Hindfoot Fusions in the Cavovarus Foot

What Is the Key for a Successful Outcome?

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KEYWORDS

- Cavovarus foot • Cavus • Arthrodesis • Triple fusion • Tendon transfer
- Wedge tarsectomy

KEY POINTS

- The aim of surgical management is to establish a painless, plantigrade, balanced and stable foot.
- A comprehensive clinical and radiographic assessment enables the surgeon to fully understand the patient's deformity and plan a reliable surgical strategy for deformity correction.
- Rigid deformities should be corrected at their apex either in the hindfoot or midfoot.
- Surgical correction must include tendon transfers when required to balance the soft tissues to reduce the risk of deformity recurrence in the long-term.

INTRODUCTION

The cavovarus foot deformity can vary in severity from subtle and flexible to severe and rigid.[1]

Treatment options for the cavovarus foot include non-operative measures such as shoe-wear modification, custom orthotics and analgesics. Orthotics aim to realign a flexible hindfoot deformity or to accommodate and distribute the pressure of a fixed hindfoot deformity.[1–3] When these simple measures fail, patients may progress to surgical intervention.

The aim of surgical management is to establish a painless, plantigrade, balanced and stable foot.[1,2] In the case of subtle or flexible deformities, this goal can often be achieved with a combination of soft tissue release or lengthening, joint sparing hindfoot, midfoot or forefoot osteotomies and tendon transfers.[1–3]

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In patients with rigid deformities and those with established articular degenerative change, joint sparing techniques are less likely to be successful.[3,4] In such circumstances, hindfoot fusions are often required to achieve the goals of surgery.[1–5] The objective of this article is to outline the key for a successful outcome when performing hindfoot fusions in the cavovarus foot.

TYPES OF CAVUS DEFORMITY

The first step to achieving a successful outcome in managing the cavus foot is to understand the patient's deformity, in order to formulate a reliable surgical strategy. We will explore these deformities in turn, explaining salient features to evaluate clinically and go on to consider the impact these findings have on achieving a successful surgical outcome.

The cavus foot is defined as a foot with a high medial arch.[2] This high arch rarely occurs in isolation and four common patterns of cavus foot deformity are recognised: the "pure" cavus foot, the cavovarus foot, the equinocavovarus foot and the calcaneocavus foot.[6]

The pure cavus foot can be idiopathic in nature or secondary to neurological causes. It is characterised by an increased medial arch alone with no other associated deformities.

A cavovarus deformity is more common and results from muscular imbalance with weakness of eversion when compared to inversion. The most common cause of this is Charcot-Marie-Tooth (CMT) disease, which results in weakness of tibialis anterior and peroneus brevis when compared to tibialis posterior and peroneus longus. The resultant deformity is a foot drop coupled with hindfoot varus and forefoot pronation. There are also often claw toes, which occur due to extensor substitution, where the long toe extensors try to compensate for weak dorsiflexion of the ankle caused by tibialis anterior weakness. Hyperextension occurs at the metatarsophalangeal joints of the lesser toes and the long toe flexors pull the distal phalanges into plantar flexion leading to clawing.

An equinocavovarus foot occurs most commonly secondary to neurological causes such as cerebral palsy, hereditary spastic paraplegia, stroke or post-compartment syndrome[6,7] (**Fig. 1**). Patients with a residual congenital talipes equinovarus deformity would also typically display this deformity. It is normally driven by spasticity and relative overactivity of the calf muscles compared to the ankle dorsiflexors, leading to foot equinus and plantarflexion of the forefoot, especially the first ray due to excessive peroneus longus contraction. First ray plantarflexion causes a compensatory foot cavus and heel varus alongside the equinus deformity.[6]

The calcaneocavus deformity occurs due to muscular imbalance between ankle dorsiflexors and plantarflexors, resulting in dorsiflexion of the hindfoot and compensatory forefoot plantarflexion. Causes of this can again be neurological such as cerebral palsy and myelomeningocoele. Another scenario where this is seen is iatrogenic overlengthening of the Achilles tendon, leading to an increased calcaneal pitch angle on lateral radiographic imaging and a cavus foot.[6]

Recognising the specific type of cavus deformity, with an appreciation of the underlying pathogenesis, is crucial to understanding and therefore appropriately planning deformity correction surgery. There can be no standard algorithm for these complex deformities and each patient must be judged on their own merit, bearing these patterns in mind.

