Function after correction of a clawed great toe by a modified Robert Jones transfer

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We carried out a cross-sectional study in 51 patients (81 feet) with a clawed hallux in association with a cavus foot after a modified Robert Jones tendon transfer. The mean follow-up was 42 months (9 to 88). In all feet, concomitant procedures had been undertaken, such as extension osteotomy of the first metatarsal and transfer of the tendon of the peroneus longus to peroneus brevis, to correct the underlying foot deformity. All patients were evaluated clinically and radiologically.

The overall rate of patient satisfaction was 86%. The deformity of the hallux was corrected in 80 feet. Catching of the big toe when walking barefoot, transfer lesions and metatarsalgia, hallux flexus, hallux limitus and asymptomatic nonunion of the interphalangeal joint were the most frequent complications. Hallux limitus was more likely when elevation of the first ray occurred (p = 0.012). Additional transfer of the tendon of peroneus longus to peroneus brevis was a significant risk factor for elevation of the first metatarsal (p < 0.0001).

The deforming force of extensor hallucis longus is effectively eliminated by the Jones transfer, but the mechanics of the first metatarsophalangeal joint are altered. The muscle balance and stability of the entire first ray should be taken into consideration in the management of clawed hallux.

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Operative correction of a clawed hallux is a challenge. The abnormality is usually part of a complex foot deformity and is commonly associated with a neuromuscular disorder and intrinsic muscle weakness. A number of causes have been suggested. With loss of intrinsic power extensor hallucis longus (EHL) and flexor hallucis longus become deforming forces. Most patients have painful corns on the dorsum of the interphalangeal (IP) joint from pressure of footwear and callosities under the first metatarsal (MT) head, which is frequently prominent because of increased plantar flexion of the first ray and shortening of the plantar fascia in a cavus foot.

Numerous operations have been proposed. Jones popularised the transfer of EHL to the neck of the first MT with release of the plantar fascia in the manually correctable claw toe. A modified operation including fusion of the IP joint to correct fixed flexion at this joint secondary to unopposed pull of flexor hallucis longus has long been well accepted.

Our aim in this retrospective study was to assess and discuss the clinical, functional and radiological outcome in all patients who had a modified Jones procedure at our hospital.

Patients and Methods

We retrospectively reviewed 81 feet (40 left, 41 right) in 51 patients (32 men, 19 women) in whom a modified Jones transfer had been carried out between 1990 and 1997 for treatment of a clawed hallux in association with a cavus varus foot deformity. Before operation, all the patients had complained of either dorsal corns and/or pressure symptoms under the first MT head. The mean age at operation was 24.5 years (6 to 56). The age range at follow-up was from nine to 57 years. The diagnosis was a cavus foot with a progressive neuromuscular disorder in 36, a cavus foot because of a static neuromuscular disorder in ten and various other causes in five. The mean follow-up was for 42 months (9 to 88). The senior author (LD) either carried out or assisted at all except two operations. A basal extension osteotomy was added in 58 feet with fixed plantar flexion of the first MT. Transfer of the tendon of peroneus longus (PL) to peroneus brevis (PB) was considered necessary in 24 because of weakness of the tibialis posterior/PB...
couple, and tibialis anterior tendon transfer for weakness of extensor digitorum longus or the peroneal muscles in 36 feet with a split transfer in 11. All patients had at least one concomitant procedure to correct fixed deformities of the hindfoot (Table I).

Operative technique. The modified Robert Jones EHL transfer was carried out by passing the freed distal tendon through a horizontal drill hole in the neck of the first MT. It was sutured to itself under slight tension with the ankle in full extension and with passive elevation of the first ray. In patients with fixed plantar flexion of the first ray in whom an extension osteotomy of the first MT was considered necessary, this was fixed with Kirschner wires before securing the transferred tendon of EHL. The IP joint was resected and the arthrodesis fixed by percutaneous crossed Kirschner wires for a period of six weeks. Passive mobility of the metatarsophalangeal (MTP) joint was assessed and ensured. All feet were immobilised for a minimum period of six weeks in a below-knee non-weight-bearing cast. Radiographs were then taken and the Kirschner wires removed. In the feet with additional midfoot or hindfoot osteotomies the period of immobilisation was extended for a further four to six weeks in weight-bearing casts. After the removal of the cast, temporary protective custom-made orthopaedic shoes were worn for six months. All patients had physiotherapy for at least three months.

