Aspects of current management

THE MANAGEMENT OF CLUB FOOT: ISSUES FOR DEBATE

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Epidemiology and aetiology

Congenital talipes equinovarus (CTEV) is a common and challenging musculoskeletal deformity. The prevalence in a recent, prospective national survey is 0.89 per thousand live births¹ although rates of 1.24² or greater³ have been reported in the UK. Thus in a district general hospital with a catchment population of 500 000 up to ten babies with CTEV will present annually. Increasingly, the presence of CTEV can be diagnosed prenatally by ultrasound.⁴

Racial and genetic factors are influential. Maoris and other Pacific islanders present with a rate of prevalence of 6 to 7 per thousand live births, whereas in the Chinese and Japanese the rate is 0.5 per thousand.⁵ Some of this variation may reflect different attitudes to the inclusion of postural (resolving) deformities and of syndromic (non-idiopathic) club feet (Table I). Idelberger's twin studies⁶ identified a monozygote concordance of 32.5%, strongly suggesting a genetic influence since dizygotic twin concordance was only 2.9%.

Acquired or modulating factors, leading to a multifactorial inheritance pattern, are reflected in the seasonal variation of the condition^{1,3,7} and in the neurological deficit which may underly the deformity.⁸⁻¹⁰ The proportion of muscle fibre types in the calf have been variously described as normal or abnormal by a large number of authors but may be a secondary feature rather than a primary alteration. Vascular anomalies have also been described along with many other intrinsic abnormalities involving the soft tissues of the affected foot.¹¹

Clinical assessment

The assessment of the club-foot deformity, and the imposition of a classification system, are contentious, but neces-

Table I. Conditions associated with (syndromic) CTEV

Spina bifida myelomeningocele	Constriction band syndrome (Streeter's dysplasia)
Sacral agenesis	Freedman-Sheldon syndrome
Arthrogryposis	Fetal alcohol syndrome
Congenital myopathy	Down's syndrome
Dystrophic dwarfism	

sary for review and comparison. The system needs to be reproducible between observers, practical and reliable in its clinical application, particularly in relation to prognostication. There is no such classification in existence although the simple grading of Harrold and Walker¹² has much to commend it. Both these authors and others¹³ have confirmed that the pretreatment assessment correlates reasonably well with outcome. When different grades of staff and a physiotherapist assessed both normal and club feet before operation, agreement between observers was highest using the Harrold and Walker classification.¹⁴ When normal feet were excluded and the assessment confined to two experienced orthopaedic surgeons, the system used by Diméglio et al¹⁵ was considered to be more reliable although it is complex to apply and the four-group system used by these authors is somewhat confusing. Flynn, Donohoe and Mackenzie¹⁶ noted that independent assessment of both the Diméglio classification and the evaluation proposed by Pirani et al¹⁷ produced acceptable interobserver reliability. Photographic and radiological assessment are static but offer a good record of the deformity.¹⁸

The dynamic portrayal of the deformity is difficult to quantify, but is important when stiffness is being assayed since this is one of the main predictors of success or failure after treatment. It is also appropriate to recognise that the typical, idiopathic club foot may differ in its response to treatment from the atypical (syndromic) club foot. Additionally, the severity of deformity, principally its rigidity, may affect the hindfoot, midfoot and forefoot differentially.

The preoperative grading of the foot does predict the outcome^{10,12,19} although this view is not universal.²⁰ Comparisons of management (both operative and mainly conservative) have suggested that the end result may be

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enhanced by a more comprehensive release.²¹⁻²⁴ Equally, Laaveg and Ponseti¹⁹ cautioned against the stiffness and iatrogenic deformity which may follow inadequately performed or excessive surgical release.²⁵ The effect of persisting neuromuscular imbalance is also poorly appreciated and a lack of recovery of the peroneal muscle after operation or persisting neurophysiological deficit^{9,10,26} may be critical.

