Selective soft-tissue release for recurrent or residual deformity after conservative treatment of idiopathic clubfoot

We reviewed the results of a selective à la carte soft-tissue release operation for recurrent or residual deformity after initial conservative treatment for idiopathic clubfoot by the Ponseti method. Recurrent or residual deformity occurred in 13 (19 feet) of 33 patients (48 feet; 40%). The mean age at surgery was 2.3 years (1.3 to 4) and the mean follow-up was 3.6 years (2 to 5.3). The mean Pirani score had improved from 2.8 to 1.1 points, and the clinical and radiological results were satisfactory in all patients. However, six of the 13 patients (9 of 19 feet) had required further surgery in the form of tibial derotation osteotomy, split anterior tibialis tendon transfer, split posterior tibialis transfer or a combination of these for recurrent deformity.

We concluded that selective soft-tissue release can provide satisfactory early results after failure of initial treatment of clubfoot by the Ponseti method, but long-term follow-up to skeletal maturity will be necessary.

The Ponseti method has been shown to be an effective initial treatment for clubfoot deformity. However, recurrence of the deformity is common if appropriate bracing is not used or compliance with bracing is poor. Recurrent or residual deformity usually involves ankle equinus, hindfoot varus and forefoot adduction.

Previous studies have indicated that incompletely corrected or recurrent clubfoot deformity will deteriorate if appropriate treatment is not applied and early recognition results in easier and more effective treatment. However, two or three manipulations plus casting every two weeks can be difficult in children of walking age if they are uncooperative. If the equinus is not correctable after manipulation and casting, lengthening of the tendo Achillis should be considered. Such lengthening can be achieved in two ways, depending on age: percutaneous tenotomy in younger patients and open tendon lengthening in older ones. In patients with persistent forefoot supination during gait, anterior tibial tendon transfer can be performed at around 2.5 years, when the ossific nucleus of the third cuneiform is sufficiently large to ensure that the tendon will attach to bone.

There are several reports of the treatment of neglected club foot using the Ponseti method and also of recurrent or residual clubfoot deformity after Ponseti treatment. We hypothesised that an à la carte approach to the recurrent or residual deformity would be beneficial.

This paper describes a retrospective study using prospectively gathered data to evaluate the results of selective soft-tissue release for recurrent or residual clubfoot deformity following Ponseti treatment.

Patients and Methods

Between March 2000 and July 2006, 33 patients with 48 idiopathic clubfeet were treated using conservative methods by one of the authors (S-SP). The Ponseti method was used as the guideline for conservative treatment. All of the patients had serial Ponseti casting started during the first two months of life. The use of a Denis Browne abduction orthosis full time for three months was recommended in all patients to prevent recurrence after the completion of cast treatment, which included percutaneous Achilles tenotomy when necessary. During primary treatment, we considered a percutaneous Achilles tenotomy in patients with a high Pirani hindfoot score of 2.5 or 3. After three months’ full-time bracing, night-time bracing was advised until the age of three years. Following fitting with braces and shoes, all patients were scheduled to attend the outpatient clinic regularly to check for early recurrence or residual deformity which was defined as any foot having <5° of ankle dorsiflexion, apparent forefoot...
adduction, or resting heel varus with or without forefoot supination during gait.

Recurrent or residual deformity was seen in 13 of the 33 patients with 19 clubfeet (Table I). Correction of residual deformity was performed by using an à la carte method of soft-tissue release. The tendo Achillis was selectively lengthened using a percutaneous tenotomy in one foot or a Vulpius procedure for the equinus component in 15 feet having < 5° of ankle dorsiflexion through a new skin incision. Aponeurotic lengthening of the posterior tibialis tendon was performed in 17 feet for varus deformity of the hindfoot. Aponeurotic lengthening of the anterior tibialis tendon was performed in one foot when dynamic forefoot supination was apparent during gait. All feet underwent myofascial release of the abductor hallucis muscle for adduction deformity of the forefoot, and three required a concomitant medial joint capsulotomy and Kirschner-wire fixation. For any residual cavus component, a plantar fasciotomy was performed at the same time in two feet. After surgery, a long-leg cast in maximal ankle dorsiflexion, external rotation and forefoot abduction was applied for three to four weeks. We prescribed night splints in the position of maximum correction, and daytime clubfoot shoes or wearing normal shoes on the opposite foot (the wrong-way round).