EVALUATING CAVUS DEFORMITIES AND MUSCLE BALANCE

Patients must be clinically assessed by taking a comprehensive history, acknowledging comorbidities such as neurological issues and previous surgery. Certain neurological conditions are associated with typical patterns of deformity.

Fig. 1. Clinical photograph of a rigid equinocavovarus deformity.

The specific foot and ankle examination should include an assessment of the patient's footwear and gait. Global inspection of the feet can reveal the cavus foot deformity type and identify hindfoot, midfoot and forefoot deformity components and signs of pressure areas. Tenderness should be elicited by systematic palpation of the feet and mobility of deformities should be established, understanding if the cavus foot is flexible and correctible or rigid and stiff. First ray mobility should also be noted.[1–3]

The Coleman Block test can be helpful in assessing correctability of the hindfoot, however simple assessment of the movement of the subtalar joint with the patient non-weightbearing also serves as a useful guide to whether the hindfoot deformity is rigid or flexible.[4,5] The Silfverskiold test is essential to assess if the Achilles tendon is contracted or if the gastrocnemius is tight. Achilles lengthening or gastrocnemius recession may then be planned as part of deformity correction surgery based on this assessment. The relaxation of a gastrocnemius contracture may also induce some flexibility in a seemingly rigid deformity.

A full systemic, local and neurological examination should be performed, assessing for possible spinal or neurological etiologies for the cavus foot deformity.[2] It is imperative to evaluate muscle power, commonly using the Medical Research Council (MRC) power scale.[1,2,4] Specifically, the major hindfoot invertor, tibialis posterior, must be compared to peroneus brevis and longus as these muscles may be causing the cavovarus foot deformity and often need to be transferred as part of corrective surgery.[8] Furthermore, power of ankle dorsiflexion and plantarflexion should be assessed, as for example, a foot drop may have bearing on choice of tendon transfer.

Relevant imaging is also essential for surgical planning. Plain weight-bearing AP and lateral radiographs of both ankles and a dorsoplantar weight-bearing view of both feet should be obtained to identify the site of deformity and also the degree of correction that may be required.[1,2] In our unit, we also have access to weight-bearing computed tomography (CT), which has proved a helpful and informative tool in understanding these complex multiplanar deformity patterns and helps us to plan accurate correction surgery (**Fig. 2**). It is important to systematically appreciate the deformity at all levels.

- *Ankle*: Evaluate for varus at the ankle and if present, whether joint is congruent or incongruent. Also evaluate for arthritic changes.
- *Hindfoot*: Evaluate for talonavicular over coverage, hindfoot varus, evidence of arthritis.
- *Midfoot*: Evaluate for sagittal and axial deformity in the midfoot. For example, is there adduction through the midfoot that might persist after correction of the hindfoot? Is the apex of the cavus deformity in the midfoot, rather than the hindfoot?

Fig. 2. Weight-bearing CT three-dimensional reconstruction of a cavovarus foot.

- *Forefoot*: Evaluate for first metatarsal pronation, or pronation of the entire forefoot. Metatarsus adductus. Toe deformities.

In our unit, the CT scans can also be used to inform custom patient specific cutting guides to permit accurate planning and deformity correction surgery in specific types of deformity.[9,10]

PLANNING AND PERFORMING CAVUS HINDFOOT CORRECTION SURGERY

Once the information regarding the patient's cavus foot pathology has been gathered, the following principles can guide the surgical correction plan.

1. Release or lengthen soft tissue to aid deformity correction
2. Prepare tendon transfers
3. Correct the hindfoot deformity
4. Correct the midfoot deformity if required
5. Correct the forefoot deformity if required
6. Secure tendon transfers at appropriate tension to correct residual deformity[6]

The rationale for this order is to first release the tight structures, including tendons, to facilitate correction, then to correct from proximal to distal, then to secure the tendon transfers at the end to balance the foot in its new position. It is also practically sensible to fix the tendon transfers at the end, where there is less manoeuvring of the foot, which can risk stretching or pulling out the transfer.

