

Conservative Treatment in Clubfoot Deformity

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Abstract: Treatment of the congenital clubfoot (CCF) starts its development in the early 20th century and is still continuing today. Surgical techniques provide functional and radiographic data, but the subsequent later data of poor function and recurrence of deformity gave grounds the overall therapeutic process to be reconsidered in the middle of the last century. There are two methods that are generally accepted as proved to be effective in clubfoot treatment. In 1939 Kite introduced a method to correct the clubfoot by using a series of plaster casts. Two decades later his follower – Ignasio Ponseti. (1968) modified the method, developed and completed it. Regardless of literature evidence on significantly better results after the Ponseti treatment, Kite's method is still popular and used in some isolated countries in the world. Knowledge of both methods as stages in the development of theory and practice in the correction of the congenital clubfoot along with modern understanding of the etiology and in particular of the pathobiomechanics of the condition, create a positive outlook for improvement in the prognosis and treatment outcomes of this disease. Level of evidence: Second Level, systematic overview.

Keywords: congenital clubfoot, Ponseti Method, Kite's Method

1. Introduction

Treatment of the congenital clubfoot (CCF) starts its development in the early 20th century and is still continuing today. In the beginning, efforts of the authors mostly towards operational intervention on the foot joint-ligament apparatus prevailed. However, the experience gained increased everybody's impressions of the predominance of unsatisfactory results, at that – shortly after the surgery (Figure 1).

Following the critical analyses for the unsuccessful middle an long term results after the classical surgical techniques the new era in treatment with conservative approaches was founded by the American surgeon Kite. After his personal disappointment after surgery in CCF, he changed the therapeutic approach towards conservative treatment using plaster casts. Despite of his efforts and personal statements, there were a large percentage of cases, where after the cast a surgery was required.



Figure 1: Grave deformity of untreated clubfoot

During this period of primary investigation on the reasons for these failures another American orthopedic surgeon – Dr. Ponseti, introduce few little, but significant changes and details, which, ultimately, form an individual and finished conservative new approach that managed to improve the final outcome and to reduce the need for further small and major surgeries.

The Ponsetimethod was implemented in the Department of Orthopedics and Traumatology at the Medical University of Varna since 15 years, after a long period of Kite method application, done before.

Following a great number of literature data Ponsetimethod has a better prognosis, improvement of deformities and achieving a function compared to that of a healthy foot. The aim of this review is to provide and discuss the main ideas in the conservative correction of CCF, based on literature evidence and own experience, thereby increasing the knowledge of the treatment and developing a modern concept of the etiology, pathology and treatment of CCF.

2. Congenital Clubfoot

Clubfoot is described as a congenital condition of the foot, characterized by complex poor alignment of the foot components which includes soft tissues and bone structures. The anterior foot compartment is in cavus and adduction (Figure 2) and posterior foot compartment is in equinus and varus (equinovarus). CCF average incidence ratio is 1:1000 live births; it is twice most common in males (2:1) and bilateral in 50% of the cases (1). Population variations in the incidence have been established, as in Caucasians, including Bulgarian population 1 to 3 cases per 1000 live births are observed (24, 25).



Figure 2: Left unilateral Clubfoot

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3. Congenital Clubfoot Pathoanatomy

The most severe deformities are in the posterior plantar compartment. Ponseti(1996) describes serious changes in three-dimensional connection of bones. In this region talus and calcaneus are in equinus, the calcaneus is located medially and is in an inverted position (pes varus), and the navicular bone is in medial deviation. The talus is modified as its neck is shortened, tilted and in some cases it is even missing (Figure 3).

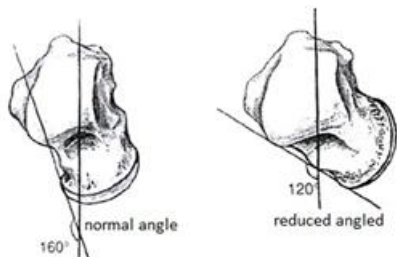


Figure 3: Pathological tilt of the talus neck and body

The calcaneus is medialized, adducted and everted as the front of the anterior tubercle faces the lateral malleolus and is situated under the neck of the talus. The navicular bone is in eversion, medialized and shifted under the neck of the talus. The cuboid bone is shifted medially. The medial plantar compartment is medialized, adducted in pronation with respect to the distal plantar compartment (Figure 4).



