Clubfoot: an overview and the latest UK guidelines

Abstract

Clubfoot is one of the most common congenital anomalies, affecting every 1 of 1000 live births in the UK. Historically, clubfeet have been managed with a variety of conservative and operative techniques. Over the last two decades, the Ponseti serial casting method has become the gold standard of treatment. In July 2021, the British Society of Children's Orthopaedic Surgery (Gelfer et al, 2022) published a consensus statement that outlines the optimal management for clubfoot. This article provides an overview of clubfoot and a summary of the latest management guidelines.

Key words: British Society of Children's Orthopaedic Surgery consensus; Clubfoot; Congenital talipes equinovarus; Ponseti

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Introduction

Clubfoot, also known as congenital talipes equinovarus, is one of the most common congenital anomalies. Babies are born with an inward-facing foot with fixed varus and equinus of the hind foot, a high medial longitudinal arch (cavus) and abduction of the forefoot (metatarsus abductus) (Figure 1). Some 50% of clubfeet are unilateral, and 50% bilateral. In most cases, there is no known underlying cause, which is referred to as idiopathic clubfoot. Secondary clubfoot is less common and results from an underlying condition, such as distal arthrogryposis or myelomeningocoele. Clubfoot can be diagnosed antenatally on ultrasound (Bar-On et al, 2005) or postnatally as part of the newborn and infant physical examination screening programme. These examinations are performed within 72 hours of birth and again at 6–8 weeks of age (Public Health England, 2021).

If left untreated, a child with clubfoot will walk on the lateral side or dorsum (top) of the foot. This will result in pain, callosity formation, skin breakdown, the inability to wear normal footwear, poor balance and reduced mobility. Treatment aims to produce a foot that is pain-free, fits in normal footwear and allows normal mobility. This article gives an overview of clubfoot and a summary of the latest management guidelines.

Figure 1. Typical posture for congenital talipes equinovarus.

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Epidemiology

The incidence of clubfoot varies, depending on ethnicity and geographical location. In the UK, 1 per 1000 live births (0.1%) have clubfoot (Ansar et al, 2018). Using data from large, multi-national epidemiological studies, the birth prevalence of clubfoot ranges between 0.39 per 1000 births in the Chinese population, 1.1 per 1000 live births in Caucasian populations, 2 per 1000 live births in Turkey and up to 6.8 per 1000 births in some Polynesian populations (Smythe et al, 2017). Clubfoot is twice as common in men than in women, and is more common in first-born children. Clubfoot appears to be more prevalent in lower middle-income countries, with some studies reporting that up to 90% of the 174 000 children born annually with clubfoot come from lower middle-income countries (Owen et al, 2018). The underlying reasons for this variation in incidence of clubfoot in different populations are not understood.

Aetiology

The aetiology of clubfoot is unknown, but is likely to involve a complex series of interactions between multiple genetic and environmental factors. Traditionally, it was hypothesised that clubfoot arose from mechanical or constraining forces, such as breech birth, oligohydramnios and multiple pregnancies. However, more recent evidence does not support this hypothesis (Werler et al, 2013). Environmental factors, such as parental smoking (either the mother or father) and maternal obesity, are associated with clubfoot (Chen et al, 2018).

Studies have increasingly highlighted the role of genetic factors in the development of clubfoot – for example, the PITX1-TBX4 transcriptional pathways, which are uniquely expressed in the hindlimbs and are important for normal development (Dobbs and Gurnett, 2012). Furthermore, if an identical twin has clubfoot, there is a 33% chance that the second twin will be affected (Engell et al, 2014). Almost 25% of all clubfoot cases are familial; 20% of cases of clubfoot are non-idiopathic and are associated with other skeletal disorders and genetic syndromes, such as trisomy 18 (Edwards' syndrome) or chromosome 21q11 deletion syndrome (DiGeorge syndrome) (Dobbs and Gurnett, 2012). Therefore, while the full aetiology has not been elucidated, certain key limb development pathways and genes may play a role.

Latest UK management guidelines for clubfoot

In 2022, the British Society of Children's Orthopaedic Surgery published a consensus statement that outlined the optimal management for clubfeet (Gelfer et al, 2022). The consensus divided the management of clubfoot into six stages: initial assessment, Ponseti serial casting, Achilles tenotomy, use of a foot abduction brace, recognition of relapse, and treatment of relapse. Each of these stages is discussed in turn.