If we revisit the different cavus foot deformity patterns, management strategies can be broadly formulated bearing the above principles and deformity patterns in mind.

In rigid cavovarus feet with a hindfoot apex of deformity, either subtalar or triple arthrodesis is a reliable surgical option.[4] A subtalar fusion alone may be suitable in cases of milder hindfoot deformity but a triple fusion is a more reliable option in severe cases as the potential for deformity correction is greater.[4] Triple fusion in the cavovarus foot was first described by Ryerson in 1923.[11] A modification to the triple arthrodesis specifically for managing cavus feet was proposed by Siffert in 1966, called the beak triple arthrodesis.[12] Siffert's modification involved an osteotomy of the anterior calcaneus extending through the talar head and neck but retaining a shelf of bone at the dorsal talus. This shelf resembled a bird's beak, hence the name of the arthrodesis. The prepared navicular joint surface can then be positioned inferior to this beak and joint preparation can also take a dorsal closing wedge, accounting for correction of varus and supination.[4,12]

In the equinocavovarus foot, the management strategy is similar to the management of the cavovarus foot, however more attention must be paid to correction of the equinus deformity, which will limit progress if not addressed appropriately. This can be done by gastrocnemius recession or Achilles tendon lengthening procedures depending on which is tight as guided by the Silfverskiold test. If a plantigrade position of the ankle is not achievable after soft tissue release and lengthening, a good subsequent option is a Lambrinudi arthrodesis, where an anterior wedge is excised from the talus and calcaneus to permit hindfoot dorsiflexion and achievement of a plantigrade foot after subtalar fusion.[13] It is important to only correct the hindfoot to a neutral calcaneal pitch and not to over lengthen the Achilles to accommodate a concomitant midfoot cavus deformity (**Fig. 3**).

In pure cavus feet, correction only needs to be considered in the sagittal plane. If isolated plantar flexion of the first ray is causing the deformity, then one may opt for a dorsiflexion osteotomy to correct the pure cavus foot. But if the deformity is occurring at the talonavicular and calcaneocuboid joints or in the midfoot, then a Chopart or

Fig. 3. Post-operative lateral radiograph illustrating a double hindfoot arthrodesis for a cavovarus foot deformity. Overcorrection of calcaneal pitch has been avoided., If the forefoot is excessively dorsiflexed, functional over lengthening of the Achilles tendon can occur.

midfoot arthrodesis at the apex of the deformity with a dorsal closing wedge may be a more suitable surgical option.[6]

When dealing with a calcaneocavus foot, the priority is refunctioning the Achilles tendon and overcoming weak hindfoot plantarflexion. This is a challenging task and can be done by transferring tibialis anterior to the Achilles tendon, but reported results are variable. The cavus portion of the deformity can be addressed similar to the suggestions above once Achilles function has been restored.[6]

For the remainder of this article, we will focus on managing the more common rigid cavovarus and equinocavovarus deformities, which will form the bulk of patients seen.

Our preferred technique for managing rigid hindfoot deformity in this cohort is to perform a double or triple arthrodesis. The calcaneocuboid joint is included if it has degenerative changes, or to aid in positioning of the lateral column if required.[3]

The patient is positioned supine with a thigh tourniquet and a sandbag under the ipsilateral buttock to raise the lateral hindfoot for surgical access. If the Achilles tendon is tight and the ankle cannot be brought to neutral, we perform a Hoke triple cut percutaneous Achilles tendon lengthening with two cuts medially and one cut laterally to minimise potential for sural nerve injury[14] (**Fig. 4**). If percutaneous Achilles lengthening will not suffice to achieve a plantigrade ankle, a formal open Achilles release can be performed via a posteromedial approach and Z-lengthening technique.[15] It is important the incision for the open Achilles lengthening is straight and does not curve distally, as a curve will lead to gapping of the wound after deformity correction, which can cause a difficult to manage soft tissue defect. We are also extremely cautious not to over lengthen the Achilles tendon, which can cause a calcaneus deformity.

