CHEVRON OR WILSON METATARSAL OSTEOTOMY FOR HALLUX VALGUS
A PROSPECTIVE RANDOMISED TRIAL

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We compared the chevron and the Wilson metatarsal osteotomy for hallux valgus in a prospective randomised trial on 87 feet in 51 patients, reviewed at averages of 5.5 and 38 months after operation.

The patients in the chevron group returned to work earlier and mobilised faster, but, at the later review, those in the Wilson group had better functional results and were more satisfied with the appearance of the foot. Correction of the hallux valgus angle was better maintained in patients in the Wilson group and they had a better range of motion at the metatarsophalangeal joint; fewer complained of metatarsalgia.

Received 29 October 1992; Accepted after revisions 25 March 1993

More than 130 operations have been described for hallux valgus (Kelikian 1965). The 'chevron osteotomy' uses a horizontal 'V' division of the first metatarsal head to correct the deformity (Johnson, Cofield and Morrey 1979; Austin and Leventen 1981; Lewis and Feffer 1981), and has been reported to give good results with few complications (Horne, Tanzer and Ford 1984). Mann (1982) has warned, however, that the potential complications include avascular necrosis, malalignment of the metatarsal head, excessive shortening of the metatarsal, and overcorrection.

The Wilson osteotomy is a simple procedure which causes little soft-tissue damage (Helal 1974, 1981). Double obliquity of the cut, in both longitudinal and coronal planes, improves the bony stability and reduces the need for internal fixation (Helal, Gupta and Gojaseni 1974; Helal 1981).

We report a prospective randomised trial of the chevron and Wilson osteotomies for the correction of hallux valgus.

PATIENTS AND METHODS

Fifty-one consecutive patients (44 women and 7 men) with unilateral or bilateral hallux valgus gave their informed consent before entering the trial. The type of osteotomy for each patient was randomised by the use of a computer-generated list. In bilateral cases, both feet had the same selected operation during the same operating session. The Wilson group included 42 feet in 26 patients (3 with rheumatoid arthritis) with an average

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Fig. 1

Methods used to measure the hallux valgus angle (x, left), the intermetatarsal angle (x, right), and shortening of the first metatarsal from standard weight-bearing anteroposterior radiographs. The percentage shortening of the first metatarsal is expressed as a/b before operation, divided by a'/b' at review, × 100.

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0301-620X/93/5637 $2.00
age of 45 years ± 11.4 SD (20 to 77). The chevron group comprised 45 feet in 25 patients (4 with rheumatoid arthritis) with an average age of 45 years ± 8.6 SD (23 to 72).

Preoperative assessments included the site of pain, the degree of discomfort from the exostosis, and the presence of plantar callosities and metatarsalgia. We also recorded the major indications for surgery according to the patients; better appearance was a major concern of five patients, 37 wanted relief of pain, and 31 wanted easier, better shoe-fitting.

**Radiography.** Radiographs were taken preoperatively, at 6, 12 and 24 months and at final review. Standard weight-bearing anteroposterior views were studied to measure the hallux valgus angle, the intermetatarsal angle and the shortening of the first metatarsal (Fig. 1). A 60° internal oblique view, giving true laterals of the first metatarsals, was used to assess postoperative displacement of the distal fragment.

**Footprints.** Harris and Beath mats were used to record changes in the distribution of weight (Harris and Beath 1947).

**Operative techniques.** All the operations were performed with a thigh tourniquet, through a 5 to 8 cm dorsomedial incision centred over the first metatarsophalangeal joint (MTPJ). The skin was closed with interrupted Ethilon. **Wilson osteotomy** (Fig. 2a). The first MTPJ was not exposed. A double oblique 45° osteotomy was performed using an oscillating saw. The distal fragment was then displaced laterally. The obliquity of the cut provided a 'roof' over the distal fragment to reduce the risk of dorsal angulation. Where necessary, the bony spike of the osteotomy was trimmed, but exostectomy was not routine.

