Guideline

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Management of Infants and Children with Congenital Talipes Equinovarus

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Summary Practice guidelines for management of infants and children with congenital talipes equinovarus.

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GUIDELINE SUMMARY

MANAGEMENT OF INFANTS AND CHILDREN WITH CONGENITAL TALIPES EQUINOVARUS

PURPOSE

The *Management of Infants and Children with Congenital Talipes Equinovarus (CTEV) Practice Guideline* has been developed to ensure a consistent, evidence based approach to the multidisciplinary management of infants and children born with structural CTEV in NSW. It is to be used in conjunction with the 'learnpaediatrics Congenital Talipes Equinovarus e-learning module' and practical training such as the Ponseti Education Day conducted by the Sydney Children's Hospitals Network (Randwick and Westmead).

The Practice Guideline was prepared for the NSW Ministry of Health by an expert clinical reference group.

KEY PRINCIPLES

This Guideline reflects what is currently regarded as a safe and appropriate approach to care and should be used as a guide to be followed in respect of each individual presentation. Each patient should be individually assessed and a decision made as to appropriate management in order to achieve the best clinical outcome. Local protocols may be developed based on this State-Wide guideline and all clinicians involved in the treatment of patients born with structural CTEV should be educated in the use of the guideline and locally developed protocols.

This document should be used as a guide, rather than as a complete authoritative statement of procedures to be followed in respect of each individual presentation. **It does not replace the need for the application of clinical judgement to each individual presentation.**

USE OF THE GUIDELINE

Chief Executives should ensure:

- Local protocols are developed based on the *Management of Infants and Children with Congenital Talipes Equinovarus (CTEV)* Practice Guideline
- Local protocols are in place in all hospitals and facilities likely to be required to assess or manage infants or children with CTEV
- Ensure that all staff treating infants and children are educated in the use of the locally developed paediatric protocols.

Directors of Clinical Governance are required to inform relevant clinical staff treating paediatric patients of the new guideline.

REVISION HISTORY

Version	Approved by	Amendment notes
GL2014_014	Chief Health Officer & Deputy Secretary, Population and Public Health	New Guideline

ATTACHMENT

Management of Infants and Children with Congenital Talipes Equinovarus Practice Guideline.

Management of Infants and Children with Congenital Talipes Equinovarus

NSW GOVERNMENT Health

GUIDELINE

Issue date: July-2014

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1 BACKGROUND

1.1 Purpose

This guideline has been developed to ensure infants born with CTEV in NSW receive quality care, based on current evidence integrated with clinical expertise and parent/carer advice and perspectives, consistent with universal recommendations.

1.2 Development

This guideline is based on the best available research evidence and is aimed at achieving quality care for babies born with structural congenital talipes equinovarus (CTEV) in New South Wales (NSW). This document reflects what is currently regarded as a safe and appropriate approach to care and should be used as a guide to be followed in respect of each individual presentation.

This guideline was developed by the NSW CTEV Working Party in response to identified variability in management of babies born with CTEV in NSW. The scope of the guideline, including exclusions, users and intent, was determined by the working party. Details of the working party membership are provided in Appendix 9.4. The process undertaken to develop this guideline was evidence-based. Initially a search was undertaken to identify existing evidence-based guidelines, which could be adapted for local use. The published literature, key clinical practice guideline websites and websites of a variety of professional organisations were searched. Recommendations are based on evidence found, integrated with clinical expertise and parent contribution.

It is intended that this guideline be updated every 5 years, to reflect changes in the available evidence and any relevant local changes.

1.3 About this document

1.3.1 Scope

The working party agreed that the guideline would focus on establishing a consistent approach to the management of structural CTEV across NSW.

1.3.2 Exclusions

This guideline has been developed to apply to structural CTEV not positional talipes equinovarus or metatarsus adductus. Some of the content of this guideline may be appropriate for infants in these groups. Clinicians should use their clinical expertise regarding infants with significant relevant co-morbidities or chronic illnesses and consult with appropriate specialists.

1.3.3 Users

This guideline is intended for use by orthopaedic surgeons, paediatricians, physiotherapists and orthotists involved in the care and management of babies and

children born with CTEV in NSW. Adaptation for local use may be necessary in other contexts, with care taken to ensure continued compliance with best practice.

1.4 Framework for decision-making

Guidelines are a tool used to improve patient care and do not replace the central role of clinical expertise and reasoning in determining appropriate patient care. Clinicians should apply this guideline in the context of the individual patient and their family. Variations from this guideline should be documented in the patient's medical record at the time the relevant decision is made. The recommendations in this guideline were based on evidence available at the time of searching, and should be read with an awareness of any more recent evidence. A number of supporting documents have been developed to facilitate the implementation of the recommendations of this guideline into practice. These include flowcharts (see Figure 1) and information brochures for parents and carers (see Appendix 9.3).

Each patient should be individually assessed and a decision made as to appropriate management in order to achieve the best clinical outcome. Local protocols may be developed based on this state-wide guideline and all clinicians involved in the treatment of patients born with structural CTEV should be educated in the use of the guideline and locally developed protocols.

2 PRINCIPLES OF PRACTICE

This guideline has been developed to ensure a consistent, evidence based approach to the multidisciplinary management of infants and children born with structural CTEV in NSW. It is to be used in conjunction with the 'learnpaediatrics Congenital Talipes Equinovarus e-learning module' and practical training such as the Ponseti Education Day conducted by the Sydney Children's Hospitals Network (Randwick and Westmead).

There are three key principles that underpin successful management of CTEV in NSW:

Paediatric orthopaedic surgeons and physiotherapists adhering to the Ponseti Method of Clubfoot Management, working collaboratively and ensuring long term follow-up of all patients

The Ponseti Method of Clubfoot Management is an evidence based treatment protocol proven to be inexpensive and effective[17]. The orthopaedic and physiotherapy departments at the three Children's Hospitals in NSW (see Appendix 9.2.2) work in partnership to support the use of this method by providing formal training and workplace learning opportunities for physiotherapists across NSW. Current information about prenatal and postnatal referral processes are also made available to ultrasound centres, obstetricians, and paediatricians (see Appendix 9.2.5). Successful collaboration between all clinicians involved in the care of a baby born with CTEV is paramount to ensure long term bracing and follow-up. Bracing is a very important component of the Ponseti method and requires competent clinicians to supply, fit, troubleshoot and stringently follow-up all patients wearing the boots and bar brace.

Multidisciplinary teams and parents working closely together

At the three Children's Hospitals in NSW it is recognised that every infant and family is unique. To ensure the needs of infants and families are met, clinicians work closely with parents, respecting their decisions about the care of their infant and offering support to attain the goals they set. Parents are encouraged to be involved during the initial casting stage and their compliance with the bracing protocol is crucial to the success of CTEV correction.

Effective service planning to ensure best practice for babies born in NSW with CTEV

The NSW CTEV Working Party was established to ensure best practice for babies born in NSW with CTEV. Regular meetings to discuss and review processes, education and training opportunities, and quality and research activities aim to ensure that infants receive quality care and their families are well supported.

3 KEY ELEMENTS

Structural congenital talipes equinovarus (CTEV), also known as idiopathic clubfoot, is a common congenital paediatric condition involving one foot or both. The foot is typically in equinus and cavus positions, with the hindfoot in varus and internally rotated and the forefoot adducted[12]. If left untreated this leads to long term functional disability, deformity and pain[17]. Soft tissue contractures seem to be the primary factor in the development of the equinovarus deformity. It is widely accepted that the bone and cartilage changes are secondary to the soft tissue contractures.

