

CURRENT CONCEPT REVIEW

Relapsing and Residual Clubfoot Deformities After the Application of the Ponseti Method: A Contemporary Review

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Abstract

The Ponseti method is a safe and effective treatment for congenital clubfoot, and radically decreases the need for extensive corrective surgery. But a group of patients will still present with under corrected residual equinovarus deformities despite the proper use of the Ponseti method. About 25% of operated clubfeet will develop recurrence or show a marked residual deformity (recurrent clubfoot); however, in the recent literature, the failure rate of the Ponseti method, defined by the need for corrective surgery, ranges from 3% to 5%. Deformities encountered in patients with residual clubfeet comprise of various degrees of equinus, varus, adduction, supination, cavus, and toe deformity. Joint flexibility or stiffness, tarsal dysmorphism, articular incongruence, and progressive degrees of degeneration may be also present. We try to emphasize the current solutions for these deformities.

Key words: Clubfoot, Ponseti, Relapse, Residual

History and clinical depiction

Clubfoot was first depicted in ancient Egyptian tomb paintings and its treatment was described in India as early as 1000 B.C. The first written description of clubfoot was given by Hippocrates (c. 400 B.C.), who believed the causative factor to be mechanical pressure (1).

Clubfoot is the most common congenital deformity of the lower extremity. Lehman classified clubfoot into three types: type 1 is mainly postural in nature, type 2 is idiopathic (the most common type), and type 3 includes secondary cases such as arthrogryposis multiplex congenita and myelomeningocele (2).

In 1948, Professor Ignacio Ponseti began a non-operative management form of treatment for severe talipes equinovarus and reported his significant results in 1963 and 1972 (3). For decades, surgery was the treatment of choice by most orthopaedic surgeons worldwide, and so Ponseti's method was not widely accepted. In the late 1990s, this method gained increasing acceptance as the treatment modality of choice for surgeons, and became accepted as the gold standard for the conservative management of clubfoot.

Currently, the most widely accepted treatment of clubfoot consists of a series of long leg casts, and in most cases, a percutaneous tenotomy of the Achilles tendon,

followed by 4 years of foot abduction orthotic use. The Ponseti method is a safe and effective treatment for congenital clubfoot, and radically decreases the need for extensive corrective surgery (4). The goal of clubfoot treatment is to have a functional, pain-free, plantigrade foot with good mobility, which does not require the patient to wear modified shoes (5).

Some feet can be fully corrected to functional plantigrade feet, whereas others will still present with under corrected residual equinovarus deformities despite the proper use of the Ponseti method. About 25% of operated clubfeet will develop recurrence or show a marked residual deformity (recurrent clubfoot); however, in the recent literature, the failure rate of the Ponseti method, defined by the need for corrective surgery, ranges from 3% to 5% (3). Moreover, there is no consensus regarding which clubfeet will still have residual deformities after non-operative treatment using the Ponseti method (6).

Forefoot adduction is the most common residual deformity in the treatment of pediatric clubfoot. Little documentation exists regarding its late occurrence and early detection. These deformities are usually non-apparent; consequently, postoperative talo-first metatarsal and talocalcaneal angles are obtained from radiographs to determine the deformity. The persistent forefoot ad-

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duction becomes more evident with growth and additional treatment becomes necessary.

The aim of this review is to provide the readers with an overview of existing information related to persistent clubfoot after the application of the Ponseti method. We also sought to determine the current theories about the etiology and treatment of the failed Ponseti method.

Rationale for treatment

The fact that clubfoot is one of the most common musculoskeletal birth defects, much is still unknown about its etiology and there is continued controversy regarding optimal treatment strategies. The Ponseti method has excellent long-term results and appears to be effective for most patients irrespective of the etiology and hence, this method has revolutionized the management of clubfoot around the world. The results of this treatment are superior to surgical management with respect to deformity correction, prevention of overcorrection, and most importantly, markedly improved functional outcome (2). The primary treatment goal is to provide long-term correction of a foot that is fully functional and pain-free; however, this is unrealistic since foot and ankle deformities are sometimes too severe to be fully corrected, and persistent deformities or recurrences are inevitable (7).

Currently, a foot is considered resistant when the deformity shows no evidence of further improvement after three months of adequate conservative treatment (8). Deformities encountered in patients with residual clubfeet comprise of various degrees of equinus, varus, adduction, supination, cavus, and toe deformity. Joint flexibility or stiffness, tarsal dysmorphism, articular incongruence, and progressive degrees of degeneration may be also present.

In the first orthopedic examination, it is necessary to assess the gait, the presence of deformities other than that of the foot, the components of foot deformity, the range of motion, and skin condition (9, 10). Faced with what seems to be true recurrence, the surgeon must candidly assess the original procedure because of the generally accepted belief that the majority of recurrences are merely a persistence of deformity, which was never completely corrected in the first place. If the assessment concludes that there is complete correction followed by true recurrence, non-idiopathic causes such as neurologic disorders must be considered (11). This assessment includes the evaluation of muscle tone, motor power, sensation, reflex activity, and gait.

Radiographic evaluation has been extensively used as a measure of the success of idiopathic clubfoot treatment. However, several authors have questioned the correlation between functional and radiographic outcomes as well as the prognostic value of radiographs. Radiographs are difficult to evaluate due to multiplanar deformities with multiple bone involvement, the small size or complete absence of ossification nuclei, considerable overlap between radiographic values of normal feet and clubfeet, and difficulty in positioning the stiff and deformed foot (12).