Conservative management

Advocates of a more conservative approach recommend repeated manipulation of the deformed foot, with or without plaster splintage, whereby applied tension and subsequent relaxation of the tight soft tissues ultimately lead to correction.^{15,19,27-29} The graduated improvement in anatomical alignment is achieved by sequential stretching of the different components of the deformity. The key to reduction, according to Ponseti,²⁹ is reversal of the cavus by dorsiflexion of the first metatarsal during the initial stage of treatment. Supination and equinus are accepted until the metatarsal is adequately dorsiflexed. Reduction in the cavus unlocks the midfoot, the forefoot being allowed to remain supinated. Subsequent correction occurs by using the uncovered talar head as a lateral fulcrum.

The forefoot is progressively abducted but not pronated, achieving the normal anatomical divergence of the axes of the calcaneum and the talus. In turn, as the calcaneum dorsiflexes during its external rotation, the equinus is reversed although up to 90% of patients will require a tenotomy of tendo Achillis. Pressure over the lateral aspect of the hindfoot, in the vicinity of the calcaneocuboid joint, should be avoided since this prevents abduction of the calcaneum, and inhibits the correction of heel varus.

While the use of preliminary strapping and casts is the mainstay of the early management of all types of club foot, some surgeons doubt whether these individual components of the deformity can be isolated for correction as suggested by Ponseti²⁹ and his adherents. Furthermore, the release of tendo Achillis percutaneously is necessarily 'blind', and excessive dorsiflexion of the foot subsequently may overlengthen the tendon and lead to a calcaneus deformity. Correction and maintenance of the talonavicular dislocation are ignored and the considerable deforming force of the tendon of tibialis posterior, which is often equivalent in power to the calf muscle in its resistance, is not addressed.

Ideally, lengthening of muscle should be the goal rather than elongation of the tendon. If this can be achieved conservatively, it is obviously preferable. Compression of the cartilaginous tarsal bones occurs after both conservative or surgical treatment and this process may not be entirely innocent. 'Remodelling' occurs in response to the altered mechanics produced by splintage, with changes in both the shape of the bones of the hindfoot and midfoot and altered congruity of the joints.

Clinically, manipulations for two to three minutes may be all that the surgeon can give, so that other therapists

including the parents, should be involved. Plaster-of-Paris casting, maintaining the knee in at least 70° of flexion, should ensure that the position is maintained after manipulation. These casts are a vital part of treatment (whether conservative or postoperative) and therefore their precise position must be maintained for five to seven days. Subsequent changes of cast repeat the process, and the corrected foot is finally immobilised for three weeks "in 70 degrees of abduction and 20 degrees of dorsiflexion".²⁹

After two to three months of this treatment the splintage is changed to a foot abduction bar, which restricts the infant up to the age of approximately six months. Part-time use of the abduction bar is recommended during periods of sleep until the age of three to four years. Diméglio et al³⁰ advocate a more intensive programme of manipulation, necessitating prolonged inpatient care for both physiotherapy and continuous passive motion. This approach, although admirable, is unlikely to be cost-effective in most health-care systems. While the earlier results of treatment in plaster²⁷ gave results which did not seem to be reproducible by many others, recent application of the Ponseti technique³¹ suggests that greater attention to detail during the plastering process yields correspondingly better results. The exact number of minor surgical interventions required during this 'conservative' approach is not always clear, nor is patient and parental compliance assured when the period of splintage extends over many months and relies upon a foot abduction bar well into childhood.

Operative management

If surgical treatment is recommended, most surgeons prefer to consider this at three to six months of age, once the effects of strapping and plaster splintage have become clear. Neonatal surgical intervention was advocated by Ryöppy and Sairanen³² and Pous and Diméglio,³³ but the general view prevails that this is too early. The operative field is restricted and the margin for error small. Some resolving club-foot deformities may be operated on unnecessarily and the tiny, very stiff foot at birth represents a formidable proposition, even under magnification. Safe anaesthesia may also be a concern at this age in some hospitals, and plaster splintage is required until the child is walking.