The cause of CTEV is unknown although it is accepted that genetic, environmental and ethnic factors play a role. It is expected that genetic studies will ultimately identify CTEV as a spectrum of genetic disorders[7]. Twenty-five percent of affected individuals have a family history of CTEV [14]. The incidence of CTEV is one to two per 1000 Caucasian newborns[4] and six to seven per 1000 in live Polynesian/Australian Aboriginal births.

CTEV occurs in males more often than in females by a ratio of 2½:1 and approximately 50% of cases are bilateral. In most cases it occurs in isolation but CTEV often coexists with other congenital abnormalities such as arthrogryposis, myelomeningocele and Larsen syndrome. When associated with other conditions it is often severe and more resistant to treatment[13].

The preferred method of treatment is the Ponseti technique. This technique results in feet that are strong, flexible and plantigrade. Maintenance of function without pain has been demonstrated in a 35 year follow up study[1].

3.1 Pathoanatomy

Table 1: Clinical Features[11]

Clinical Appearance	Bony Deformity	Soft Tissue Contractures	
		Tendons and muscles	**Ligaments**
• Leg shortening, atrophic muscles below the knee, short foot, medial rotation of tibia • Ankle and subtalar equinus • Calcaneal adduction • Heel varus • Empty heel pad • Forefoot cavus (depressed first metatarsal) • Transverse medial crease • Curved lateral foot border • Forefoot pronation	• Talus in equinus and medially rotated • Medial displacement of navicular with uncoverage of talus laterally • Navicular may be touching medial malleolus • Medial angulation of talar neck • Calcaneus in equinus, varus and internal rotation • Cuboid medially displaced with sloped calcaneocuboid joint • Ossific nuclei not centrally located on MRI	• Achilles • Tibialis posterior • FDL/FHL • Abductor halluces, FDB • Plantar quadrates • Plantar fascia	• Spring • Bifurcate • Deltoid • Posterior calcaneo-fibular • Posterior talofibular

4 ASSESSMENT

4.1 Screening

Foot deformities often occur in neonates. Frequently this is positional equinovarus, metatarsus adductus or calcaneovalgus and resolves without intervention or with minimal intervention. Health professionals screening newborns or infants for foot and/or hip deformities include ultrasonographers, midwives, paediatric medical teams, orthopaedic teams, physiotherapists and early childhood nurses.

Whenever prenatal or postnatal examination reveals a possible structural foot deformity, information should be provided to the parents (see Appendix 9.3) and arrangements made for the family to see a paediatric orthopaedic surgeon who will confirm the diagnosis, screen for associated orthopaedic or neurological conditions, explain the condition and facilitate arrangements for ongoing care. After birth, the baby's spine, hips and neck will be examined with both passive and active ranges of movement noted. Follow up monitoring will include gross motor development.

4.2 Range of movement – active and passive

NORMAL DORSIFLEXION = 15-50°
NORMAL ABDUCTION = 20-60°

4.3 Classification

Table 2: Types of CTEV

Idiopathic (isolated)	Syndromic (associated with other conditions)
• Found in otherwise normal infants • Generally corrects with up to six serial casts • With Ponseti management the long-term outcome is good to excellent • **Resistant atypical CTEV:** feet are often pudgy; stiff, short, chubby, with a deep crease in the sole of the foot and behind the ankle, shortening of the first metatarsal with hyperextension of the metatarsal phalangeal joint. This deformity occurs in the otherwise normal infant • **Recurrent typical clubfoot:** may occur irrespective of the original treatment method. Relapse is often due to a premature discontinuation of bracing. The recurrence is most often supination and equinus that is first dynamic but may become fixed with time.	• 20% of CTEV cases are associated with other congenital abnormalities[21] syndromal or neurogenic • Although Ponseti management is the method of choice, correction usually is more difficult and the final outcome may depend more on the underlying condition than the CTEV.

4.4 Atypical CTEV

Atypical CTEV is a subset of CTEV and may occur in isolation (idiopathic) or associated with other congenital deformities (syndromal). Atypical CTEV presents with some similar signs to idiopathic CTEV but in greater severity. In idiopathic CTEV the first ray is pronated or in plantar flexion, however in Atypical CTEV all metatarsals are found in this position.

The 1st ray or Great Toe is often in such severe plantar flexion that it compensates by extreme hyperextension at the metatarsal phalangeal joint, giving the appearance of being shortened compared to the other toes. Atypical CTEV is resistant to most standard management and modified approaches are regularly required [18]. Assistance from a tertiary children's hospital is recommended in the management of these cases.

4.5 Scoring

4.5.1 Pirani scoring

The Pirani scoring system is simple to administer and used to monitor improvement during the initial casting phase. It is a 0-6 point scale; the higher the score, the more severe the deformity.
All items are scored in a maximally corrected position except for curvature of the lateral border. A score of 0, 0.5 or 1 is given for each of six items[16]. See Appendix 9.2.3.

4.5.2 Dimeglio classification

The Dimeglio classification is a 0-20 scoring system comprising four range of movement measures and four observational features. It is useful in monitoring change in older children[3]. See Appendix 9.2.4.

Part of the Dimeglio classification includes the measurements of dorsiflexion and abduction. Although the Dimeglio asks for range of movement to be classified as a range (eg 0-20 degrees), many therapists find recording actual measurements a more sensitive tool for early detection of relapse.

5 TREATMENT

5.1 Ponseti management

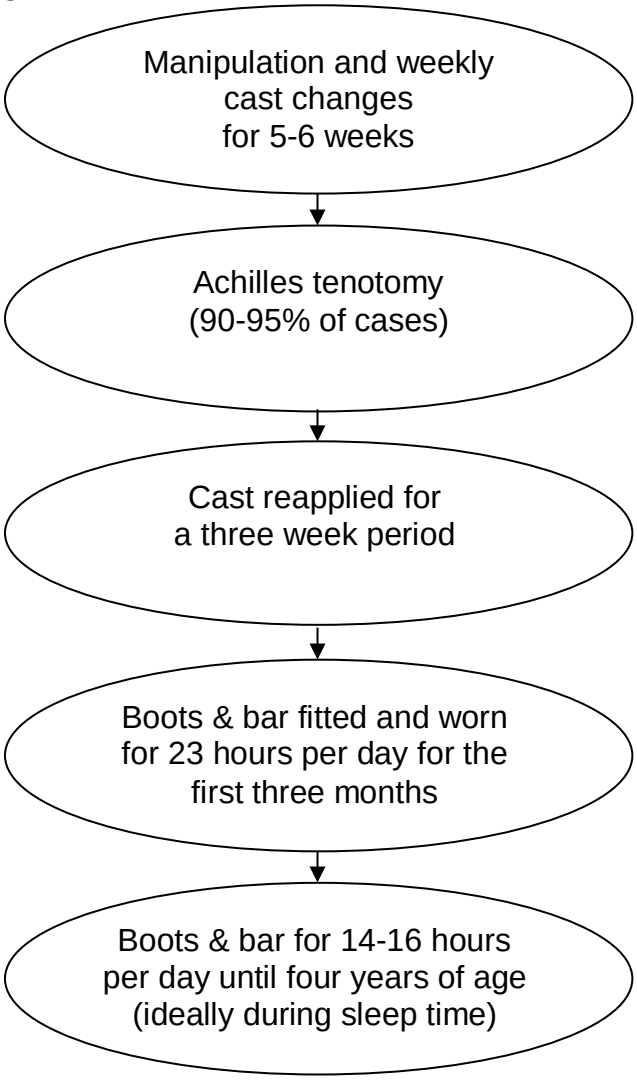
The Ponseti technique is currently the most practised treatment with excellent long-term outcomes[1]. This technique involves gentle manipulation around the talar head followed by application of long leg casts changed weekly, for approximately six weeks. Up to 90% of cases require an Achilles tenotomy to correct remaining equinus deformity[8]. This is considered part of routine treatment.