Initial assessment of clubfoot

All children presenting with a clubfoot deformity receive a comprehensive clinical assessment comprising a full history (including social history and family set-up) and examination. The examination includes Pirani scoring, a neurological assessment and documentation of features of an atypical foot (Table 1). The Pirani scoring system (Table 2) (Pirani et al, 2008) is used to grade the severity of the clubfoot. The score ranges from 0 (normal foot) to 6 (severe club foot). Three hindfoot features and three midfoot features are each given a

Table 1. Features of an atypical clubfoot

Shortening on foot (short, fat foot)
Severe equinus – tighter posterior foot (tight medially in typical clubfoot)
Flexion of first metatarsal and hallux hyperextension
Deep transverse crease across middle of sole of foot (Figure 2)

Figure 2. A deep transverse crease across the mid foot – atypical feature of congenital talipes equinovarus.

Table 2. The Pirani scoring system	
Midfoot (midfoot contracture score)	Medial crease (Figure 3)
	Curved lateral border (Figure 4)
	Lateral head of talus
Hindfoot (hindfoot contraction score)	Posterior crease (Figure 3)
	Empty heel
	Rigid equinus

From Pirani et al (2008)

score of 0 (normal), 0.5 (partially abnormal) or 1 (very abnormal). These scores are added to give the overall score. A screening hip ultrasound is recommended to rule out associated developmental dysplasia of the hips.

The Ponseti clinic

A named consultant leads all Ponseti clinics, with at least two Ponseti-trained practitioners providing a weekly clinic service. The clinic environment should be child-appropriate and separated from adult care. Regional networks of clinics with referral pathways provide support for difficult cases, where greater experience may be needed. General clubfoot and Ponseti information, alongside emergency contact details, is given to all parents. Outcome measures are regularly audited, to ensure acceptable results.

Ponseti casting technique

The Ponseti casting method is the gold standard treatment for clubfoot in the UK. Casting is performed using a single layer of padding under quick-setting plaster of Paris. Casts

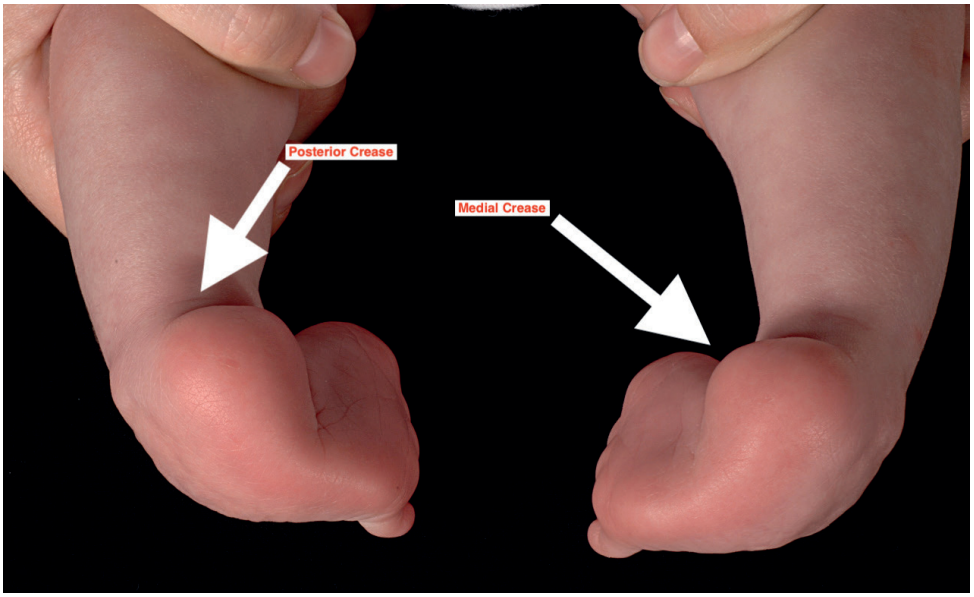

Figure 3. Demonstration of medial and posterior crease for Pirani score. There is also a fleshy appearance to the heel pad for the empty heel pad score – this should be determined clinically through palpation.

Figure 4. Demonstration of curved lateral border and rigid equinus deformity.

run from above the knee to the exposed toes, and are changed every 4–7 days. Each cast gradually corrects the foot deformity. The first cast lifts the first metatarsal and corrects the cavus deformity. The subsequent casts simultaneously correct the hindfoot varus and metatarsus adductus. This is achieved by abducting the forefoot while maintaining pressure on the lateral side of the talar head. The hindfoot itself is never manipulated but corrects because of the coupling of the movements of the tarsal bones. Once the hindfoot varus and metatarsus are corrected, there is usually residual hindfoot equinus, which can only be adequately treated with an Achilles tenotomy. Cast complications are rare, but include pressure ulcers and cast slips. Parents are taught how to identify a slip and how to remove the cast if this occurs. Onward referral or help should be sought if the child develops repeated pressure ulcers or slips, requires more than six or seven casts or their Pirani score is stalling.