The patients were evaluated using the same standardised protocol both clinically and radiologically. Patient satisfaction was graded as very pleased, pleased but some reservations or unhappy. Pain was graded as either none, mild to moderate or severe. In patients with bilateral procedures the subjective assessment was noted for each foot separately. Clinical evaluation included the passive range of movement at the ankle and first MTP joint, active dorsiflexion and elevation of the first ray to assess the transfer of EHL, the presence and function of extensor hallucis brevis (EHB), the presence and extent of plantar callosities under the MT heads, problems of the nail-bed of the great toe, hallux flexus (HF) and hallux limitus (HL; defined as painful stiffness at the IP joint).

Radiological evaluation included measurements of the lateral talometatarsal angle before and after surgery to detect elevation of the first MT, the presence of degenerative changes at the first MTP joint and union of the IP joint and the basal MT osteotomy. In 21 feet, no preoperative standing lateral radiographs were available for evaluation.

Statistical analysis. All patients had more than one operative procedure. We therefore chose a multivariate statistical approach to identify potential risk factors for the outcome. We used a stepwise logistic regression analysis with concomitant procedures as independent variables. At each step the independent variable with the smallest level of significance ($p \leq 0.05$) is entered into the model. The algorithm ends when all of the remaining variables have a significance level of $p > 0.05$. Significance of bivariate associations was assessed using Fisher’s exact test. P values $\leq 0.05$ were considered to be significant. All statistics were calculated using SPSS 7.5 for Windows.

### Table I. Concomitant procedures carried out in 51 patients

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peroneus longus to peroneus brevis</td>
<td>24</td>
</tr>
<tr>
<td>Tibialis anterior transfer (complete)</td>
<td>25</td>
</tr>
<tr>
<td>Split tibialis anterior transfer</td>
<td>11</td>
</tr>
<tr>
<td>Closing-wedge dorsal proximal osteotomy of the first metatarsal</td>
<td>58</td>
</tr>
<tr>
<td>Plantar fascia release</td>
<td>24</td>
</tr>
<tr>
<td>Triple arthrodesis</td>
<td>15 - 37</td>
</tr>
<tr>
<td>Anterior tarsal wedge osteotomy</td>
<td>17</td>
</tr>
<tr>
<td>Lengthening of tendo Achillis</td>
<td>29</td>
</tr>
<tr>
<td>Calcaneal osteotomy</td>
<td>6</td>
</tr>
<tr>
<td>Closing-wedge dorsal proximal osteotomies of the second to fifth metatarsals</td>
<td>7</td>
</tr>
<tr>
<td>Hibbs procedure</td>
<td>19 - 8</td>
</tr>
<tr>
<td>Bony procedures of the lesser toes</td>
<td>24</td>
</tr>
<tr>
<td>Tendon procedures of the lesser toes</td>
<td>6</td>
</tr>
<tr>
<td>Transfer of tibialis posterior</td>
<td>54</td>
</tr>
<tr>
<td>Extensor augmentation procedures</td>
<td>6</td>
</tr>
</tbody>
</table>

### Table II. Patient satisfaction related to predominant postoperative symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Very pleased</th>
<th>Pleased with reservations</th>
<th>Unhappy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of feet</td>
<td>36</td>
<td>38</td>
<td>7</td>
<td>81</td>
</tr>
<tr>
<td>No symptoms</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Pain first MT head</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Transfer metatarsalgia</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Transfer lesions</td>
<td>3</td>
<td>15</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>Painful corns on lesser toe</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Painful dorsal corn first MTP with hallux flexus</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Catching of great toe walking barefoot</td>
<td>19</td>
<td>29</td>
<td>0</td>
<td>48</td>
</tr>
<tr>
<td>Ankle pain (impingement)</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>
Results

**Patient satisfaction.** Patient satisfaction was related to the predominant postoperative symptom as shown in Table II. Catching of the great toe was not a notable problem. In the group ‘pleased with reservations’ this symptom was the main complaint in four feet. No pain was experienced in 48 feet (59%), mild to moderate pain (MTP-joint, metatarsalgia and/or ankle joint) in 32 (39%) and severe pain secondary to HR in one foot.

**Clinical assessment.** There was free mobility of the first MTP joint (Fig. 1) in 29 of 81 feet (36%). HF and HL (Fig. 2) were noted in 26 (32%), HF in a further six (7%), HL in a further 18 (22%), and HR in four. There was no correlation between HL and/or HF and the diagnosis. HL was present in 31 of 48 patients (65%) complaining of catching and HF in 20 feet (42%). In one foot, regeneration of the EHL occurred, and in nine there was active dorsiflexion at the first MTP joint in the presence of a strong EHB. None of these ten feet showed HL, but one had HF. There was no correlation between the diagnosis and the power of EHB.