Patients are then required to wear a boots and bar brace for 23 hours per day for three months and then during sleep until four years of age[17]. The Ponseti technique has been shown to significantly reduce the need for major foot surgery[15, 22].

Manipulation and casting should begin when the parents are ready, ideally within two weeks of birth. Manipulation consists of abduction of the foot in supination while counter pressure is applied over the lateral aspect of the head of the talus to prevent rotation of the talus in the ankle.

All components of clubfoot deformity, except for the ankle equinus, are corrected simultaneously. The head of the talus is the fulcrum for correction. A well-moulded plaster cast maintains the foot in an improved position. The soft tissues should never be stretched beyond their natural amount of give.

Figure 1: Ponseti Management flowchart



5.2 Preparation for treatment

- Reassurance and education for parents
- Comfortable position, baby recently fed
- Trained assistant, ideally.

5.3 Manipulation

- Before each cast is applied, the foot is manipulated
- Locate the head of the talus
- Reduce the cavus by elevating the first ray of the forefoot to achieve a normal longitudinal arch of the foot. Alignment of the forefoot with the hindfoot to produce a normal arch is necessary for effective abduction of the foot to correct the adductus and varus.

5.4 Casting

- For the first cast the foot is in equinus and forefoot is supinated
- Apply a thin layer of cast padding to allow moulding of the foot. After the padding and plaster is applied, maintain the foot in the maximum corrected position by holding the toes with counter pressure applied against the head of the talus
- First apply a below knee plaster of paris cast; begin with three to four turns around the toes; apply the plaster smoothly adding a little tension to the turns of plaster above the heel. The foot should be held by the toes and plaster wrapped over the “holder’s” fingers to provide ample space for the toes. Ensure the cast extends under the full length of the toes and that all toes are visible from above
- Do not force correction with the cast and do not apply constant pressure with the thumb over the head of the talus rather, press and release repeatedly to avoid pressure areas
- While holding the foot in the corrected position mould over the head of the talus; mould the forefoot in supination; mould the arch to avoid flatfoot or rocker-bottom deformity; mould above the heel; and mould the malleoli as well. Moulding should be a dynamic process; constantly move the fingers to avoid excessive pressure over any single site. Continue moulding until the cast hardens. The calcaneus is not touched during the manipulation or casting
- Extend cast as high as possible over thigh with either plaster of paris or semi-rigid casting material ensuring that the knee is not less than 90 degrees of flexion. This prevents the cast from slipping and holds the externally rotated position of the foot.

5.5 Cast removal

- Remove each cast in clinic just before a new cast is applied. Avoid cast removal before clinic as considerable correction can be lost from the time the cast is removed until the new one is placed
- Avoid using a cast saw as it frightens the infant and family and may also cause injury to the skin
- Appropriate use of cast breakers to remove a cast is preferred over soaking and unwrapping which is messy and requires more time. If soaking is required, soak the cast thoroughly in water and when completely soft unwrap the plaster bandage. To make this process easier, during application leave the end of the plaster bandage free for identification.

5.6 Adequate abduction

- The anterior process of the calcaneus should be palpable as it abducts out from beneath the talus; approximately 60 degrees of abduction in relationship to the frontal plane of the tibia is possible; neutral or slight valgus of os calcis; 0 to 5 degrees of dorsiflexion before performing tenotomy
- Correction is achieved by abducting the foot under the head of the talus. The foot is never pronated. At the completion of casting, the foot appears to be over-corrected into abduction with respect to normal foot appearance during walking. This is actually a full correction of the foot into maximum normal abduction. This correction to complete, normal, and full abduction helps prevent recurrence.

5.7 Correction of Equinus - Tenotomy

- Tenotomy is indicated to correct equinus when cavus, adductus, and varus are fully corrected but ankle dorsiflexion remains less than 15 degrees above neutral [20]
- Before applying the last cast, the Achilles tendon may need to be percutaneously sectioned to achieve complete correction of the equinus. The Achilles tendon, unlike the tarsal ligaments that are stretchable, consists of thick, tight collagen bundles with few cells
- Tenotomy is performed by the orthopaedic surgeon either in the outpatient clinic setting or in the operating theatre
- The procedure should be explained to the parents, with ample time available made available to discuss any questions or concerns
- The foot is held in maximum dorsiflexion, tenotomy site is about 1.5cm above the calcaneus; small amount of local anesthetic is injected just medial to the tendon (too much local anesthetic makes tendon palpation difficult and the procedure more complicated). The neurovascular bundle is anteromedial to the tendon
- Insert the tip of the scalpel blade from the medial side, directed immediately anterior to the tendon; keep the flat part of the blade parallel to the tendon – small longitudinal incision. Care must be taken to be gentle so as not to accidentally make a large skin incision. The tendon sheath is left intact. The blade is then rotated, so that its sharp edge is directed posteriorly towards the tendon. A “pop” is felt as the sharp edge releases the tendon. The tendon is not cut completely unless a “pop” is appreciated. An additional 15 to 20 degrees of dorsiflexion is typically gained after the tenotomy
- Cast is applied with the foot fully abducted (60 to 70 degrees) with respect to the frontal plane of the ankle, and maximum dorsiflexion. The foot looks over-corrected with respect to the thigh. This cast holds the foot for 3 weeks after tenotomy. It may require replacement earlier if it softens or the baby has a significant growth spurt. This is usually the last cast required in the treatment program
- After 3 weeks, the cast is removed. Twenty degrees of dorsiflexion is now possible. The tendon is healed. The operative scar is minimal. The foot is ready for bracing. The foot appears to be overcorrected into abduction. This is often a concern to the caregiver. Explain that this is not an overcorrection, only full abduction.

5.8 Boots and bar bracing

- Bracing is an essential component of the Ponseti protocol to maintain the foot in abduction and dorsiflexion
- Inform the family that premature discontinuation of bracing is usually the cause of relapse. Repeated emphasis regarding the importance of bracing from the earliest contact is essential. The family needs to be aware that maintaining the correction with bracing is as important as gaining the correction by casting and tenotomy. Without a diligent follow-up bracing program, relapse occurs in more than 80% of cases. This is in contrast to a relapse rate of only 6% in compliant families[15]
- The brace is applied immediately after the last cast is removed. For unilateral cases, the brace is set at 60 degrees of external rotation on the clubfoot side and 30 to 40 degrees of external rotation on the unaffected side. In bilateral cases, it is set at 60 degrees of external rotation on each side. The bar should be of sufficient length so that the heels of the shoes are at shoulder width
- The brace should be worn full time (23 hrs per day) for the first 3 months. After that, the child should wear the brace for a total of 14 to 16 hours during each 24 hour period. This protocol continues until the child is 4 years of age
- Clearly pass the responsibility to the family to maintain the correction with bracing and encourage bracing to be a part of the normal life of the infant
- Demonstrate how to apply the brace and ask the parent to apply the brace while being supervised
- Make certain the infant is comfortable in the brace. If the infant is uncomfortable, remove the brace and examine the skin for evidence of irritation with reddening of the skin
- For the first few days, suggest that the brace may be removed for brief periods to improve tolerance. Advise the parents to avoid removing the brace if the infant cries. If the infant learns that by crying the brace will be removed, the pattern will be difficult to correct
- Schedule a return visit in 7-14 days to monitor the use of the brace. If the bracing is going well, schedule the next visit in about 3 months. At that time, the bracing may be discontinued during the day. The brace must then be worn 14-6 hours per day
- Encourage the family to call the treating therapist or return to clinic if they have any concerns or experience difficulty with bracing.