Achilles tenotomy

Up to 95% of clubfoot cases require an Achilles tenotomy (dividing of the Achilles tendon) (Scher et al, 2004). This is a standard feature of the Ponseti method. The tenotomy is performed once the foot is ready (Table 3), or once the midfoot contracture score is 0.5 or less. This is usually achieved after three to six casts. The procedure can be performed percutaneously under local anaesthetic for most babies under 6 months of age. It is performed or supervised by an appropriately trained surgeon in a quiet and clean environment. Using an aseptic technique, the Achilles tendon is divided using a small blade. The procedure takes a few seconds to perform, and the leg is cast for 3 weeks after surgery. The complication rate is low. The most common complication is bleeding, caused by accidental sectioning of the peroneal artery (Dobbs et al, 2004). Any bleeding must be monitored until full haemostasis is achieved.

Foot abduction bracing

Following foot correction by the Ponseti method, the foot is held in an abducted and dorsiflexed position in boots that are connected by a bar. This is known as a foot abduction brace, or 'boots and bar' (Figure 5). For the first 3 months, it is recommended that the

Table 3. Features that suggest clubfoot is ready for tenotomy

Talar head is covered
Heel in neutral or valgus
Anterior process of os calcis has come out from under talus

Figure 5. Foot abduction bracing

foot abduction brace is worn for 23 hours a day. Following this, the child will wear the foot abduction brace at night and during naptimes, up to the age of 5 years. The foot abduction brace is fitted and regularly checked in clinic. Up to the age of 2 years, check-ups are usually performed every 3 months; up to the age of 5 years, this is performed every 6 months. Parent education about the foot abduction brace is paramount. There is strong evidence that poor compliance with the foot abduction brace leads to a higher rate of subsequent club foot relapse (Thacker et al, 2005). Parents should be confident when applying the foot abduction brace and should be aware of common complications, such as skin rubbing and skin breakdown. They should be given the details of reliable support services (eg, lower limb condition charity STEPS Worldwide; https://www.stepsworldwide.org/) and made aware of signs of clubfoot relapse. After the age of 5 years, children are usually followed up annually in a dedicated paediatric foot clinic, until skeletal maturity. Function is assessed, alongside monitoring for any signs of relapse. In parallel with clinic follow up, patients can benefit from physiotherapy to improve ankle function and balance (Tarakci et al, 2022).

Relapse recognition and management

Relapse is common (approximately 40%) following clubfoot correction by the Ponseti method and can occur at any time following correction (Masrouha et al, 2021). Parents should be fully informed of this outcome during early Ponseti clinic visits. Early recognition of relapse allows for prompt management. Indicators of relapse include:

- Poor tolerance of the foot abduction brace, with reappearance of elements of clubfoot in a foot that previously fitted well in the foot abduction brace
- A foot that never settled into a foot abduction brace.

Early relapse in pre-walkers is treated with recasting. A revision tenotomy is performed if there is recurrent hindfoot equinus. This is usually performed under a general anaesthetic. Once relapsed elements have been successfully treated with casting, a foot abduction brace should be reintroduced. It is possible for relapse to occur more than once in some children, so these children require close follow up. In children with recurrent relapses, the possibility of secondary clubfoot should be considered, and a possible underlying cause investigated.

Children with clubfoot may develop dynamic supination (turning in) of the foot when mobilising. This can be successfully treated by performing a tibialis anterior tendon transfer at approximately 4 years of age (Holt et al, 2015).

Conclusions

Clubfoot is a common congenital foot deformity. The Ponseti method of treatment is both safe and effective. Relapse is the most common complication but is treatable. A British Society of Children's Orthopaedic Surgery consensus statement outlined how the Ponseti method should be delivered in the UK.

Key points

- In children and infants up to walking age, the Ponseti serial casting method should be the first line of treatment.
- Dedicated Ponseti clinics should be in place to provide easy access pathways, to allow early referral of affected infants.
- For uncomplicated cases of idiopathic clubfoot, serial casting should begin between 2 and 6 weeks of age.
- Maintenance of foot correction relies upon good compliance with a foot abduction brace.
- Recognition of atypical features of clubfoot and relapse following treatment should be well known, and extra support should be sought with these cases if necessary.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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