Correction of hammer toe with an extended release of the metatarsophalangeal joint

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Between March 1995 and January 2000 we reviewed retrospectively 84 patients with hammer-toe deformity (99 feet; 179 toes) who had undergone metatarsophalangeal soft-tissue release and proximal interphalangeal arthroplasty. The median follow-up was 28 months. Patients were assessed by the American Orthopaedic Foot and Ankle Society Scores (AOFAS) and reviewed by independent assessors.

The median AOFAS score was 83, with 87% of patients having a score of more than 60 points; 83% were satisfied and 17% were dissatisfied with the procedure. Pain at the metatarsophalangeal joint was the commonest cause of dissatisfaction, with 14% having moderate or severe pain. Only 2.5% had instability and 9% had formation of callus.

There was no statistical difference for the age and gender of the patients, the number of toes operated on, associated surgery for hallux valgus or length of follow-up. Our study was based on an anatomical model and shows good results with no recurrence of deformity.

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Deformities of the lesser toes are a common source of discomfort in the forefoot. Hammer toe and claw toe are terms which are often used interchangeably. As a result, their definition is somewhat confusing.¹ A hammer toe is, however, generally considered to be one in which there is a flexion contracture of the proximal interphalangeal joint (PIPJ). The metatarsophalangeal joint (MTPJ) is frequently hyperextended.² A claw toe is generally considered to be

one in which there is a flexion contracture of the distal interphalangeal joint.³

The aetiology of the hammer toe appears to be multifactorial. It may be associated with hallux valgus, trauma, inflammatory arthritis, contracted flexor digitorum longus, diabetes, disease of the lumbar disc, neuromuscular abnormalities, postural deformities,² congenital deformity⁴ and instability of the MTPJ.⁵ Shoes are often considered to be an important cause of hammer toes, with the confinement of high-heeled, pointed shoes playing a major role.¹ Hammer-toe deformity is one of the commonest problems of the forefoot in shoe-wearing societies.¹

Since the first description of an extensor tenotomy for hammer toes, many techniques have been described.⁶ These have included arthrodesis of the PIPJ,^{7,8} resection of the distal part of the proximal phalanx,² resection of the base of the proximal phalanx,⁹ resection of the metatarsal head,¹⁰ and transfer of extensor and flexor tendons.¹¹⁻¹³ These have all been moderately successful. There has, however, been an unacceptably high rate of recurrence for some of these procedures.¹⁴

Harmonson and Harkless¹⁵ reviewed the literature on the operative procedures for the correction of hammer and claw toes and found no comparative studies with objective data. Myerson and Shereff¹⁰ described the pathological anatomy of hammer and claw toes in a cadaver model. They dissected feet with these deformities and determined the contributions made by the soft tissues to any deformities of the MTPJ and PIPJ. The skin, tendons, joint capsule and collateral ligaments were sequentially released and the extent of correction and joint mobility was determined. They found that an extensive soft-tissue release was necessary for the adequate correction of hammer toes. Mann¹⁶ subsequently questioned the lack of clinical data to support the theoretical model of Myerson and Shereff.¹⁰ Our technique for the correction of hammer toes is based on this model and we present our results.

Patients and Methods

We have used a simple classification of hammer toes based on the flexibility of the MTPJ and PIPJ (Table I). For type-1 toes we performed a transfer of the tendon of flexor digitorum longus. For type-3 toes, we performed an open

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Table I. Classification of deformities of the toes. The PIPJ is tested in 20° plantar flexion in order to relax the long flexor tendon

Type	MTPJ	PIPJ
1	Flexible	Flexible
2	Flexible	Rigid
3	Subluxed/dislocated and irreducible	Fixed

reduction, stabilisation and Weil osteotomy¹⁷ or the procedure of Stainsby and Briggs.⁹ Our treatment of type-2 toes was based on the model of Myerson and Shereff.¹⁰

All patients who underwent surgery for symptomatic type-2 toes (i.e. with flexible MTPJs and fixed PIPJs) between March 1995 and January 2000 were included in the study. Patients were assessed retrospectively. Case notes were reviewed and age, gender, preoperative signs and symptoms, other associated forefoot pathology, and details of surgery were recorded.

The patients were reviewed by independent assessors (VD or SH) at a minimum follow-up of 12 months. Assessment was by the American Orthopaedic Foot and Ankle Society scores (AOFAS) for the lesser toes¹⁸ in which the higher the score the better the outcome. Patients were also asked about their satisfaction and whether or not they would recommend the operation to a close family member.