5.9 Regular follow up

Ponseti protocol[17] recommendations for review to check brace and monitor compliance or evidence of relapse are as follows:

- **At 1-2 weeks** to check for compliance of full-time bracing
- **At 3 months** to graduate to 14-16 hours per day
- **Until age 3** check every 4 months to monitor compliance and for relapses.
- **Age 3 to 4 years** check every 6 months
- **From 4 years until skeletal maturity** check every 1 to 2 years.

6 COMMON ERRORS AND COMPLICATIONS

Table 3: Manipulation Errors

Manipulation error	Description	How to avoid
Pronation or eversion of the foot	Worsens the cavus deformity	Never pronate the foot Keep 1st ray supinated
External rotation of foot to correct adduction while calcaneus remains in varus	Causes a posterior displacement of the lateral malleolus by externally rotating the talus in the ankle mortise	Use the Ponseti grip with the second finger behind the lateral malleolus and the thumb stabilising the lateral head of talus
Abduction of the foot at the midtarsal joints with the fulcrum near the calcaneocuboid joint	Abduction of the calcaneus is blocked, preventing correction of heel varus and causing hyper abduction of the metatarsals	The foot must be abducted using the talus as the fulcrum for correction Do not touch the calcaneus Hand/finger positions must be correct
Premature equinus correction	Attempting to correct the equinus deformity before the heel varus, foot supination and adduction are corrected results in mid foot break	Never force the foot into dorsiflexion. Equinus through the subtalar joint will improve with abduction of the foot
Failure to manipulate the foot before casting	Without manipulation prior to casting the foot must be forced during casting to obtain an improved position	Take time to feel and improve the foot position with manipulation (stretching) prior to casting

Table 4: Treatment Complications

Complication	Cause	Recommendations
Rocker-bottom deformity	Attempts to correct equinus deformity prematurely against a tight Achilles tendon	Never force the foot into dorsiflexion Mould the medial longitudinal arch Ensure a straight line (heel to toe) on lateral border of foot in each cast
Slipped cast	A poorly moulded/fitting cast, excessive padding. Knee not flexed to 90° and a cast short on the thigh can all contribute to a cast slipping	Use an experienced holder. Minimal padding with a well moulded cast, bend the knee to 90-110° of flexion, pad to the groin and mould the anterior and posterior thigh flat
Pressure sores	Too much pressure in one location, poor technique or too little padding. Common sites include over the head of talus, under the first metatarsal head and in the popliteal and groin regions	Never apply prolonged pressure in any one location. A superficial sore may be dressed and a cast reapplied with appropriate padding and care. A deep sore may need to be dressed and left out of a cast to allow the skin to heal
Deformity not correcting as expected	Poor manipulation and casting technique. Cast may have slipped	The foot should improve with every cast If there is no improvement after two consecutive casts it may be necessary to seek advice from a specialist centre If the cast slips, seek advice

Table 5: Casting Errors

Casting Errors	Problem	Recommendations
Failure to maintain the foot in the most corrected position throughout cast application	Loss of the correction achieved with manipulation and having to force the foot into a corrected position after the cast is applied	Manipulate the foot before casting and use an experienced holder to maintain the corrected position throughout cast application
Applying a short leg cast	Does not hold the foot abducted	Always extend the cast to the groin
Applying a long leg cast that is too short on the thigh	Increases the chance of the cast slipping	Expose the upper thigh by undoing the nappy and positioning infant in slight side lying. Pad high into the groin
Applying a cast that is not snug enough	Increases the risk of the cast slipping	Use minimal padding applied firmly; maintain the foot in the corrected position throughout casting and mould the cast well as it sets
Crowded toes	Pressure areas. Infant uncomfortable	The holder should use their fingers to create space for the infant's toes. Never wrap plaster too tightly over the toes
Not bending the knee to 90°	Increases the chance of the cast slipping	Use an experienced holder to maintain 90° of knee flexion throughout cast application

Table 6: Tenotomy Errors

Errors	Problem	Recommendations
Premature equinus correction	Attempts to correct the equinus before the heel varus and foot supination are corrected will result in a rocker-bottom deformity	Equinus through the subtalar joint can be corrected only if the calcaneus abducts. Tenotomy is indicated after cavus, adductus, and varus are fully corrected
Failure to perform a complete tenotomy	Failure to achieve a “pop” may indicate an incomplete tenotomy	Repeat the tenotomy maneuver to ensure a complete tenotomy if there is no “pop” or “snap”

Table 7: Bracing Complications

Complications	Recommendations
Excessive heel valgus and external tibial torsion while using the brace	Reduce the external rotation of the shoes on the bar from 60 degrees to 40 degrees
Child is uncomfortable in brace	The bar may be too short or too long. A narrow brace is a common reason for a lack of compliance

7 MANAGING CTEV RECURRENCE

Recurrence or relapse refers to the loss of passive range of motion in either abduction, dorsiflexion or both, that requires repeat casting and treatment.

Table 8: Recognising Recurrence

Equinus Recurrence	Varus Recurrence
Consider ROM post initial correction and last appointment. Loss of ROM is a concern <0-10 degrees dorsiflexion requires casting	Rigid varus coincides with loss of abduction ROM (<15 degrees requires Ponseti casting) Varus is best assessed from behind, when the child is in standing or prone (Varus > 0 degrees requires Ponseti casting)

7.1 Reasons for recurrence

- CTEV has a tendency to recur. Recurrence is caused by the same pathology as initial CTEV deformity[17]
- Good initial correction will not prevent recurrence[19]
- Recurrence is most commonly caused by non-compliance with bracing[15] however, may also occur during periods of significant growth.

7.2 Improving Compliance

- Compliance with the boots and bar bracing protocol may be facilitated by:
    - Establishment of a strict and clear bracing protocol
    - Provision of consistent education to parents at the initial consultation, as well as at each cast change and review regarding:
        - the importance of boots and bar to the maintenance of correction
        - the potential for recurrence
        - methods for assessing ROM
    - Regular follow-up of children, particularly during bracing to provide ongoing support and prompt treatment of any issues of concern.

7.3 Recurrence treated with the Ponseti method

- Ponseti casting aims to achieve:
    - 60 degrees abduction; less in the older child
    - 15+ degrees dorsiflexion, then continue bracing

- Repeated tenotomy (or achilles tendon lengthening) may be necessary

- If dynamic supination is present, tendon transfer may be required. Tendon transfer is not routinely undertaken until at least 2.5 years of age when the ossific nucleus of the cuneiform is large enough to ensure the tendon can heal to the cuneiform and not damage the growth plate [2]. Best results are achieved for children older than 30 months with a minimum dorsiflexion of 10-15 degrees.
- Long leg Ponseti casts should be used to improve foot abduction range, cavus and some degree of equinus.
- In the older child (> 3 years old)
    - The knee can be cast at 30-40 degrees of flexion to help with ambulation
    - Short leg serial casting can be used to improve equinus providing there is sufficient foot abduction (30-40 degrees).

8 KEY RECOMMENDATIONS

The preferred method of treatment for CTEV is the Ponseti technique. This technique results in feet that are strong, flexible and plantigrade. Maintenance of function without pain has been demonstrated in a 30 year follow-up study[1].