Figure 4: Pathological shift of all bone foot and ankle elements

Posterior ankle ligaments and posteromedial ligaments of the posterior plantar compartment are shortened, and the calcaneonavicular ligament is elongated and thinned. Some muscles and their tendons such as m. triceps are shortened and in contracture and its insertion on the calcaneus is in more medial direction being a prerequisite for the formation of a varus angle (10, 11).

4. Methods of Treatment

Following the today's understanding and acceptance of the thesis of the structure of the connective tissues of the newborn child foot and its pathological response after a limited or extended surgical management, the trend of mainly conservative management as the main approach to the correction of this congenital condition prevails. Such are the Kite and Ponseti Methods (8, 9, 10, 18, 19, 20).

5. Kite's Method

Kite differed his postulate in CCF treatment as follows:

1. The adduction is corrected by abduction of the foot with an anchor point in the medial plantar compartment.
2. The varus is corrected by eversion of the posterior plantar department.
3. The equinus of the medial and anterior plantar departments are corrected by progressive dorsiflexion (10).

The serial and non-simultaneous correction of individual elements is the cause of prolonged treatment.

In recent years the main disadvantages and misunderstanding of the foot mechanics that had been developed in Kite method are assessed as reasons for failures in treatment as:

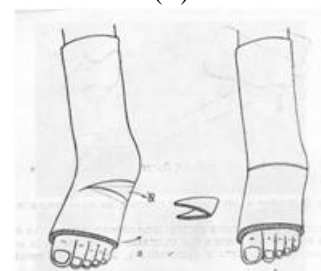
- Attempts for independent correction of the adduction by influencing on Shopard joint.
- The abduction of the foot is achieved with counter pressure on the cast at the level of the calcaneo – cuboideal join (Figure 5A).
- However, this wrong counter pressure blocks the abduction of the heel bone and thus stops the correction of its varus
- Kite wrongly believed that the heel varus would correct and the talocalcanealangle would open later by everything the calcaneus (Figure 5-B).



(A)



(B)



(C)

Figure 5 A: Abduction of the anterior plantar compartment with counter pressure on calcaneocuboid joint (mistake!). The calcaneus remains under the talus, tarsal bones are dislocated; **B** – The calcaneus remains in varus; **C.** Removal of a wedge from the cast.

- Due to this misconception, the treatment lasts for several months and the dozens changes of casts are performed to invert calcaneus under the talus and so to correct the varus(10, 16).
- He fulfills the manual correction by weekly removal of wedges from the cast in the area (Figure 5 C).
- Pressing the foot to the flat sole of the cast attempts to correct the cavus but this is wrong step and targets to limitation and recurrences (19).
- Wrong attempt in correction of the subluxated navicular bone by lifting the anterior foot but not supinating it.
- Prevention from the hypercorrection to avoid foot pronation.

These shortcomings in the plaster technique of Kite lead to slow and disappointing results for his followers who in most cases resorted to surgical management earlier (16).

6. Ponseti Method

It consists of several serial plaster castings ending with tenotomy of the Achilles tendon. How these steps are organized;

- First is cavus correction buy a hyper supination of the forefoot
- Then, Slight and constant abduction of the forefoot with counter pressure on the lateral aspect of the talar body
- Achillotomy to correct the heel equinus and varus(in 85%).
- Treatment continues with abduction foot device - Denis Broun type – firstly all-day long, later only during sleep.

Due to the excellent functional results, the Ponseti Method is gradually replacing the other surgical and conservative managements for treatment of CCF. It is successfully used in the treatment of non-idiopathic clubfeet as well – such as in arthrogryposis, myelomeningocele, untreated and later treated children, complex and resistant feet; recurrences, etc (11, 15, 18).

Shortened and modified elements of the foot which have great elasticity in growing children are corrected. Not only stretching the ligaments, tendons and interosseous ligaments occur, but also bone remodeling due to mechanical stimulation.

Treatment by Ponseti Method must begin in the first days after birth as plaster casts are changed every 5 to 7 days (Figure6).



Figure 6: First cast on the 10th day after birth in marked supination of the foot

The cast is mid-thigh as the knee joint is in 90° flexion. As it was mentioned first, the cavus is corrected by supination of the anterior plantar compartment. The varus adduction is corrected in the following three or four casts by a counter pressure on the lateral portion of the head of the talus by putting the anterior plantar department in abduction and supination (Figure 7 – A, B, C).