Once the ankle can be brought to plantigrade, the sinus tarsi approach can be utilized to gain access to the subtalar joint. An incision is made from the base of the fibula in line with the 4th metatarsal. Subcutaneous dissection will reveal extensor digitorum brevis, which is elevated from its insertion to access the subtalar joint. The subtalar joint can now be prepared using flexible bone chisels. A laminar spreader can be

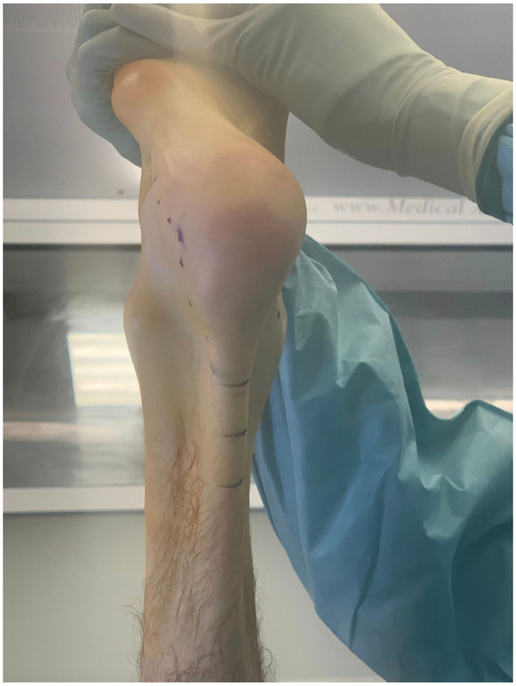

Fig. 4. Clinical photograph demonstrating skin incision markings for a Hoke triple-cut percutaneous Achilles tendon lengthening.

used to help to open up space in the subtalar joint to access the posterior, middle and anterior facets. Once the articular surfaces are fully denuded of cartilage and sclerotic subchondral bone to reveal cancellous bleeding bone, the surface is fenestrated using a 3.2 mm Kirschner wire and fish-scaled using a narrow osteotome. We in our institution term this process “petallising” the articular surface, as the end result of the prepared bony surface can look like the petals of a flower, increasing the available surface area for bony union.

After preparing the subtalar joint, the talonavicular joint is approached via our preference of a dorsal incision. Some authors propose a medial incision between tibialis anterior and tibialis posterior.[3,5] With our dorsal foot incision, extensor hallucis longus and tibialis anterior are palpated and marked on the skin and an incision is made between these landmarks. Sharp, deeper dissection between these two tendons is then performed, protecting them and in turn protecting the neurovascular bundle of dorsalis pedis and the deep peroneal nerve, which typically lies lateral to EHL at this level. The talonavicular joint capsule is divided to gain access to the joint and preparation of the articular surfaces is again performed in a systematic manner, with space being created between the surfaces using a laminar spreader or Hintermann retractor. The joint surfaces are denuded to subchondral bleeding bone and “petallised” as described above.

Finally, if the calcaneocuboid joint is identified as a potential pain generator, the lateral sinus tarsi incision is extended distally to adequately expose the calcaneocuboid joint and permit preparation after distraction using a Hintermann distractor. As is standard for our technique, the surfaces are “petallised” to promote joint surfaces favourable for arthrodesis.

The authors preferred reduction manoeuvre for a hindfoot fusion in a cavovarus foot is to push the talar head from the lateral side to reduce the talar head onto the navicular. Once the talonavicular joint is reduced, it is pinned with a Kirschner wire to hold the reduction. On occasion, once the talonavicular joint is reduced, a compression staple is applied from the lateral side to hold the reduction. We then proceed to formal fixation of the subtalar and talonavicular joints.

We usually fix the subtalar joint first, with the heel in physiological valgus, then proceed to talonavicular fusion. This is because the fixed subtalar joint will still allow a small degree of 'fine tuning' movements through the talonavicular joint, but the reverse is less possible.

Our preferred fixation of the subtalar joint is to use two partially threaded 8.0 mm or 6.5 mm cannulated screws, depending on available bone stock, passed from a stab incision in the heel. The screws should pass perpendicular to the prepared subtalar joint surfaces and compression is ideally seen in both intra-operative fluoroscopy and under direct vision in theatre.