Successful management of CTEV in NSW is based on:

- ✓ Paediatric orthopaedic surgeons and physiotherapists adhering to the Ponseti Method of Clubfoot Management[17] working collaboratively and ensuring long term follow-up of patients
- ✓ Multidisciplinary teams and parents working closely together
- ✓ Effective service planning to ensure best practice for babies born in NSW with CTEV.

9 APPENDICES

9.1 APPENDIX ONE: REFERENCES

1. Cooper, D., & Dietz, F. (1995). Treatment of Idiopathic Clubfoot: a thirty-year follow-up note. *The Journal of Bone and Joint Surgery, 77-A*(10), 1477-1489.
2. Dietz FR. (2006). Treatment of a recurrent clubfoot deformity after initial correction with the Ponseti technique. *Instructional Course Lectures, 55*, 625-629.
3. Dimeglio, A., Bensahel, H., Souchet, P., Mazeau, P., & Bonnet, F. (1995). Classification of clubfoot. *Journal of Pediatric Orthopaedics, 4*, 129-136.
4. Dobbs, M. B., Nunley, R., & Schoenecker, P. L. (2006). Long-term follow-up of patients with clubfeet treated with extensive soft-tissue release. *The Journal of Bone & Joint Surgery - American Volume, 88*(5), 986-996.
5. Farsetti P, C. R., Mancini F, Potenza V, Ippolito E. (2006). Anterior tibial tendon tranfer in relapsing congenital clubfoot. Long-term follow-up study of two series treated with a different protocol. *Journal of Pediatric Orthopaedics, 26*(1), 83-90.
6. Gray, K., Pacey, V., Gibbons, P., Little, D., Frost, C., & Burns, J. (2012). Interventions for congenital talipes equinovarus (clubfoot). *Cochrane Database of Systematic Reviews, 4*, CD008602.
7. Gurnett, C. A., Alaee, F., Kruse, L. M., Desruisseau, D. M., Hecht, J. T., Wise, C. A., Dobbs, M. B. (2008). Asymmetric Lower-Limb Malformations in Individuals with Homeobox PITX1 Gene Mutation. *The American Journal of Human Genetics, 83*(5), 616-622. doi: http://dx.doi.org/10.1016/j.ajhg.2008.10.004
8. Haft, G., Walker, C., & Crawford, H. (2007). Early clubfoot recurrence after use of the Ponseti method in a New Zealand population. *The Journal of Bone and Joint Surgery, 89*(3), 487-493.
9. Harnett, P., Freeman, R., Harrison, W. J., Brown, L. C., & Beckles, V. (2011). An accelerated Ponseti versus the standard Ponseti method: a prospective randomised controlled trial. *Journal of Bone & Joint Surgery - British Volume, 93*(3), 404-408.
10. Harvey N, D. D., Mudge A, Sims S, Adams R, . (2012). Reliability of physiotherapists using the Pirani scoring system for clubfoot. *International Journal of Therapy and Rehabilitation, 19*(8), 439-445.
11. Herzenberg, J. (2008). *Pathoanatomy of congenital club foot*. Paper presented at the 2nd Australiasian Ponseti Method Conference, Sydney, Australia.
12. Herzenberg, J. E., Carroll, N. C., Christofersen, M. R., Lee, E. H., White, S., & Munroe, R. (1988). Clubfoot Analysis with Three-Dimensional Computer Modeling. *Journal of Pediatric Orthopaedics, 8*(3), 257-262.
13. Janicki, J., Narayanan, U., Harvey, B., Roy, A., Ramseier, L., & Wright, J. (2009). Treatment of neuromuscular and syndrome-associated (non-idiopathic) clubfeet using the Ponseti method. *Journal of Pediatric Orthopaedics, 29*(4), 393-397.
14. Lochmiller, C., Johnston, D., Scott, A., Risman, M., & Hecht, J. T. (1998). Genetic epidemiology study of idiopathic talipes equinovarus. *American Journal of Medical Genetics, 79*(2), 90-96.
15. Morcuende, J., Dolan, L., Dietz, F., & Ponseti, I. (2004). Radical reduction in the rate of extensive corrective surgery for clubfoot using the Ponseti method. *Pediatrics, 113*(2), 376-380.
16. Pirani, S., Outerbridge, H., Sawatzky, B., & Stothers, K. (1999). *A reliable method of clinically evaluating a virgin clubfoot evaluation*. Paper presented at the 21st SICOT Congress.
17. Ponseti, I. (2005). *Clubfoot: Ponseti Management* (Second Edition ed.): Global-HELP Organization.

18. Ponseti IV, Z. M., Davis N, Sinclair M, Dobbs M, Morcuende JA. (2006). Treatment of the complex idiopathic clubfoot. *Clinical Orthopaedics and Related Research*, 1-6. doi: http://dx.doi.org/10.1097/01.blo.0000224062.39990.48
19. Richards, B., Faulks, S., Rathjen, K., Karol, L., Johnston, C., & Jones, S. (2008). A comparison of two nonoperative methods of idiopathic clubfoot correction: the Ponseti method and the french functional (physiotherapy) method. *The Journal of Bone and Joint Surgery, 90*, 2313-2321. doi: http://dx.doi.org/10.2106/JBJS.G.01621
20. Scher, D. M., Feldman, D. S., van Bosse, H. J. P., Sala, D. A., & Lehman, W. B. (2004). Predicting the Need for Tenotomy in the Ponseti Method for Correction of Clubfeet. *Journal of Pediatric Orthopaedics, 24*(4), 349-352.
21. Siapkara, A., & Duncan, R. (2007). Congenital talipes equinovarus: a review of current management. *Journal of Bone & Joint Surgery - British Volume, 89*(8), 995-1000.
22. Zionts, L. E., Zhao, G., Hitchcock, K., Maewal, J., & Ebramzadeh, E. (2010). Has the rate of extensive surgery to treat idiopathic clubfoot declined in the United States? *Journal of Bone & Joint Surgery American, 92*(4), 882-889.

9.2 APPENDIX TWO: RESOURCES

9.2.1 Recommended Reading

Gray, K., Pacey, V., Gibbons, P., Little, D., Frost, C., & Burns, J. (2012). Interventions for congenital talipes equinovarus (clubfoot). *Cochrane Database of Systematic Reviews, 4*, CD008602.

Harvey N, D. D., Mudge A, Sims S, Adams R, . (2012). Reliability of physiotherapists using the Pirani scoring system for clubfoot. *International Journal of Therapy and Rehabilitation, 19*(8), 439-445.