(A)



(B)



(C)

Figure 7: Ponseti management, demonstrated on a model.

A – Abduction of foot with a counter pressure on the lateral surface of the head of the talus. Tarsal bones are shifted in a block; **B** – The calcaneus is verticalized spontaneously, **C** – cast with forefoot in supination

Although that in the proper modeling of the cast, the calcaneus do not pass spontaneously into equinus under the talus and in over 85% of the cases Ponseti recommended percutaneous Achilles tenotomy (Figure 8 A, B). The symptom for this is the limited dorsal flexion of the foot up to 0° and the visible groove of the heel, caused by this tightness.



(A)



(B)



(C)

Figure 8: Limited dorsal flexion (A) and groove requiring percutaneous Achilles tenotomy (B). Plaster modeling with dorsal flexion of the ankle with mild pressure over the heel (C).

This mini intervention (Figure 8 B) is simple and is done in a sterile environment under local or general anesthesia, followed by a plaster.

The splint treatment (Figure 9 –Denis Browne splint) is the final stage in the treatment of the clubfoot deformity. It is placed immediately after the removal of the last cast, which, if after Achilles tenotomy- is worn for 20 days. Unlike the previous phases lasting from 1 to 3 weeks, the splint phase lasts up to the 2nd – 4th year – in the beginning it should be worn 24 hours a day and after the 6th-8th month – the splint is worn only during sleep.

Many authors believe that the early recurrences are due mainly to incorrect or inconsistent use of the splint, i.e. non-cooperation of parents in the long-term treatment by Ponseti method.



Figure 9: Splint of Denis Browne for long-term maintenance of the abduction of the feet.

7. Discussion

Literature on conservative management of the idiopathic clubfoot offers many articles, examining and comparing Kite's and Ponseti's methods as the main popular methods (2, 5, 12). Most authors quickly got to the conclusion that Ponseti method has many advantages:

- Significantly higher levels of excellent or very good results.
- It can also be applied to very severe stage of deformed feet.
- Correction happens in considerably short time.
- Achieving short-term results is due to the simultaneous impact on various elements of the deformity.

Such a simultaneous action is the transformation of the cavus in supination and hyper-abduction of the entire feet under the talus without directly manipulating the calcaneus. This maneuver is called "the magic move" of the Ponseti technique.

Regardless of the treatment applied, clubfoot tends to relapse in 20% of treated children – earlier (after the second year or later about the 6th-7th year). Although nothing certain could be said about the causes of the recurrence, as it was already mentioned, the main doubts are to parents and their cooperation in the treatment, mostly in the period of using the abduction splint.

The profile of recurrences depends of treatment. For example, feet recurrences managed by Ponseti are focused in all directions of the initial deformity. This means that the force applied in the simultaneous manipulation on individual components or clubfoot was insufficient. Cases treated according to Kite's method show recurrence mainly at the expense of the heel varus, and this mistake, according to critics, is the basic one underlying the failures

of Kite. This is indicated by Ponseti himself in his comments to Kite. Talonavicular joint is in extreme medial subluxation – the navicular bone is with medial almost plantar position to the head of the talus. Therefore the aim of the adjustment is the stretching of medial capsule and the ligaments making the navicular bone to pass laterally. Putting a counter pressured on the talar head instead on the calcaneocuboid joint will render this impossible. But the counter pressure on the calcaneocuboid joint is identified as a pivotal mistake of the Kite's Method, leading to delay in treatment or to inability of proper positioning of the heel (11, 12, 13, 14).

Authors, who have used the Kite and Ponseti methods, found that the second one demonstrates higher results in the correction, achieved in a shorter time. Therefore the need of surgical management is significantly reduced. Consequently, the Ponseti method is to be preferred (12, 13, 14, 22, 23).

8. Conclusions

The Kite and Ponseti methods are the two best systematized works considering the conservative management of congenital clubfoot. From the perspective of contemporary critics, Kite method possess many inaccuracies and inaccurate formulations, but it is the basis on which contemporary authors such as Ponseti, Demeglio and other developed their theories and conservative methods, which are already established with much more higher final results in the management of clubfoot, at that with safer and easier maneuvers for the child.

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