After skin closure and application of dressings, a below-knee plaster was applied, with an extension to hold the hallux in its corrected position. A walking heel was added after 48 hours and the patient was discharged from hospital on the following day. The plaster was removed six weeks later.

**Chevron osteotomy** (Fig. 2b). A distally based 'V'-shaped flap of the medial capsule of the MTPJ was raised, the joint was opened and the exostosis excised with a saw. A drill was used to mark the centre of the metatarsal head and to penetrate the lateral cortex to facilitate completion of the osteotomy. Soft-tissue stripping was minimised, the lateral capsule being preserved to protect the blood supply of the metatarsal head. An oscillating saw was used to cut a horizontal 'V'-shaped osteotomy in the metatarsal head, taking great care not to split it. The head was then displaced laterally, rotated to the required position, and impacted on to the metatarsal shaft. The prominent medial shaft was excised flush with the metatarsal head, and the medial capsular flap was sutured to the periosteum of the metatarsal shaft only along its superior margin in order not to limit MTPJ extension. After soft-tissue closure, a carefully applied wool and crepe bandage was used to hold the toe in its corrected position. After 48 hours, weight-bearing was allowed as tolerated. dressings were changed by the operating surgeon after two weeks and discarded at four weeks.

**Review.** Patients were reviewed at an average of 5.5 months and again at 38 months after operation. At the later review, 50 patients were assessed by JKK, who had not been involved in the initial treatment. Only one patient, a 20-year-old woman, refused to be reviewed. She had had bilateral chevron osteotomies and a poor result at the early review.

Because some patients were not willing to attend hospital, they were examined at home, and radiographs were not taken. Of the 42 feet in the Wilson group, 31 radiographs of 23 patients were available. Of the 45 feet in the chevron group, 36 radiographs in 22 patients were available.

**Statistical analysis.** The data were analysed using Systat (Leland 1988). When a patient had bilateral hallux valgus, we used the average of the hallux valgus angle, the metatarsal shortening value and range of motion on the two sides. One- or two-way analysis of variance (ANOVA) was then used to evaluate differences between the two groups. ANOVA for repeated measures was used for overall differences between preoperative, early and late postoperative findings. A post hoc Student's t-test for paired measures was used to assess differences.

For patients with bilateral hallux valgus, the pres-
ence of callosities and of metatarsalgia was recorded when at least one foot was affected, and a chi-squared test was used to analyse the data. Significance was set at the 0.05 level.

RESULTS

Postoperative follow-up. Thirty-seven Wilson osteotomies in 23 patients and 41 chevron osteotomies in 23 patients were re-examined, at an average of 22 weeks (11 to 40). Twenty-six patients (42 feet) in the Wilson group and 24 patients (43 feet) in the chevron group were also re-examined respectively at an average of 37 months (10 to 45) and 38 months (9 to 45) postoperatively.

Radiography. The average preoperative hallux valgus angle was $29^\circ \pm 7.9^\circ$ SD (26 to 41) in the Wilson group and $30^\circ \pm 8.8^\circ$ (27 to 40) in the chevron group. At early review, the hallux angle in the Wilson group had been corrected to $14.5^\circ \pm 6.9^\circ$ (9 to 21) compared with $21.2^\circ \pm 8.3^\circ$ (15 to 26) in the chevron group. At the later review, the Wilson group had maintained correction with an average of $13.3^\circ \pm 8.1^\circ$ (9 to 22) while in the chevron group the angle had increased to $25.7^\circ \pm 10^\circ$ (20 to 27). The difference between the two groups was statistically significant at both early ($p = 0.004$) and late review ($p = 0.0005$).

The Wilson osteotomy produced an average shortening of 10 mm (6 to 20) compared with an average of 6 mm (0 to 11) after the chevron procedure ($p = 0.02$). No patient complained of having a short hallux. Elevation of the metatarsal head was only appreciable on the early review radiographs, and was seen in six feet (14% of those in the Wilson group). By the later review, remodelling had obscured the original position of the distal fragment. Depression of the metatarsal head was seen in five patients after chevron osteotomy and in three after Wilson osteotomy.