9.2.2 NSW Tertiary Children's Hospitals – Physiotherapy Departments

John Hunter Children's Hospital, Newcastle
Lookout Road
NEW LAMBTON HEIGHTS, NSW 2305
Ph: 02 4921 3700

Sydney Children's Hospitals Network, Randwick
High Street
RANDWICK, NSW 2031
Ph: 02 9382 1050

Sydney Children's Hospitals Network, Westmead
Cnr Hawkesbury Rd & Hainsworth St
WESTMEAD, NSW 2145
Ph: 02 9845 3369

Ponseti Clubfoot Clinic
Sydney Children's Hospitals Network, Westmead
Cnr Hawkesbury Rd & Hainsworth St
WESTMEAD, NSW 2145
http://www.chw.edu.au/prof/services/clubfoot/

9.2.3 Pirani assessment

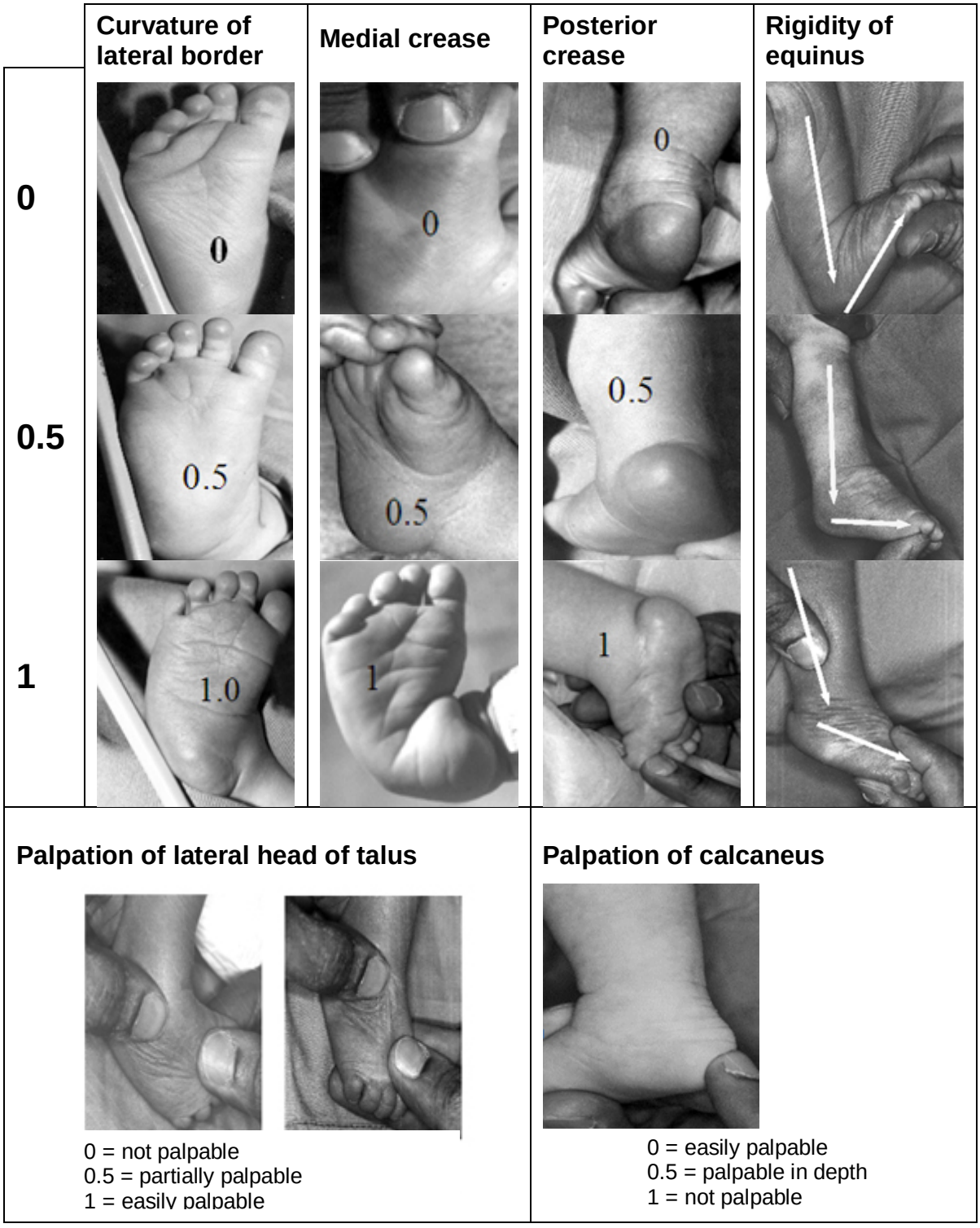


Figure 2: Pirani Assessment. Adapted from Ponseti, I. (2005). Clubfoot: Ponseti Management (Second Edition ed.): Global-HELP Organization.

9.2.4 Dimeglio assessment

Classification			Assessment of Clubfoot by Severity Scale			
Classification grade	*Type*	*Score*	*Characteristics: Deformity*	*Points (pts)*	*Characteristics: Other parameters*	*Points (pts)*
I	Benign	(<5)	90-45°	4	Posterior crease	1
II	Moderate	(=5<10)	45-20°	3	Medial crease	1
III	Severe	(=10<15)	20-0°	2	Cavus	1
IV	Very severe	(=15<20)	<20 to –20°	1	Poor muscle condition	1

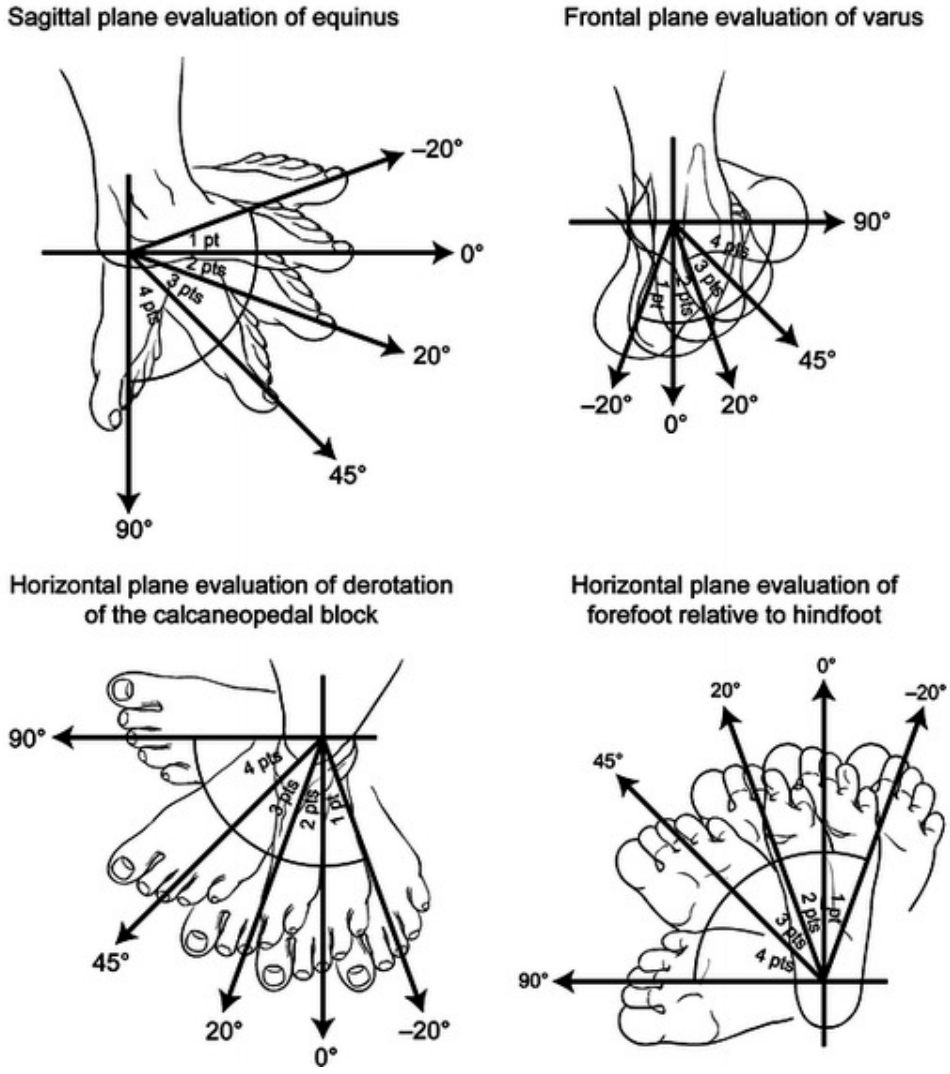


Figure 3: The Dimeglio Classification System.
Reprinted From The Clubfoot: Congenital Talipes Equinovarus. In M. Benson, J. Fixsen, M. Macnicol & K. Parsch (Eds.), Children's Orthopaedics And Fractures (Pp. 541-558) By D. Eastwood, 2009, London:Springer. Copyright 2013 By Springer-Verlag London limited. Reprinted With Permission.