Further treatment following selective soft-tissue release was required in six patients (nine feet), such as tibial derotational osteotomy, split anterior tibialis tendon transfer, or split posterior tibialis tendon transfer after a mean follow-up of 2.7 years (2 to 3.7).

For the purpose of this study, the results in the six patients who required additional surgery were considered to be final just prior to the further surgery. For clinical outcome measurements, patients were evaluated using the six-point Pirani classification system. Parental satisfaction

Table I. Details of 13 patients with 19 recurrent or residual or relapsed club foot deformities

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* TM, talofirst metatarsal angle; TCI, talocalcaneal index; TCIC, tibiocalcaneal angle
† AHAL, abductor hallucis aponeurotic lengthening; TPAL, tibialis posterior aponeurotic lengthening; TAL(V), vulpius-type tendo Achillis lengthening; MC, medial capsulotomy; PFR, plantarfascia release; TAAL, tibialis anterior aponeurotic lengthening; TAL(P), percutaneous Achilles tenotomy
‡ SPLATT, split anterior tibialis tendon transfer; TDO, tibial derotational osteotomy; SPOTT, split posterior tibialis tendon transfer
with regard to cosmetic appearance, pain and walking after surgery was evaluated using a visual analogue scale (VAS) (0 to 10). Standing anteroposterior (AP) and dorsiflexion lateral radiographs of the feet were taken pre-operatively and at the time of the latest follow-up, or prior to further treatment if required. On the AP view, the talocalcaneal angle and talofirst metatarsal angle were recorded. On the dorsiflexion lateral view, the talocalcaneal and tibio-
calcaneal angle were recorded.

Statistical analysis. The paired t-test was used to compare the results of clinical and radiological measurements. All statistical analyses were performed using SPSS version 12.0
(SPS Inc., Chicago, Illinois) and a p-value < 0.05 was considered to indicate a significant difference.

Results
We treated 33 patients with 48 clubfeet conservatively by the Ponseti method. The mean Pirani score was 4.3 points (3 to 6) at initial evaluation after birth. Percutaneous Achill-
es tenotomy was performed in 41 of the 48 feet (85%) as the primary treatment. During the follow-up period we identified 19 feet with recurrent or residual deformity. Achilles tenotomy as primary treatment was carried out in 26 of the 29 feet without recurrence (90%) and in 15 of the 19 feet with recurrent or residual deformity (79%). Recur-
rent or residual deformity did not appear to be related to the requirement for primary tenotomy.

The mean Pirani score improved to 1 point (0.5 to 2) after a mean follow-up of 4.4 years (2.5 to 8.6) (p < 0.05) in the non-recurrent group, and 2.8 points (2 to 3.5) in the recurrent or residual group after a mean follow-up of two years (1 to 3.7) before selective soft-tissue surgery was per-
fomed (p < 0.05). In the 19 feet with recurrent or residual deformity there were four with recurrent and 15 with resid-
ual deformity. The mean age of the patients at the time of surgery was 2.3 years (1.3 to 4), and the mean follow-up was 3.6 years (2 to 5.3).

The overall mean Pirani score was 2.8 points (2 to 3.5) before surgery, which reduced to 1.1 points (0.5 to 2.5) at the last follow-up (p < 0.05). All parents were satisfied with the final results. Overall satisfaction after surgery was 8.0 (SD 2.0) according to the VAS at the last follow-up. The mean tibiocalcaneal angle improved from 87.4° (60° to 117°) pre-operatively to 69° (52° to 82°) at the last follow-up (p < 0.05). The mean talofirst metatarsal angle improved from 7.2° (-1° to 27°) to 4.8° (-5° to 14°) at the last follow-up (p < 0.05). The mean talocalcaneal index improved from 40.4° (24° to 64°) pre-operatively to 52.1° (28° to 65°) at the last follow up (p < 0.05).