The talonavicular joint can be stabilized using cannulated 5 mm partially threaded compression screws or a combination of partially threaded screws, compression plates and/or memory staples. The calcaneocuboid joint in our practice is most commonly stabilised and compressed using cannulated 4.5 mm partially threaded compression screws.

At the end of our surgical procedure, the patient is placed into a below knee backslab. Post-operatively, we see the patient at two weeks in the outpatient clinic to remove the backslab, check the wound and remove sutures as appropriate and place the patient into a lightweight fiberglass below knee cast for a further ten weeks. The patient is seen again in the clinic at the six-week post-surgery mark with the cast removed to assess the soft tissues and a new lightweight cast is applied at this stage. For the first four weeks post-surgery, we advise the patient is non-weight-bearing. For the middle four weeks, the patient can partially weight-bear in the cast and for the final four weeks, the patient can fully weight-bear through the cast. After twelve weeks, the patient is seen again in the outpatient clinic for radiographic assessment of deformity correction and assessment of bony union with a weight-bearing CT scan. Provided union and soft tissue healing is satisfactory, the patient will be provided with an Aircast boot and advised to fully weight-bear in the boot and wean out of the boot into their own comfortable and supportive footwear over the next 3 to 6 weeks. Based on the current evidence base for early weight bearing in hindfoot fusion, we are in the process of re-evaluating this regimen.

In some cases of more severe deformity, it may be necessary to excise wedges of bone when performing joint preparation in order to achieve a plantigrade foot with complete deformity correction. Given the varus nature of deformity, it is most common to take a lateral based wedge out of the calcaneocuboid joint, hence facilitating closing of the lateral column to correct any adductovarus deformity in the foot.[8] After this lateral wedge is excised, the calcaneocuboid joint fusion can be performed similar to the triple fusion fixation construct as suggested above.

ADJUNCTIVE PROCEDURES FOR SUCCESSFUL CAVUS CORRECTION

Whilst hindfoot arthrodesis techniques as outlined above are often important in the correction of the rigid cavovarus foot, it is essential to perform relevant adjunctive procedures alongside double or triple hindfoot arthrodesis to ensure success. Hindfoot arthrodesis alone is unlikely to work without balancing the deforming forces around the foot, as left unaddressed, there is a high chance of recurrent or persistent deformity.

It is firstly important to mention that in a rigid cavovarus foot where the apex of the deformity in the sagittal and/or axial plane is within the midfoot, a hindfoot fusion may not be indicated, and a midfoot wedge tarsectomy may be more appropriate. Similarly, there are a subset of cavovarus feet, where once the hindfoot is corrected, there remains midfoot adduction and rotation, and these may need combined hindfoot fusions with a wedge tarsectomy. It is the authors' experience that leaving a persistent midfoot adductus, despite hindfoot correction, may cause persistent pressure on the outer border of the foot and less satisfactory outcomes. Multiplanar corrections in the sagittal, axial and coronal plane via wedge tarsectomy can be complex, and a recent development in our practice is to use patient specific three-dimensional (3D) guided cutting jigs based on CT scans to plan the cuts to be as accurate as possible.[2,9,10] (**Fig. 5**). These can be particularly helpful where the computer planning can simulate the hindfoot correction and reveal the resultant midfoot deformity, to plan to extent of the tarsectomy and options for fixation.

There are multiple wedge tarsectomies described at different levels. Jahss described a dorsal wedge at the level of the tarsometatarsal joints and Cole and Japas both performed midfoot arthrodesis procedures after excising a dorsal wedge at the naviculocuneiform/cuboid level.[16–18] A dome osteotomy of the midfoot has also been described by Wilcox and Weiner, known as the Akron osteotomy, where again a wedge wider dorsally than plantarly is excised to correct the midfoot cavus deformity.[2,19] The specific techniques of these arthrodeses are beyond the scope of this hindfoot focused article.

