TOTAL REPLACEMENT OF THE FIRST METATARSOPHALANGEAL JOINT

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Various prostheses for total replacement of the first metatarsophalangeal joint for painful hallux valgus and hallux rigidus are briefly discussed. Altogether, the results of eighty-six replacements in sixty-nine patients have been recorded after an average interval of two years. In seventy-eight operations a Silastic* prosthesis as designed by Swanson for the replacement of metacarpophalangeal joints was used, with no case of fracture or deep infection up to date. Overall, the assessment of pain showed that 98 per cent of operations gave either complete or considerable relief. For hallux valgus, the objective assessment showed excellent or good results in 79 per cent, fair in 16 per cent and poor in 5 per cent. For hallux rigidus the corresponding figures were 86, 14 and 0. The technique of replacement described promises to be most satisfactory, especially for hallux rigidus. In selected cases of hallux valgus, a basal osteotomy of the first metatarsal should be added.

Many operations for hallux valgus and hallux rigidus have been based on the excision arthroplasties of Keller (1904) or of Mayo (1908) and on arthrodasis of the first metatarsophalangeal joint (Clutton 1894). Although these procedures have given good results, they are open to criticism. Excision arthroplasty is a destructive operation that relies on the formation of a pseudarthrosis. The Keller procedure may leave a shortened great toe with poor function (Bonney and Macnab 1952), whereas the Mayo operation removes the weight-bearing surface of the head of the first metatarsal and so disturbs the general distribution of pressure on the metatarsal heads (Morton 1930). Arthrodasis, of course, gives an almost rigid toe, and the position of fusion, if not ideal, can give rise to symptoms, often from undue pressure over the interphalangeal joint (Fitzgerald 1969).

Prosthesis used. The present report is based on experience gained from replacement of the gap left by resection of the first metatarsophalangeal joint. In four cases a Silastic block measuring 1.8×1.2×1.2 centimetres and shaped by ourselves was inserted, and in five cases a Swanson great toe prosthesis. In both these procedures, although satisfactory results were obtained, there was no stabilising effect. A Calnan-Nicolle polypropylene finger prosthesis was therefore used in three cases, but one fractured and was therefore removed. Seventy-eight replacements with a Swanson finger prosthesis (Swanson and Herndon 1977), usually a size 7 or 8 with a shortened distal stem, were then performed (Fig. 1). The results were the same whether the prosthesis was placed in its orientation for use in the hand or "upside down". This prosthesis requires minimal bone resection, confers mobility with inherent stability, and gives a satisfactory cosmetic appearance. The operation entails excision of both joint surfaces, which we consider desirable for the relief of joint pain.

*Silastic is a registered trademark of Dow Corning Corporation.

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Fig. 1

Diagrams of replacement for hallux valgus showing (left) the bone to be resected and (right) the prosthesis in situ.

TECHNIQUE OF OPERATION

Under general anaesthesia and using an exsanguinating tourniquet, the joint is exposed through a dorsomedial incision. The capsule is incised parallel to the inner side of the tendon of extensor hallucis longus, and the articular surfaces and exostoses are then exposed. In a case of hallux valgus the medial exostosis is excised with a reciprocating power saw. In a similar way the part of the metatarsal head that is covered by articular cartilage is excised, and approximately 8 millimetres (a third of an inch) of the base of the proximal phalanx, measured from the rim (Fig. 2).
The medullary cavities of the first metatarsal and of the proximal phalanx are then reamed out just enough to take the stems of the prosthesis (Fig. 3) and the size required is determined by trial. The distal stem is shortened by one centimetre and the prosthesis inserted firmly without cement (Fig. 4). It is important that the box section is well formed near the shoulder of the prosthesis so as not to allow rotation within the medullary canal. If necessary, the tendon of extensor hallucis longus is lengthened. The capsule is carefully closed over the prosthesis, the skin sutured, and a pressure dressing of polyethylene foam bandage applied.

Postoperative care. On the first day, foam pads are applied to the foot and limited walking without an aid is encouraged. Patients are discharged as soon as they can walk satisfactorily. Sutures are removed on the fourteenth day.

