphis Med* 1958;**33**:271–5
- 29 Shea JJ. Vein graft closure of eardrum perforations. *Northwest Med* 1960;**59**:770–2
- 30 Grote JJ. Tympanoplasty with calcium phosphate. *Arch Otolaryngol* 1984;**110**:197–9
- 31 Grote JJ. Total artificial middle ear – preliminary report. *Am J Otol* 1995;**16**:797–800
- 32 Wehrs RE. Hydroxyapatite implants for otologic surgery. *Otolaryngol Clin North Am* 1995;**28**:273–86
- 33 Wehrs RE. Incus replacement prosthesis of hydroxyapatite middle ear reconstruction. *Am J Otol* 1989;**10**:181–2
- 34 Goldenberg RA. Reconstruction of the middle ear using hydroxyapatite hybrid prosthesis. *Oper Tech Otolaryngol Head Neck Surg* 1992;**3**:225–31
- 35 Goldenberg RA. Hydroxyapatite ossicular replacement prosthesis: preliminary results. *Laryngoscope* 1990;**100**:693–700
- 36 Ho SY, Battista RA, Wiet RJ. Early results with titanium ossicular implants. *Otol Neurotol* 2003;**24**:149–52
- 37 Krueger WW, Feghali JG, Shelton C, Green JD, Beatty CW, Wilson DF *et al.* Preliminary ossiculoplasty results using the Kurz titanium prostheses. *Otol Neurotol* 2002;**23**:836–9
- 38 Maassen MM, Lowenheim H, Pfister M, Herberhold S, Jorge JR, Baumann I *et al.* Surgical handling properties of the titanium prosthesis in ossiculoplasty. *Ear Nose Throat J* 2005;**84**:142–4, 147–9
- 39 Yung MW. Literature review of alloplastic materials in ossiculoplasty. *J Laryngol Otol* 2003;**117**:431–6
- 40 Vartiainen E, Nuutinen J. Long-term hearing results of one-stage tympanoplasty for chronic otitis media. *Eur Arch Otorhinolaryngol* 1992;**249**:329–31

## Appendix 1. Ossiculoplasty questionnaire

Please tick one box for each question.

### About yourself

- 1 Have you been a consultant for: under 10 years <sup>1</sup>, 10 to 20 years <sup>2</sup>, or over 20 years <sup>3</sup>?
- 2 Do you work in a teaching hospital <sup>4</sup>, or district general hospital <sup>5</sup>?
- 3 Do you routinely perform surgery for CSOM? Yes <sup>6</sup> or No <sup>7</sup>
- 4 If Yes, approximately how many cases per year? <sup>8</sup>
- 5 Do you routinely perform surgery for cholesteatoma? Yes <sup>9</sup> or No <sup>10</sup>
- 6 If Yes, approximately how many cases per year? <sup>11</sup>
- 7 Do you perform ossiculoplasties? Yes <sup>12</sup> or No <sup>13</sup>. If No, please stop at Q 8.
- 8 If No, do you refer to a colleague in the same hospital <sup>14</sup> or in another hospital <sup>15</sup>, or provide a hearing aid if suitable (including BAHA) <sup>16</sup>?
- 9 If Yes, on average, how many ossiculoplasties do you perform each year? <sup>17</sup>
- 10 Do you perform revision ossiculoplasties? Yes <sup>18</sup> or No <sup>19</sup>

### Indications and timing of surgery

- 11 Do you operate for unilateral conductive loss? Yes <sup>20</sup> or No <sup>21</sup>
- 12 Do you perform ossiculoplasty in an only hearing ear? Yes <sup>22</sup> or No <sup>23</sup>
- 13 If No, reasons (please specify): <sup>24</sup>
- 14 Do you perform ossiculoplasty with primary tympanoplasty surgery? Yes <sup>25</sup> or No <sup>26</sup>

- 15 Do you perform ossiculoplasty with primary cholesteatoma surgery? Yes <sup>27</sup> or No <sup>28</sup>
- 16 If No to Q 14 or Q 15, is it (can tick more than one): due to risk of failure <sup>29</sup> or risk of SN loss <sup>30</sup>
- 17 Do you perform bilateral ossiculoplasties? Yes <sup>31</sup> or No <sup>32</sup>
- 18 If Yes, how long do you wait before doing the second side? \_\_\_<sup>33</sup>

#### *Operative technique*

- 19 Do you prefer to perform ossiculoplasties under LA <sup>34</sup> or GA <sup>35</sup>?
- 20 Do you routinely use patient's own ossicles? Yes <sup>36</sup> or No <sup>37</sup>
- 21 Do you use cartilage, Yes <sup>38</sup> or No <sup>39</sup>, or cortical bone, Yes <sup>40</sup> or No <sup>41</sup>?
- 22 Do you use homograft ossicles? Yes <sup>42</sup> or No <sup>43</sup>
- 23 Do you use prostheses? Yes <sup>44</sup> or No <sup>45</sup>
- 24 If Yes, which do you prefer? HA only <sup>46</sup>, HA with titanium <sup>47</sup>, titanium only <sup>48</sup> or other (please specify): \_\_\_<sup>49</sup>
- 25 Do you use different materials for different situations? Yes <sup>50</sup> or No <sup>51</sup>
- 26 Do you use fibrin glue, Yes <sup>52</sup> or No <sup>53</sup>, or bone cement, Yes <sup>54</sup> or No <sup>55</sup>?

- 27 Do you cover the prosthesis with fascia only <sup>56</sup>, perichondrium only <sup>57</sup>, cartilage + perichondrium only <sup>58</sup>, cartilage + fascia <sup>59</sup>, or none of the above <sup>60</sup>?

#### *Post-operative care*

- 28 Do you routinely use antibiotics after ossiculoplasty? Yes <sup>61</sup> or No <sup>62</sup>
- 29 Do you restrict driving, flying or strenuous work post-operatively? Yes <sup>63</sup> or No <sup>64</sup>  
If so, for how long? \_\_\_<sup>65</sup>
- 30 Do you restrict swimming or water sports post-operatively? Yes <sup>66</sup> or No <sup>67</sup>  
If Yes, after how many days do you allow swimming? \_\_\_<sup>68</sup>
- 31 How long do you follow up these patients? Up to 1 yr <sup>69</sup>, 1-3 yrs <sup>70</sup>, up to 5 yrs <sup>71</sup>, up to 10 yrs <sup>72</sup> or lifelong <sup>73</sup>

Address for correspondence:

Mr G Dhanasekar,  
6, Woodhayes Croft,  
Wolverhampton WV10 8PP, UK.

E-mail: dhanasekarent@aol.com

---

Mr G Dhanasekar takes responsibility for the integrity of the content of the paper.  
Competing interests: None declared

---