In 20 feet there were postoperative problems of the nailbed with recurrent ingrown toe nails or infections; 17 had either HF and/or HL.

**Abnormalities of gait.** Disturbance of gait with either premature lift-off of the heel or a pattern of avoidance of roll-over (Fig. 3) was noticed in 63 feet, of which 44 (70%) had HL. In 12 feet there was subjective catching, but not HF or HL.

**Elevation of the first ray.** Clinically and radiologically, an elevated first ray with dorsal prominence of the head of the first MT (Fig. 4) was noted in 25 feet (31%). In 21 of these (84%) a transfer of the PL to the PB tendon had been carried out, while ten feet also had an additional basal extension osteotomy of the first MT. In three feet, no elevation of the first MT occurred after both of these procedures. In 41 of 44 feet (93%) with osteotomy of the first MT but without transfer of PL to PB there was no elevation of the first ray. PL to PB transfer was the only significant risk factor (Fisher’s exact test, p < 0.0001) for producing elevation of the first ray. In feet with elevation of the first MT the incidence of HL, but not HF, was twice as high as in feet with no elevation (Fisher’s exact test, p = 0.012). Transfer lesions with callosities under the head of the fifth MT were evident in 64% (16 of 25) and dorsal...
corns in 44%. There was no correlation with additional transfer of tibialis anterior, regardless of which of the above procedures had been combined.

Radiological union. There was radiological nonunion of the IP joint in nine feet (11%) with no correlation with HL or HF. None of these had symptoms; seven were in children (aged 6 to 11 years). Malalignment with recurrent clawing was present in one child with nonunion. No child had damage to growth plates because of fixation with Kirschner wires. All 58 extension osteotomies united.

Discussion

The modified Robert Jones procedure proved to be effective for correction of clawing and relief of pain, with a high degree of patient satisfaction. HF with secondary catching of the great toe did not cause distress, perhaps because most patients were pleased with the relief of pain and the improved appearance after correction of the severe cavus deformity.

It is difficult for the patient to assess the first ray independently from the overall result. Several clinical rating systems have been proposed, but none is particularly satisfactory. Although the data would have been sufficient to calculate the ‘hallux metatarsophalangeal-interphalangeal scale’, we found the various categories to be unsuitable for the assessment.

It is difficult to restore muscle balance by tendon transfer which may explain why transfer of the PL to the PB was the most significant factor in elevation of the first MT. Although it is difficult to define a clear indication or contraindication for transfer of the PL to PB to augment a
weak PB, we cannot recommend this procedure in the passively correctable foot since overcorrection may result. Postoperative elevation of the first ray is most likely to be secondary to muscle imbalance and can lead to increased weight transfer through the lateral MT with transfer lesions, pain and/or corns as a consequence.

When there is a fixed deformity with plantar flexion of the first ray an additional basal dorsal wedge extension osteotomy should be considered. Nonunion of the IP joint, as a complication of fusion, is well documented.

The use of screws is attractive, but it may be difficult to control rotation. There is also discomfort at the tip of the hallux because of prominence of the screw which may have to be removed later.

The postoperative problem of HF associated with the loss of active dorsiflexion at the MTP joint is well recognised. Duchenne anticipated this and stressed the importance of preserving the EHB to obviate subsequent dropping of the toe. Wagner transplanted the long extensor of the little toe to the base of the proximal phalanx to avoid HF. Kirk et al suggested a tendon tenodesis of the EHL, but published only five cases. HL has not previously been described as a complication after the modified Jones procedure and is most likely to occur if no active dorsiflexion can be generated at the MTP joint. Furthermore, transfer of the PL to the PB is a significant risk factor if elevation of the first MT has occurred. Since there is no standard definition of HL, we used passive dorsiflexion of less than 20° as the criterion. For normal gait, at least 55° are considered necessary. We do not know the long-term complications of HL, but eventually joint degeneration may result, as occurred in four of our patients, one of whom required a Keller arthroplasty.

Both HF and HL may result in disturbances of gait which may be aggravated further by extensor weakness. In the absence of HF, HL alone does not result in avoidance of roll-over as passive dorsiflexion at the MTP joint is still possible. We carried out gait analysis in a limited number of patients and there was a good correlation with our visual assessment. More comprehensive studies and further research using a pedobarograph are required.

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