Another set of essential adjunctive procedures that must be considered and performed where appropriate alongside hindfoot fusions for the cavovarus foot are tendon transfers and balancing. The most commonly transferred tendon is tibialis posterior.[4,20] In the CMT disease cavovarus foot, tibialis posterior and peroneus longus act excessively in relation to tibialis anterior and peroneus brevis, leading to an inversion and equinus force on the foot and ankle. If a hindfoot fusion procedure is done in isolation, there is a high chance of long-term failure of the procedure with recurrence of deformity owing to the persistent activity of tibialis posterior.[4,8,20]

In addition to a tibialis posterior tendon transfer, a peroneus longus to brevis tenodesis can also be a useful soft tissue balancing option alongside a tibialis posterior tendon transfer. Peroneus longus inserts on the plantar first metatarsal base and thus acts to plantarflex the first ray. In the cavovarus foot, the first ray is often plantarflexed, with a varus heel sometimes occurring secondary to this forefoot deformity (forefoot driven hindfoot varus). Alternatively, in a hindfoot driven pes cavus, plantarflexion of the first ray can occur to compensate for a rigid varus heel malalignment.[1] After correction of the hindfoot with an arthrodesis, the peroneus longus may continue to attempt to plantarflex the first ray and thus, removing this deforming force can be important to prevent future deformity recurrence, a principle we have now established.[8]

Our preferred technique for a tibialis posterior tendon transfer is via the interosseous route (**Fig. 6**). An incision is made centered on the navicular and the incision is extended proximally along the line of the tibialis posterior tendon. The tendon is identified within its sheath and the tendon sheath is split to expose the tendon. A tendon hook is used to isolate the tibialis posterior and the tendon is harvested as distal as possible from its navicular insertion. The tendon is then whip-stitched at its free end to create a neat distal tendon stump. A further medial incision is made approximately 5 cm proximal to the medial malleolus. The tibialis posterior tendon is identified in this level and again, the tendon is isolated within its sheath. The free whipstitched end of the tibialis posterior tendon is pulled out medially and delivered into this wound. The