For statistical analysis we used the Mann-Whitney U test with significance set at $p \leq 0.05$.

Operative procedure. The operation was normally a day-case procedure done under general, spinal or regional anaesthesia. A single dose of a broad-spectrum antibiotic was administered at induction. The patient was placed supine and a tourniquet was applied unless there was a specific contraindication. Interdigital incisions were made between the second and third MTPJs and the fourth and fifth MTPJs as required (Fig. 1). The incisions were deepened by blunt dissection down to the extensor tendons. The long extensor tendon was either divided or lengthened in a Z-configuration depending on its size. The short extensor

tendon was divided. The alignment was assessed after each step. If the MTPJ lay in a neutral position with the ankle plantigrade and the plantar fat pad reduced, no further release was necessary. If not, the dorsal capsule of the MTPJ was released. The collateral ligaments were then released from the metatarsal head, the plantar plate identified under the MTPJ, mobilised and reduced under the metatarsal head. If the extension deformity of the MTPJ persisted, a Weil osteotomy was carried out. Additional stabilisation of the MTPJ was achieved by flexor to extensor tendon transfer (Figs 2 to 4).

The PIPJ was exposed by elevating or dividing the extensor mechanism and the head of the proximal phalanx excised using a power saw. The base of the middle phalanx was also excised to correct the deformity of the PIPJ. A 1.6 mm Kirschner wire was used to stabilise the arthroplasty.

Patients were mobilised fully weight-bearing and the wire was removed four to five weeks later.

Results

A total of 84 patients (99 feet; 179 toes) with type-2 toes was studied. Four patients had died from unrelated causes during the follow-up period. Two had moved abroad and we were unable to contact a further nine. Therefore, 69 patients (78 feet; 157 toes) were available for assessment. The median time to follow-up was 28 months (12 to 68). The median AOFAS score was 83 (32 to 100).

Pain at the MTPJ was the commonest cause of dissatisfaction with 11 of 78 feet (14%) being moderately or severely painful. Two feet (3%) had instability of the MTPJ and seven (9%) had formation of callus. There was poor alignment of the toe in ten feet (13%). Three toes (3% of toes, 4% of feet) were overcorrected with discomfort under the tip of the toe. Analysing the subjective and objective scores, 83% of feet had subjective AOFAS scores between 40 and 60 and 81% had objective scores of between 20 and 40 (Fig. 5).

Fig. 1

Diagram showing sites of the incisions on the dorsum of the foot.

Fig. 2

Diagram of the lateral view of the preoperative deformity showing extension at the MTPJ and dorsal displacement of the fat pad.

Fig. 3

Diagram showing the lateral view of the toe after the plantar plate has been reduced.

Fig. 4

Diagram of the anteroposterior view of the toe showing release of the extensor tendon and collateral ligaments.

Fig. 5a

Fig. 5b

Fig. 5c

Histograms showing a) the subjective b) objective and c) total AOFAS scores for the 78 feet after hammer-toe correction with an extended MTPJ release.

The median total AOFAS scores in the lesser toes were compared for age (80 for < 55 years, 85 for > 55 years), gender (80.5 for men, 85 for women), number of toes corrected (85 for 1, 83 for >1), and length of follow-up (83 for < 2 years, 82 for >2 years). The median score was 81.5 for patients who underwent simultaneous correction of hallux valgus and 83 for those with surgery on an isolated

lesser toe. Those with extensor tenotomy had a median score of 85 and with extensor lengthening a median score of 80. These differences were not significant.

Forty-nine patients (71%) were satisfied, eight (12%) were satisfied with reservations and 12 (17%) were dissatisfied with the results. Forty-eight (70%) would have recommended the procedure to close family or a friend, five

(7%) would have recommended it with reservations and 16 (23%) would not have recommended it.

Discussion

A hammer deformity may involve either a single or multiple toes. The second toe is the most commonly involved.² A possible explanation is the wearing of shoes which are too short causing the long second toe to buckle.¹⁹ In our series this toe was most commonly affected.