The comparison of the results of early (three to six months of age) *versus* later surgery are limited by the lack of prospective, matched series. Porat, Milgrom and Bentley³⁴ considered that earlier surgery was advantageous although the severity of the deformity in their two treatment groups was unclear. DePuy and Drennan³⁵ compared clinical and radiological outcomes in children operated on at four, six and nine months of age. Early surgery produced the best results although this was not the experience of Ghali et al.³⁶ Operative intervention should be delayed if the deformity continues to improve with conservative treatment, and also when the small and very stiff foot is under consideration.¹³

The Cincinnati incision³⁷ affords excellent exposure both posteromedially and posterolaterally although skin healing may be adversely affected if the foot is dorsiflexed too rapidly after operation. For this reason, pinning of the tarsal bones is not advocated. The talonavicular joint can be reduced adequately by abducting the forefoot using plasters, and the restoration of the hindfoot relationships can only be achieved in a graduated fashion since rapid stretching of the neurovascular bundle and the soft-tissue structures may lead to complications.

There are many areas which are open to debate. Should the interosseous subtalar ligaments be transected? Is a calcaneocuboid release required?^{28,39} Do the tendons of flexor hallucis longus and flexor digitorum merit elongation or not? Should the naviculomedial cuneiform joint be opened? How extensively should the cavus be released?

Complications

These can be grouped into three broad categories as follows:

- 1) Undercorrection.
- 2) Overcorrection.
- 3) Surgical error.

Undercorrection, whether after conservative treatment or a conventional surgical release, leaves the foot deformed at various sites. Supination and adduction are relatively common and may improve with time if adduction is the predominant appearance. When supination is mobile, transfer of the tendon of tibialis anterior may be effective. If the deformity is fixed, further release of the medial column of the foot will be required, combined with shortening of the lateral column in the older child. Residual or recurrent equinus, with or without varus of the heel, may respond to a short course of stretching casts. Further posteromedial release runs the risk of overcorrecting the hindfoot, thus producing a calcaneocavus or calcaneovalgus deformity. It may be functionally better to leave the hindfoot slightly undercorrected than to produce a calcaneus heel. A cavovarus deformity results from inadequate release of the midfoot, including a failure to address the talonavicular subluxation and tight plantar structures. If the hindfoot is mobile, further soft-tissue release may suffice. If the hindfoot is fixed, an additional calcaneal osteotomy may be indicated.

Overcorrection produces a foot which may function very poorly. Overlengthening of tendo Achillis and the tendon of tibialis posterior must be avoided at all costs. This risk is enhanced when surgery is carried out percutaneously or is repeated. Fixed valgus of the hindfoot is almost impossible to correct although the use of an orthotic support may limit its impact. Forcible manipulation of the club foot may result in damage to the articular surfaces of the tarsal bones with gross changes in their shape. A 'rocker-bottom' foot or dorsal subluxation of the navicular cannot be reversed.

Surgical error can only be avoided by a thorough knowledge of the relevant anatomy and an appreciation that aberrant

structures and relationships characterise the club foot. Sharp dissection is vital during certain phases of the operation but may be damaging to neurovascular and cartilaginous tissues. Excessive stripping of the tarsal bones and release of the subtalar interosseous ligaments will produce avascular necrosis. Injury to the posterior tibial neurovascular bundle imperils the foot as the anterior tibial (dorsalis pedis) arterial supply is deficient to varying degree. Correcting the foot too rapidly postoperatively will also eliminate much of the arterial supply and exacerbate oedema secondary to venous stasis. Hypersensitivity of the scar, loss of sensation, skin sloughing and gangrene should be avoidable by careful surgical technique and a graduated correction by plaster casting of the foot.

Conclusions

The management of club foot in the infant continues to promote much debate. At present, there is a swing towards conservative management, possibly because the results of surgical intervention are unpredictable. Uncertainties will inevitably persist because of the varying aetiology of the deformity and hence its prognosis. Grading systems are simplistic and inadequate in their portrayal of the severity of the deformity before conservative or operative management. Underlying neurological deficits are poorly evaluated. Informed decision-making is hampered by a lack of convincing long-term reviews of treatment based on prospective assessment and unbiased comparisons of different techniques.

In a review of this sort space restricts discussion of the use of distraction frames, whether initially or in the management of later relapse and deformity.

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