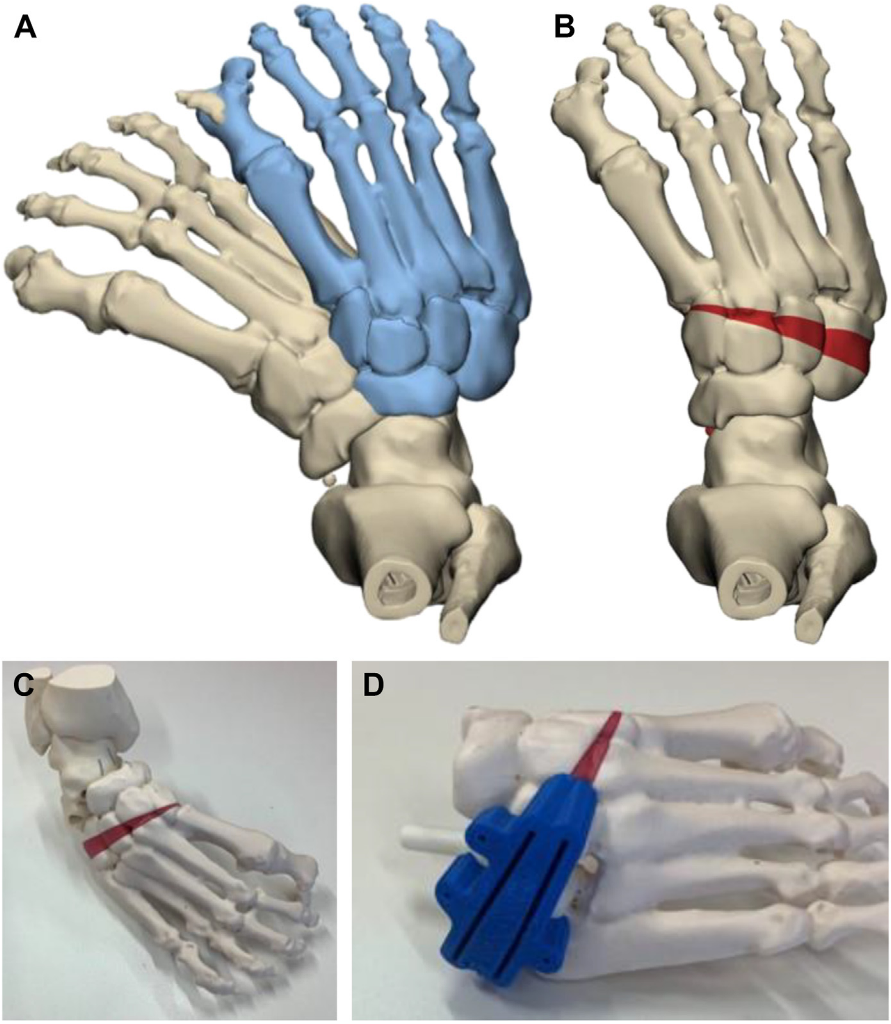

Fig. 5. Examples of wedge tarsectomy computer simulation based on three-dimensional CT planning, and a patient specific model and cutting guide produced from these computer simulations. (*A*) Computer simulation of forefoot position after hindfoot correction. (*B*) Computer simulation of midfoot wedge tarsectomy to achieve correction of residual forefoot adduction after hindfoot deformity correction. (*C*) Model based on computer simulation of midfoot wedge tarsectomy. (*D*) Model of midfoot wedge tarsectomy with patient specific cutting block in position to guide tarsectomy cut.

tendon is then routed between the tibia and fibula through the interosseous membrane, with a channel being made by passing curved Mayo scissors along the posterior border of the tibia. A corresponding incision is made laterally at the tip of the scissors and a tendon passer is used to deliver the tibialis posterior from the medial to lateral wound. Finally, the tibialis posterior tendon is routed to its distal insertion point. If tendon length is sufficient to permit insertion in the cuneiform bones distally, then the tendon end is sized and a tunnel is drilled in the appropriate cuneiform to

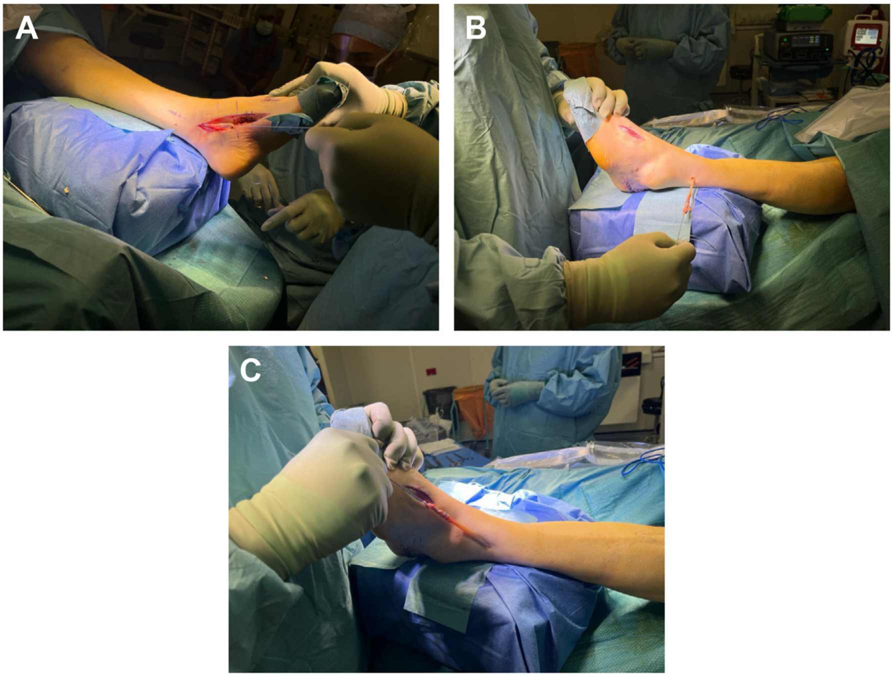

Fig. 6. Clinical photographs of tibialis posterior tendon transfer technique. (*A*) Medial approach and harvested, whip-stitched tibialis posterior tendon delivered into wound. (*B*) Tibialis posterior tendon transfer brought out through stab incision laterally after routing through interosseous membrane. (*C*) Length check of tibialis posterior tendon transfer with plan to fix tendon distally in cuneiform bone to balance foot position.

correspond to the width of the tibialis posterior tendon, with fixation with the appropriate size biotenodesis screw. We tend to use the lateral cuneiform to provide eversion and dorsiflexion, and the middle cuneiform if it is predominantly dorsiflexion required.