Functional assessment. Before operation the passive arc of motion of the first MTPJ in the Wilson group was $63^\circ \pm 6^\circ$ SD (51 to 72) and in the chevron group $57^\circ \pm 9^\circ$ (50 to 62). At early review, the mean ranges were not significantly different, at $29^\circ \pm 7^\circ$ (21 to 45) and $31^\circ \pm 9^\circ$ (25 to 45). At later review, the Wilson group had regained an average of $42^\circ \pm 11^\circ$ (31 to 55) compared with $36^\circ \pm 8^\circ$ (26 to 42) after the chevron procedure. Only one patient after a unilateral Wilson osteotomy had a final range of less than $30^\circ$ compared with 11 (17 feet) in the chevron procedure. In both groups the great toe was weight-bearing in 86% of feet.

Metatarsalgia and callosities. Despite the greater shortening, only five patients in the Wilson group as against ten in the chevron group complained of central metatarsalgia. New central callosities had developed in seven patients (nine feet) in the Wilson group and in five feet (three patients) in the chevron group. One foot in a patient with bilateral hallux valgus lost central callosities after a Wilson osteotomy compared with four patients (five feet) in the chevron osteotomy group. None of these differences was statistically significant.

Footprints. Using the Harris and Beath footprint method, 12 feet of the Wilson group (29%) showed evidence of increased central ray loading compared with seven after a chevron osteotomy (16%) (Fig. 3).

Fig. 3a

Preoperative (a) and 35-month review (b) Harris and Beath footprints in a patient who had a double oblique Wilson osteotomy. There is evidence of increased central ray loading.

Fig. 3b

Functional results. Rehabilitation was more rapid after chevron osteotomy because of the absence of plaster immobilisation. These patients returned to work at $7 \pm 1.2$ weeks SD (5 to 9) after surgery, compared with $10 \pm 3$ weeks (7 to 14) for the Wilson group.

At early review, 22 of the chevron group had unlimited walking distances while only seven of the Wilson group had no limitation. By the later review, the Wilson group had improved: only four complained of limited walking distance compared with five of the chevron group. About three-quarters of the patients in both groups were able to run.

Thirty-one patients gave improved shoe-fitting as one of the indications for surgery. Preoperatively, 12 patients in the Wilson group had needed special broad-fitting shoes; only three still needed them at late review. Of the 15 patients requiring broad shoes before the chevron procedure eight still required them at late review.
Complications. Table I gives the complications. No patient had radiological or clinical signs of partial or total avascular necrosis after chevron osteotomy. No Wilson osteotomy failed to unite. Nine chevron procedures in eight patients were failures, as compared with five Wilson osteotomies in three patients.

Chevron procedure. Two of the nine failures in the chevron group were probably due to poor clinical selection. One was a 34-year-old woman with rheumatoid arthritis and valgus deviation of the lesser toes, in addition to hallux valgus. The other toes were not corrected, and after an initially good correction, the hallux drifted back into valgus. The second was also in a 34-year-old woman who had minimal hallux valgus with a relatively short first metatarsal. Surgery shortened the metatarsal further. The MTPJ became stiff with only 20° movement, the hallux no longer bore weight, and painful central callosities developed. The other seven failures were multifactorial, due to five stiff MTPJs in four patients, metatarsalbrid in four and recurrence of deformity in six. Wilson procedure. One of the five failures in the Wilson group (in 3 patients) was due to poor selection. A 50-year-old woman with rheumatoid arthritis had bilateral hallux valgus of 50° with subluxed minor toes and painful plantar callosities. Helal metatarsal osteotomies of the central rays were combined with Wilson osteotomies. The wounds were slow to heal and there was foot oedema. All MTPJs became stiff and the hallux valgus deformity and metatarsalgia recurred.