9.2.5 CTEV Referral recommendations for ultrasound centres and birthing centres

Refer to next page for information. This page can also be printed as a separate information sheet.

CONGENITAL TALIPES EQUINOVARUS (ALSO DESCRIBED AS IDIOPATHIC CLUBFOOT)

REFERRAL RECOMMENDATIONS FOR ULTRASOUND CENTRES AND BIRTHING CENTRES

The prevalence of congenital talipes equinovarus (CTEV) is 1 to 3 per 1000 live births in Caucasians. Male foetuses are predominately affected, with a 2:1 male to female ratio. The birth prevalence varies among different ethnic groups; the highest rates are seen in individuals of Polynesian ancestry (7 per 1000 live births) and the lowest in Asian populations (0.57 per 1000 live births). CTEV is bilateral in approximately 50% of cases.

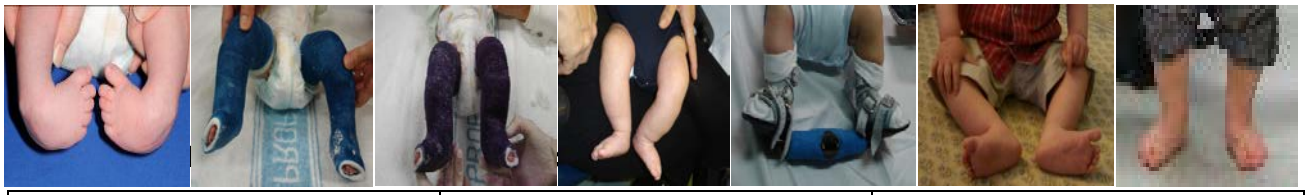
Identification of CTEV on prenatal ultrasound examination or at birth is stressful for mothers and their families. They should receive information regarding ultrasound findings in a clear, sympathetic and timely fashion. This should occur in a supportive environment ensuring privacy.

Parents should be reassured that idiopathic CTEV is a treatable condition. They should also be informed that prenatal ultrasound at 18 to 20 weeks detects structural anomalies in approximately 50% of cases. The likelihood of false positives and false negatives should also be discussed together with the possibility that the condition may be associated with other anomalies. When CTEV is detected, a targeted ultrasound should be performed at a specialised ultrasound unit to rule out the presence of associated anomalies.

In the case of prenatal identification, referral to a paediatric orthopaedic surgeon or physiotherapist at a specialist CTEV clinic should always be offered to provide the most accurate information possible. When the CTEV is identified at birth, referral to a paediatric orthopaedic surgeon and physiotherapist at a specialist CTEV clinic should occur as soon as possible. The experience of families when a child is diagnosed with CTEV during the 20 week prenatal ultrasound scan is less stressful when good quality information is provided and when families are directed to reputable sources.

Parental education plays an important part in the success of the treatment process. Early treatment is important and parents who are well informed about the diagnosis and treatment process make a smooth transition from delivery to the start of treatment.
A parent leaflet has been developed to accompany this factsheet. It includes basic information compiled in response to frequently asked questions.

PLEASE REFER TO PAEDIATRIC ORTHOPAEDIC SURGEON OR SPECIALIST PHYSIOTHERAPY CLINIC AT TIME OF DIAGNOSIS.



Sydney Children's Hospitals Network, Westmead **(02) 9845 3369** **www.chw.edu.au**	**Sydney Children's Hospitals Network, Randwick** **(02) 9382 1050** **www.sch.edu.au**	**John Hunter Children's Hospital Newcastle** **(02) 4921 3700** **www.kaleidoscope.org.au**

9.3 APPENDIX THREE: PARENT INFORMATION

Refer to next pages for information. These pages can also be printed as a separate information sheets.

(a) CTEV Information for parents with a prenatal diagnosis at ultrasound
(Pages 31-33)

(b) CTEV Parent Information Handout
(Pages 34-36)

9.3.1 CTEV Information for parents with a prenatal diagnosis at ultrasound

CONGENITAL TALIPES EQUINOVARUS
INFORMATION FOR PARENTS WITH A PRENATAL DIAGNOSIS AT ULTRASOUND

The ultrasound scan has shown the probability that your baby has a condition called congenital talipes equinovarus, also known as clubfoot. Approximately 50 per cent of cases can be detected by ultrasound before birth. This abnormality is most commonly detected at the 18-20 week scan.

In isolation this is a very treatable condition. The treatment will not stop your child from developing normally; they will roll, sit, crawl, walk and run at typical stages.
This leaflet provides you with information about:

- the condition, congenital talipes equinovarus
- the treatment that may be required after the birth of your baby
- contact details for specialist clinics where experienced staff are available to meet with you and answer your questions.

What is Congenital Talipes Equinovarus (CTEV)?

- Congenital means present at birth
- Talipes refers to the foot and ankle
- Equinovarus refers to the position of the foot - pointing down and turning inwards

It occurs in 1 to 3 Caucasian births per 1000 (higher in Polynesian babies); 50% of the babies have both feet affected and it is more common in boys than girls. This condition requires treatment to correct the position of the foot. It cannot correct on its own.

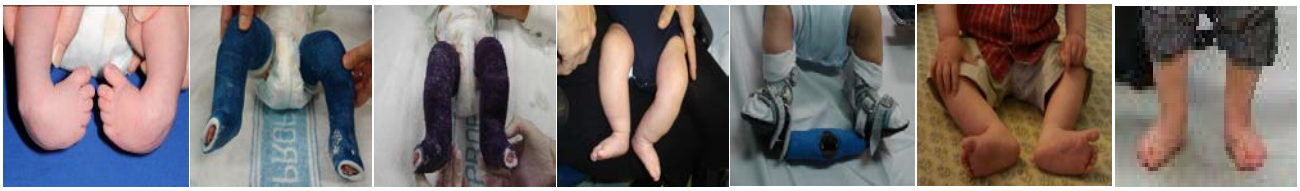
Why does this occur?
The cause for this condition is not entirely understood. It is thought to be due to an abnormality in the development of the soft tissues and bones of the ankle and foot. Clubfeet are more common in some families or cultural groups. It is likely that there is a genetic component but this is yet to be proven.

What else could be wrong?
CTEV usually occurs in isolation. However, there is a very small chance that it could be associated with other medical or physical conditions. When the condition is detected, a targeted ultrasound should be performed at a specialised ultrasound centre to rule out the presence of other issues of concern.

How will this affect the pregnancy and birth?
The baby will otherwise develop as usual during the pregnancy. Further prenatal assessment of the affected foot/feet provides no benefit to the pregnancy or the baby. Your baby is in no pain and the baby will be delivered as usual without special requirements. You will be able to hold your baby as usual afterwards. At a convenient time after the birth, the baby will be reviewed by a paediatrician and the foot/feet examined.