It should be determined whether all feet with residual

deformity or muscle imbalance should undergo additional treatment or not. It seems that due to different perceptions of surgeons and parents about the post-operative results, not all feet need to be operated on.

In most series describing the Ponseti technique, the rate of extensive surgery, defined as a posteromedial and lateral release, is less than 5%. Eventually, up to one-third of patients undergoing the Ponseti technique will require some surgical intervention including tendon transfer, tendon lengthening, or selective release (2).

Forefoot adduction and supination

In treated clubfeet, forefoot adduction and supination are the most common persistent deformities, which could present in up to 95% of the cases. In this type of deformity, parents often state that the foot looks the same as before the initial treatment, despite the fact that the hindfoot is fully corrected and only the forefoot adduction remains (8). The most reliable radiographic finding is the weight-bearing radiography of the foot, showing the talo-first metatarsal and calcaneo-fifth metatarsal angles in the anteroposterior radiograph as indicators of adduction.

In a normal foot, the metatarsal axis lies laterally to the talar axis and measures 0 to 20°. In forefoot adduction, whether due to metatarsus adductus or talonavicular subluxation, the metatarsal axis lies medial to that of the talus. Another important angle is the naviculo-metatarsal angle, with the normal range of 80-100°; an angle of more than 100° indicates metatarsus adductus. The residual adduction may be due to metatarsus varus or talonavicular subluxation, a combination of both, or severe metatarsus varus with talonavicular overcorrection (10).

Forefoot adduction alone may improve with time. If supination deformity is mobile, tendon transfer of the tibialis anterior may be effective, but when deformity is fixed, further release of the medial column of the foot will be required, combined with shortening of the lateral column in older children.

For fixed forefoot adduction, a treatment option is laterally based wedge resection from the cuboid; the size of the wedge is measured according to the predetermined amount of the cuboid cut to correct the forefoot adduction deformity (2). Moreover, it is recommended that the medial column length be corrected by a vertical osteotomy of the medial cuneiform. In this method, the foot is manipulated by bringing the midfoot and forefoot into abduction, thus correcting the adduction and supination deformity. The osteotomy site of the medial cuneiform is opened with an osteotome or a lamina spreader; the bone wedge taken from the cuboid bone is inserted into the medial cuneiform with the base of the wedge medially straight. In addition, two smooth Kirschner wires are used to fix the foot in the corrected position. It seems that the combined procedure of shortening the lateral column and lengthening the medial column is the most logical approach to address the pathology of forefoot adduction in children older than 5 years of age who have a well-developed medial cuneiform ossific nucleus resulting in a low risk of graft extrusion (13).

The “bean-shaped foot” exhibits forefoot adduction and midfoot supination and may interfere with functioning due to poor foot placement. For children less than 5 years of age, a corrective procedure combining a closing wedge osteotomy of cuboid and trans-midfoot rotation procedure is described without a medial opening wedge osteotomy.

Hindfoot varus

The most reliable measures of hindfoot varus are anterior and lateral talocalcaneal angles, respectively (2). Noh *et al* believed that clubfeet that present with increased lateral tibio-calcaneal and reduced talocalcaneal angles prior to treatment are at a higher risk of residual equinovarus deformities compared with those with reduced lateral tibio-calcaneal and increased talocalcaneal angles (5).

Hindfoot varus deformity can be treated by complete subtalar release and/or lateral closing wedge calcaneal osteotomy. However, since this procedure decreases the height of the heel to some degree and may lead to lateral impingement problems, an open wedge osteotomy or lateral displacement osteotomy may be used to correct the position of the heel (2). It should be noted that the essential prerequisite for open wedge osteotomy is that there is sufficiency of the calcaneus to stabilize a bone graft.

Equinus

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. For more severe residual equines, gastrocsoleus fascial release and other types of Achilles tendon lengthening are recommended (14). According to the results, supramalleolar osteotomy and anterior distal tibial epiphysiodesis do not seem to give a clinical improvement for this deformity (15).

Cavovarus

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 oste-

otomy may be indicated (10).

Deformities due to treatment errors

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 with gross changes in the shape of tarsal bone.

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 understanding of the structures that characterize clubfoot.

Based on a few reports, application of the Ilizarov technique according to the stages of the Ponseti method could correct multiplanar residual deformities of clubfoot; however, psychological adaptation, long duration of the process, and ankle and subtalar stiffness are the disadvantages.

Recently, the Taylor spatial frame has been described for clubfoot correction using the principles of the Ponseti technique. The results of the treatment using different techniques are satisfactory. Moreover, external fixation with soft tissue distraction even without open surgery is an effective treatment for relapsed clubfoot (16).

Conclusion

In general, revision surgery should address a specific problem or deformity, which causes pain or functional difficulties. Therefore, the best and most efficient treatment for recurrent clubfoot is prevention in the form of consistent primary treatment, constant use of braces, and regular follow-up examinations. According to a recent study, there is no association between poor bracing compliance and families’ educational level, income or cultural origin. In addition, the unavailability of orthopedic surgeons is an important parameter that may adversely affect treatment success rates (11).

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