Additional procedures. The tendon of extensor hallucis longus was lengthened in Z manner in eleven cases. In the present series basal osteotomy of the first metatarsal was performed in only one of several cases of marked metatarsus varus (Fig. 5). Nine operations on the second toe were performed, mainly wire arthrodesis for hammer toe.
RESULTS

This analysis follows the progress of eighty-six replacements performed on sixty-nine patients, seventeen of whom had the operation done on both feet. There were fifty-nine women and nine men, aged from twenty to seventy-six years with an average of fifty-one (Fig. 6). The distribution of the operations in relationship to the major symptom of the patient is shown in Table I and to the diagnosis in Table II. The length of time between operation and review varied from seven months to five and a half years, with an average of two years.

![Histogram showing age distribution of patients under review.](image)

**Fig. 6**

Postoperative progress. The duration of stay in hospital for unilateral cases ranged from one to ten days, with an average of six days. For bilateral cases the average was eight days. In forty-nine working patients the average length of time away from employment was two months for a unilateral case and two and a half months after bilateral operation. It was difficult to determine how long it took the patients to return to wearing normal shoes, but in sixty-one patients who could give a precise answer the average was eleven weeks.

Complications. There was delayed wound healing in eleven cases, one requiring excision of an area of skin necrosis. There was no case of proven deep infection.

Two patients had to have the prosthesis removed. The first was one of three in whom a polypropylene prosthesis had been inserted; the proximal stem had fractured after a year. The second had persistent unaccountable pain, but at the time of removal no fault was found. A joint space was maintained and no further resection of bone was required, but the pain was not relieved.

So far no fracture of a Swanson prosthesis has been detected, but even should this happen in any of the present seventy-eight cases it is unlikely to jeopardise the result as adequate fibrous encapsulation must already have occurred.

**Table I. Distribution of replacement in relationship to the major symptom of the patient**

<table>
<thead>
<tr>
<th>Major symptom</th>
<th>Number of patients</th>
<th>Unilateral</th>
<th>Bilateral</th>
<th>Number of replacements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>65</td>
<td>50</td>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>Difficulty with shoes</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Unsightly appearance</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>52</td>
<td>17</td>
<td>86</td>
</tr>
</tbody>
</table>

**Clinical review**

All the sixty-nine patients were seen by the authors for review and were assessed both subjectively and objectively.

**Subjective assessment (Fig. 7).** The patients were asked these questions—whether their symptoms with regard to pain, difficulty with shoes and cosmetic appearance of the toe were much improved and all that was expected; improved but not all that was expected; unchanged; or worse. As for pain, 72 per cent were much improved, 26 per cent improved, and only 2 per cent worse. The assessment regarding footwear was made difficult by...
the fact that many patients had little or no trouble before operation; however, 70 per cent came into the improved category. With regard to appearance, nearly 90 per cent felt that this had improved or much improved; only 3 per cent were worse, mainly due to shortening.

**Objective assessment**

**Movements.** Both passive and active movements of the replaced joints were measured by goniometer (Table III). Few patients could plantarflex actively beyond 10 degrees but a good range of active dorsiflexion (20 to 40 degrees or even more) was obtained in two-thirds of the cases.

**Tenderness.** This was present after ten replacements, and in eight was related to the artificial joint. In one foot there was a tender callosity on the inner side of the interphalangeal joint, and in another the tenderness was confined to the lateral side of the tendon of extensor hallucis longus.

**Malrotation of the hallux.** In six feet the hallux was rotated medially and in four laterally. In only five was this sufficient to cause symptoms, mainly due to callosities on the interphalangeal joint. The inward rotation usually present in severe hallux valgus was not totally corrected.

**Bunions and callosities.** In one replacement there was a recurrence of deformity. There were nine further callosities of the hallux related to the metatarsal head, and five to the interphalangeal joint. In eleven feet there were callosities beneath other metatarsal heads, but as the presence or absence of callosities before operation had not been recorded, the significance of this finding could not be assessed.

**Interphalangeal joint changes.** Because of the changes after arthrodesis reported by Fitzgerald (1969), these joints were critically examined in all cases at review. Significant stiffness was noted in only two joints, one of them painful. Unfortunately the range of movement had not always been recorded before operation, but later interest has shown that some degree of stiffness is often present.