Does my baby need treatment?
All babies born with CTEV need treatment and should be referred to a paediatric orthopaedic surgeon and a specialist physiotherapy clinic. You should have an initial appointment as soon as possible but treatment does not need to start immediately after your baby is born. It is fine to wait until they are a couple of weeks old and hopefully settled into a routine at home.

What is the treatment? The Ponseti Method
This is a program of treatment which starts with a series of plaster casts. These extend from the toes to the groin and are changed weekly. The foot position is gradually corrected with each cast. This is not painful for your child. Casting continues for about 6 weeks and will be done by your physiotherapist. In most cases, completion of the correction is achieved by a small surgical procedure to release the Achilles tendon (heel cord). Following this procedure a cast is applied and left in place for 3 weeks. When this cast is removed, your baby will be fitted with a pair of boots joined together with a bar. These are worn 23 hours per day for the following 12 weeks. After this they are worn 14-16 hours per day mostly while asleep at night until 4 years of age. This bracing is essential to maintain the correction.



Will my baby be able to walk normally after treatment?
Yes. Children successfully treated using casting, Achilles tendon releases and boots and bar bracing achieve typical developmental milestones and have normal looking, pain free, fully functional feet allowing them to participate in all activities including sports.

The future
Your baby should have regular reviews until they stop growing to ensure the foot/feet remain in the right position and are moving properly. Sometimes they may need further treatment as they grow.

More information
The physiotherapists at our three hospitals will be happy to answer any more questions or concerns you may have about this condition, the treatment program and pram, car seat and high chair advice. We could also facilitate a prenatal appointment with one of our paediatric orthopaedic surgeons if you wish.

Our contact details

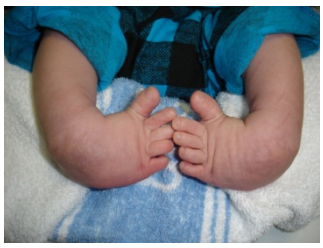
Sydney Children's Hospitals Network, Westmead Physiotherapists **(02) 9845 3369** **www.chw.edu.au**	**Sydney Children's Hospitals Network, Randwick Physiotherapists** **(02) 9382 1050** **www.sch.edu.au**	**John Hunter Children's Hospital Newcastle Physios** **(02) 4921 3700** **www.kaleidoscope.org.au**

Useful websites/addresses
www.chw.edu.au/prof/services/clubfoot
www.AussieClubFootKids.org
www.ponseti.info
www.clubfoot.co.uk

Note: This information is meant to be a helpful, informative introduction which will be followed by a consultation

9.3.2 CTEV Parent Information Handout

CONGENITAL TALIPES EQUINOVARUS INFORMATION AND TREATMENT



What is Congenital Talipes Equinovarus (CTEV)?

CTEV or clubfoot is a relatively common condition affecting the lower leg.

- Congenital means present at birth
- Talipes refers to the foot and ankle
- Equinovarus describes the position of the foot – pointing down and turning inwards

Approximately 1-2 per 1000 births are affected and 50% of the babies have both feet affected. It is three times more common in boys than girls. This condition requires treatment to correct the position of the foot. It cannot correct on its own.

Why does this occur?

The cause for this condition is not entirely understood. It is thought to be due to an abnormality in the development of the muscles and bones of the ankle and foot. It has a hereditary predisposition and there could be a genetic component.

What else could be wrong?

CTEV usually occurs on its own. However, there is a small chance that it could be associated with other abnormalities.

Will my baby be able to walk normally after treatment?

Yes, when it occurs on its own this is a very treatable condition. The treatment will not stop your child from developing normally; they will roll, sit, crawl, walk and run at typical stages.

What is the treatment? The Ponseti Method

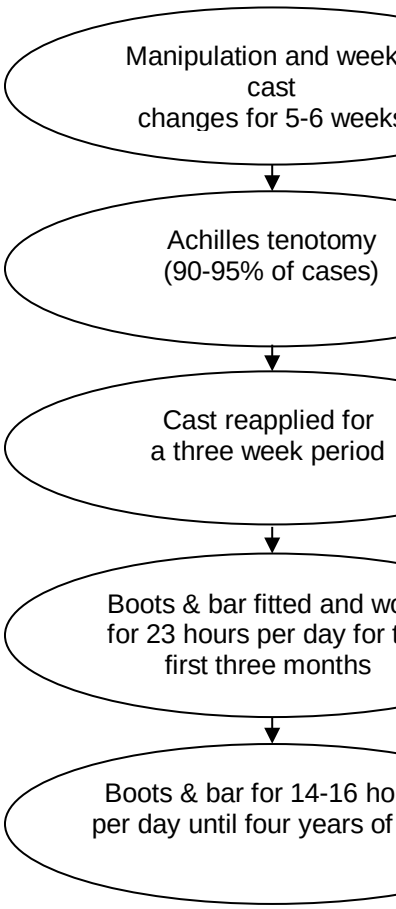
This is a program of treatment which starts with a series of plaster casts. Casting begins when you are ready, but ideally commences within two weeks of birth. The casts extend from the toes to the groin and are changed weekly. The foot position is gradually corrected with each cast. This is not painful for your baby. Casting continues for about 6 weeks and will be done by your physiotherapist. In most cases, completion of the correction is achieved by a small surgical procedure to release the Achilles tendon (heel cord). After this procedure a cast is applied and left in place for 3 weeks. When this cast is removed, your baby will be fitted with a pair of boots joined together with a bar. This brace is worn 23 hours per day during the next 12 weeks. After this the boots and bar are worn 14-16 hours per day mostly while asleep at night until at least 4 years of age. This bracing is essential to maintain the correction.

The future

Your baby should have regular reviews until they stop growing to ensure the foot/feet remain in a good position and are moving properly. Sometimes they may need further treatment as they grow.

More information

The physiotherapists at our three hospitals will be happy to answer any more questions or concerns you may have about this condition or the treatment program and can arrange an appointment for you with a paediatric orthopaedic specialist.



Sydney Children's Hospitals Network Westmead Physiotherapists	Sydney Children's Hospitals Network Randwick Physiotherapists	John Hunter Children's Hospital Newcastle Physiotherapists
(02) 9845 3369 www.chw.edu.au	(02) 9382 1050 www.sch.edu.au	(02) 4921 3700 www.kaleidoscope.org.au

Useful websites/addresses

www.chw.edu.au/prof/services/clubfoot
www.AussieClubFootKids.org
www.ponseti.info
www.clubfoot.co.uk

Note: This information is meant to be a helpful, informative introduction which will be followed by a consultation

Effective Date: June 2014 Review Date: June 2017

9.4 APPENDIX FOUR: WORKING PARTY MEMBERS

Alison Chivers	Physiotherapist Sydney Children's Hospitals Network, Westmead
Patricia Evans	Physiotherapist Royal North Shore Hospital Northern Sydney Local Health District
Kelly Gray	Physiotherapist Sydney Children's Hospitals Network, Westmead
Dr Paul Gibbons	Department Head, General Orthopaedics Sydney Children's Hospitals Network, Westmead
Pam Hennessy	Head of Department, Physiotherapy Sydney Children's Hospitals Network, Randwick
Carolyn Matthews	Head of Department, Physiotherapy Kaleidoscope Health John Hunter Children's Hospital Hunter New England Local Health District
Kate Moss	Physiotherapist Sydney Children's Hospitals Network, Randwick
Jenny Nicol	Allied Health Educator Greater Eastern & Southern Region Children's Healthcare Network
April Sutcliffe	Physiotherapist Sydney Children's Hospitals Network, Randwick
Tony Juarez	Physiotherapist Sydney Children's Hospitals Network, Westmead