Another bilateral failure in this group was caused by bilateral MTPJ stiffness after an early low-grade infection. Metatarsalgia under the second metatarsal heads was treated satisfactorily by Helal osteotomies. The third failure was on one side in a bilateral case. First metatarsal shortening with loss of plantar flexion of the hallux led to secondary metatarsalgia under the second metatarsal head.

DISCUSSION

Few comparative or prospective studies have been reported for the many surgical techniques used for this common condition.

Our average correction of hallux valgus angle is similar to that reported by Cetti and Christensen (1983). In his original paper, Wilson (1963) reported only one complete recurrence, and two patients with a valgus angle greater than 20° in a series of 34 osteotomies. The smaller correction achieved by the chevron method has been reported by Lewis and Feffer (1981) and Grill et al (1986) with average corrections of 19° at three years and by Johnson et al (1979) of 18° at ten months.

Stiffness of the first MTPJ was the commonest cause of a poor result in our series. This prevented weight-bearing on the hallux and led to transfer of load to the lateral metatarsal heads (Henry and Waugh 1975; Grace, Hughes and Klenerman 1988). Such stiffness was less frequent after the Wilson osteotomy, and a high incidence has previously been reported for the chevron osteotomy. Horne et al (1984) followed 76 feet for three years, and found that 26 had less than 30° of motion at the first MTPJ. It is clear that soft-tissue dissection around the joint causes stiffness in proportion to its extent (Helal et al 1974).

Shortening is inevitable with the Wilson osteotomy; our average of 10 mm is similar to that reported previously (Dooley 1968). It did not correlate, however, with the development of metatarsalgia. We found that post-operative metatarsalgia was more directly related to insufficient plantar displacement of the first metatarsal head (Mitchell et al 1958). Grace et al (1988) have shown that depression of the first metatarsal head tended to prolong toe-contact time.

Our use of double obliquity in the Wilson osteotomy helps to maintain plantar displacement and our results support Mitchell’s concept that this also helps to compensate for metatarsal shortening. Despite our modification, however, elevation of the metatarsal head was apparent radiographically in 20% of the feet. Internal fixation may have prevented this, but increased dissection may have caused more joint stiffness.

The chevron osteotomy has been considered to be less technically demanding than a Mitchell osteotomy, with more stability, and no need for cast immobilisation (Austin and Leventen 1981). Other authors consider that it is less stable, and requires additional fixation by a bone peg (Johnson et al 1979), or by a modification of its shape (Lewis and Feffer 1981). In our series, the main cause of poor correction was probably stretching of the medial capsuloplasty. Use of a cast mould reduces loss of correction, but may well have increased stiffness.

Excessive capsular dissection may lead to avascular necrosis of part or all of the metatarsal head (Mann 1982; Horne et al 1984) since, after osteotomy, the only remaining blood supply is from the capsule (Jaworek 1973). We took care to preserve the lateral capsule and saw no signs of avascular necrosis.

Both procedures showed a significant incidence of

<table>
<thead>
<tr>
<th>Complication</th>
<th>Wilson (n=42)</th>
<th>Chevron (n=45)</th>
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</thead>
<tbody>
<tr>
<td>Early swelling</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Hallux varus</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Slow healing of wound</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Recurrence of bunion</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Dorsal spike</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Comminuted osteotomy</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Stress fracture of third metatarsal</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Dysesthesia or hypoesthesia</td>
<td>4</td>
<td>4</td>
</tr>
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complications. Most were trivial, but about 20% of our patients were dissatisfied with the result in terms of pain relief, shoe-fitting, or appearance. Many had the false impression that the hallux should be straight after operation, not appreciating that 10° to 25° of hallux valgus is normal. Patients should be better informed before operation, and be made aware that no operation for the correction of hallux valgus can have totally successful results.

We thank Mr M. J. Evans, FRCS and Mr R. R. H. Coombs, FRCS for allowing us to study their patients.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