**Power of push-off.** An attempt was made to measure this by using a spring balance to record the power of resistance to dorsiflexion. In the fifty-seven toes thus measured the average resistance was 6 kilograms, or about half the normal.

**Metatarsalgia.** Six patients complained of metatarsalgia. In two this was generalised whereas in the other four pain was localised to the region of the second or third metatarsal heads.

**Radiological assessment**

Radiographs of both feet with the patient standing were taken at the time of review. In fourteen patients who had seventeen replacements, radiographs taken before operation were not available. Therefore sixty-nine pairs of radiographs could be compared.

**Length of the hallux.** This was shorter in thirty-seven cases, preserved in twenty-nine and increased in three. Early in the series a deliberate attempt was made to shorten the toe by half a centimetre in order to relax the capsule of the joint, but this practice has been abandoned.

**Table III.** The ranges of movement recorded at review

<table>
<thead>
<tr>
<th>Movement</th>
<th>Active</th>
<th>Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dorsiflexion</td>
<td>0°–20°</td>
<td>31</td>
</tr>
<tr>
<td>20°–40°</td>
<td>29</td>
<td>35</td>
</tr>
<tr>
<td>40° or more</td>
<td>26</td>
<td>33</td>
</tr>
<tr>
<td>Plantar flexion</td>
<td>Up to 10°</td>
<td>75</td>
</tr>
<tr>
<td>Over 10°</td>
<td>11</td>
<td>18</td>
</tr>
</tbody>
</table>

**Joint space.** There was no new bone formation around sixty-three joints. Minor encroachment was present in four and in two it was moderate. The radiographic appearance bore no correlation to the clinical result.

**Correction of valgus.** The percentage of correction in thirty-three cases of hallux valgus was calculated. It ranged from 20 to 75 per cent, the average being 43 per cent.

**The interphalangeal joint.** In four cases, there was evidence of increasing degenerative change. In no case was this severe, but the relatively short length of the follow-up must be taken into account.

**Final classification**

The results were classified into four groups: Excellent—hallux valgus less than 15 degrees, no bunion, no pain, and the total range of passive movement 50 degrees or more; Good—valgus up to 15 or 20 degrees, no bunion, no pain, and at least 30 degrees of passive movement; Fair—valgus of up to 25 degrees, slight bunion or slight pain or total passive movement less than 30 degrees; and Poor—either recurrent valgus to the amount before operation, recurrent bunion, or a dorsiflexion deformity.

For hallux valgus, 79 per cent of the results were regarded as excellent or good, 16 per cent as fair and 5 per cent as poor. For hallux rigidus, 86 per cent of the results were excellent or good, 14 per cent fair and none poor.

**DISCUSSION**

To the multiplicity of operations already described for the treatment of hallux valgus and hallux rigidus total joint replacement has recently been added. The Swanson type of Silastic metacarpophalangeal pros-
thesis seems to have no specific disadvantages apart from the actual cost of the appliance. On the other hand the advantages are several: it helps to avoid or greatly reduce shortening, which is most useful in patients with an already short first metatarsal; it allows a satisfactory range of passive movement; it avoids instability and hence gradual loss of alignment; because the procedure does not rely on the formation of a painless pseudarthrosis, delayed or partial weight-bearing after operation is unnecessary, as are various methods of distraction of the bone ends; and it leaves that part of the foot cosmetically acceptable.

It has become apparent from this review that total replacement gives the best results in cases of hallux rigidus. In the patient with severe hallux valgus and a broad forefoot due to varus of the first metatarsal, the deformity is not fully corrected by replacement alone. When the varus can be largely reduced by transverse compression of the forefoot, a basal osteotomy should be added; the early results of this combined procedure, which has now almost become routine, are most encouraging.

The relatively short-term results in this series would appear to compare favourably with the long-term results reported of Keller's operation (Cleveland and Winart 1950), Mayo's procedure (Rix 1968) and of arthrodesis of the first metatarsophalangeal joint (Fitzgerald 1969).

REFERENCES