Satisfactory results both clinically and radiologically were seen in all patients at final follow-up. There were no local complications such as infection, nerve injury or joint stiffness. However, additional procedures were required in six of 13 patients (nine feet) for persistent in-toeing gait, residual forefoot supination or hindfoot varus deformity due to internal tibial torsion or a hyperactive anterior or posterior tibialis tendon, respectively, after a mean follow-
up period of 2.7 years (2 to 3.7). Tibial derotational osteot-
omy was performed in two patients (three feet), tibial derota-
nal osteotomy with concomitant split anterior tibialis tendon transfer in one patient (two feet), and split anterior tibialis tendon transfer in two patients (two feet). Split pos-
terior tibialis tendon transfer was performed in one patient (two feet). The clinical and radiological results after these additional procedures were satisfactory.

Discussion
The method of treatment of idiopathic clubfoot described by Ponseti is now widely used as it appears to be much better at preserving a long-term mobile, functional foot than extensive operations. However, recurrent or residual deformity can occur following this type of treatment. Haft et al reported a 41% rate of early recurrence following the use of the Ponseti method. In this study, we found recurrent or residual deformity in 19 of 48 feet (40%). The risk of recur-
rence is known to be high if long-term bracing is not used or patients are non-compliant with a brace. In this study, the parents of only four of the 13 patients with recurrent or residual deformity had complied with the bracing protocol, whereas the parents of 15 of the 20 patients with no recur-
rence had been compliant, which is similar to the results of other reports.

The recurrence rate is known to be highest at one to three years of age, when the foot is growing rapidly. Once the deformity relapses, the brace usually does not fit comfort-
ably, further reducing compliance. Early recurrent or resid-
ual deformities can be treated by repeated manipulation
and casting. However, we did not do this in this series as the deformity may be refractory to further casting, and children of this age may resist further manipulation and regular cast-
ning. We therefore considered surgery when a recurrent or residual deformity became apparent. Bensahel et al reported good results of a one-stage medioposterior soft-
tissue release with an à la carte approach in a large series of patients with residual clubfoot deformity. Their initial treatment differed from ours in that they used physio-
therapy, and surgery consisted of a medial and posterior release as required. Our method was a selective approach, depending on the type and severity of the deformity.

Dietz reviewed the treatment of recurrent deformity after initial correction with the Ponseti technique. For good long-term results, he suggested joint-sparing by repeated manipulation and casting and anterior tibial tendon trans-
fer with teno Achillis lengthening as required. He did not mention the role of the tibialis posterior tendon in recurrent clubfoot deformity. In this series, when we performed aponeurotic lengthening of this tendon for hindfoot varus deformity we frequently found it to be hypertrophied.

Tendo Achilles lengthening is indicated for equinus defor-
mities, and can be done either by open tendon lengthening or by percutaneous tenotomy. Percutaneous Achilles teno-
tomy can be performed safely under the age of 18 months.
However, many of our patients had already undergone a percutaneous tenotomy under the Ponseti protocol. We believe that repeated tenotomies may not be successful because the scar can re-form and contract, leading to further recurrence. Open tendon lengthening via a posterior approach can also cause scar formation and adhesion around the lengthened tendo Achillis. We prefer to perform tendo Achillis lengthening using the Vulpius technique in the calf, rather than at previous operation sites, to ensure that the surgical field is relatively free of scar tissue. While performing a Vulpius-type tendo Achillis lengthening under the posteromedial skin incision over the calf, we found that the tibialis posterior tendon had hypertrophied. We believed that the hypertrophied tendon was responsible for varus deformity of the heel and we therefore performed aponeurotic lengthening of the tendon to correct the dynamic heel varus component in 17 of the 19 feet requiring soft-tissue surgery. However, split posterior tibialis tendon transfer was required in one patient (two feet) who had a recurrent varus deformity of the hip despite lengthening of the tibialis posterior tendon (cases 4 and 5). Aponeurotic lengthening of the tibialis anterior tendon was carried out as part of the selective soft-tissue procedure in a 28-month-old patient (case 12) for an apparent forefoot supination deformity which resolved after surgery (Fig. 1). Split tibialis anterior tendon transfer was performed as an additional procedure for dynamic forefoot supination, which was seen during follow-up in three patients. This transfer could not initially be performed in our study population because the ages (1.3 to 4) years made it difficult to identify dynamic forefoot supination owing to patient non-cooperation.

The early results in this series, with a mean follow-up of 3.6 years (2 to 5.3) suggest that selective soft-tissue release can provide satisfactory results for recurrent or residual deformity after conservative treatment of idiopathic clubfoot. However, further recurrence may occur, and long-term follow-up to skeletal maturity will be necessary.

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