Abnormal extrinsic forces and muscle imbalance lead to the development of a hammer-toe deformity. A narrow and short shoe with a high heel forces the MTPJ into hyperextension and the PIPJ into flexion, which can cause stretching and failure of the plantar plate. The intrinsic muscles stabilise the MTPJ and PIPJ by balancing the action of the extensor and flexor tendons in order to maintain a neutral position. When the longitudinal axis of the intrinsic flexors and the interossei displaces dorsal to the transverse axis, the entire extensor function is expended at the MTPJ and offers no resistance to the flexors at the interphalangeal joint. Since the lumbricals are tethered to the deep transverse metatarsal ligament, the PIPJ becomes steeply angulated and is rendered inefficient.¹⁰ The plantar fascia stabilises the longitudinal plantar arch and brings the toe to the ground (windlass effect). Failure of this mechanism results in hyperextension of the MTPJ.¹⁹ Dorsal to the MTPJ, the skin, extensor tendons, capsule and collateral ligaments shorten and fix the toe in a deformed position. The plantar plate displaces both dorsally and distal to the metatarsal head and exerts a downward pressure on it. This is known as the plunger effect.¹⁹

Various procedures have been described for the correction of a hammer-toe deformity. These include tendon release, proximal phalangeal condylectomy, proximal interphalangeal joint fusion, and partial phalangectomy. None addresses the MTPJ and all may leave a straight toe hyperextended at the MTPJ and with the toe pulp off the ground.

Myerson and Shereff¹⁰ determined the various soft tissues which contributed to the development of a hammer-toe deformity by sequential sectioning of the soft tissues and assessment of the extent of the correction. Even after tenotomy of the extensor digitorum longus and brevis tendons, and a dorsal capsulotomy, an extension contracture persisted. Only after release of the distal part of the collateral ligaments did the MTPJ assume a neutral position with the plantar plate and fat pad reduced under the metatarsal head.

The common preoperative symptom in this series was dorsal rubbing of the PIPJ. At follow-up none of the patients presented with recurrence of the deformity or with dorsal rubbing. Pain was the commonest cause of dissatisfaction. Eleven patients had moderate to severe pain which affected their daily activities. Most patients with pain had associated malalignment of the toes, which

was one of the main causes of their symptoms. Malalignment can occur in any one of three planes (mediolateral, dorsoplantar or rotational) and at either the PIPJ or MTPJ. Malalignment of the PIPJ can be avoided by meticulous bone resection. Lehman and Smith²⁰ claimed that the peg-and-socket technique of a PIPJ arthrodesis increased the inherent stability of the arthrodesis and decreased the incidence of postoperative deformity. They did not, however, show that this improved the clinical results. If the Kirschner wires are retained for a longer period the rate of fusion may increase, but this may not reduce the incidence of malalignment. Mediolateral and rotational deformities are the commonest planes of malalignment at the MTPJ, and can cause pain and rubbing against the adjacent toes. Only two patients had instability of the MTPJ and seven had formation of soft callus. Common complications of this procedure are pin-track infection and sensory disturbance in the toes.

Patient satisfaction correlated well with the AOFAS score. Patients with an overall AOFAS score of more than 80 were satisfied with the procedure. Satisfaction with reservations was mainly found in those in whom both feet had been corrected, albeit with good results in one foot and poor results in the other.

The AOFAS score incorporates the mobility of the interphalangeal joint, but this procedure aims to stiffen this joint. Two patients had mobile interphalangeal joints, but this did not affect the outcome. Baig and Geary⁸ reported that there was no correlation between the rate of fusion and patient satisfaction. Some patients were dissatisfied by the stiffness of their toe, although it was clearly explained before the operation that this was one of the goals of the procedure. We now emphasise this point more strongly during preoperative counselling.

In their series, Coughlin et al² had a minimum follow-up of two years. The results for our patients reviewed between one and two years and for those reviewed at over two years were the same. There was no significant difference in the results relating to the age, gender, single or multiple toe surgery, or associated correction of hallux valgus.

The results for the correction of a hammer-toe deformity are varied. Our study was based on an anatomical model described by Myerson and Shereff¹⁰ and showed good results with no recurrence of the deformity. Postoperative pain was the commonest cause of dissatisfaction.

Coughlin et al² quoted a mean AOFAS score of 83. Our median score was also 83. They performed "flexor and extensor tenotomies and MTP soft-tissue arthroplasty in more severe cases". The exact indication and number of more extensive procedures were not described. It may be that the procedures carried out in these two series were similar.

The results of this procedure are certainly comparable with previous studies. It usually produces a straight toe with no recurrent deformities of the MTPJ. The cost of reliably correcting the hyperextension of the MTPJ is an

incidence of pain in this joint of 14% and of symptomatic overcorrection of 4%.

Our results are similar to those reported by other authors. It may therefore be argued that there is no reason to do a more extensive procedure. A randomised, controlled trial, in order to compare our procedure with an isolated PIPJ arthroplasty would be of value.

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