If the bone is osteopenic and may not accept a biotenodesis screw, or if the tendon does not have sufficient length to be inserted into the cuneiforms, then a tenodesis can be performed with the peroneus brevis tendon, to achieve the same goal of the converting the inverting varus pulling tibialis posterior to an everting tendon, thus balancing the forces around the fused hindfoot.

With reference to the peroneus longus, our technique is similar to that described by Myerson and colleagues, where peroneus longus is sutured to peroneus brevis at the distal fibula level. Once tenodesed, the longus is cut just distal to the tenodesis. The benefit of this technique is that it ensures the peroneus longus and brevis tendons remain at the appropriate tension before peroneus longus is cut.[8,20] An alternative is to cut the peroneus longus first and then suture its free proximal end to peroneus brevis at the same level. Both of these tenodesis procedures convert the action of peroneus longus from a plantarflexor of the first ray to an ankle everter, which exerts a favourable soft tissue balancing force in the setting of the corrected cavovarus foot deformity.[8]

A common additional procedure to permit cavovarus deformity correction is a plantar fascia release.[20] The rationale for a plantar fascia release is to free the calcaneus to permit correction of its varus position.[7] Myerson and colleagues suggest that it is helpful to perform a plantar fascia release first to overcome the rigidity caused by the contracted soft tissue. The suggestion in his article is to release the plantar fascia through a 1 cm incision adjacent to the heel, which can be accessed through the medial approach to the tibialis posterior tendon.[7] Whilst a plantar fascia release for managing the cavovarus foot is a well recognised procedure in the literature, our personal preference is to preserve the plantar fascia. In our experience, we have been able to achieve satisfactory deformity correction without sacrificing the stabilising function of the plantar fascia, which plays an important role in maintaining the plantar arch of the foot through the Windlass mechanism and enabling the foot to perform as a stable and rigid lever for forward propulsion in the gait cycle.[21]

After addressing severe cavovarus hindfoot deformities, there is often a pronation of the forefoot. This may be a prominent plantar flexed first ray. In such cases it is imperative to perform a forefoot balancing procedure such as a first metatarsal dorsiflexion osteotomy or first tarsometatarsal joint arthrodesis to restore the classic tripod of the foot between the first and fifth metatarsal heads and weight-bearing point of the os calcis[4] (**Fig. 7**).

It is also common for patients to have neurological imbalance of the toe extensors and flexors, leading to claw toes, which are characteristic in neurological conditions such as CMT. In such cases, flexor tenotomies in flexible deformities or corrective lesser toe fusions may be considered to prevent prominent areas of the toes rubbing plantarly or dorsally in footwear.[22] Similarly, plantarflexion at the hallux interphalangeal joint is also frequently seen in these patients and a Jones procedure can be

Fig. 7. First metatarsal basal dorsal closing wedge osteotomy to address plantar flexed first ray after hindfoot deformity correction.

undertaken, whereby the extensor hallucis longus is transferred to the neck of the first metatarsal, elevating the first ray. A later modification also added a hallux interphalangeal joint fusion, helping to correct the hallux clawing definitively.[22,23] It should be noted that forefoot procedures do not necessarily have to be undertaken at the time of hindfoot arthrodesis, due to the risks of causing excessive soft tissue swelling and wound issues, which can increase the risk of infection.[4]

SUMMARY

The key to a successful outcome of a hindfoot fusion is therefore multifaceted.

Firstly, a thorough clinical and radiographic assessment of the patient is essential prior to embarking on surgery. This is to achieve an understanding of the deformity and the deforming forces. This will ensure that the correct patients are selected for a hindfoot fusion in the setting of cavovarus and that the correct additional procedures are performed to enable a satisfactory and long-standing correction.

In this article, we have outlined several core principles of performing hindfoot arthrodesis in the cavovarus foot and outlined the authors preferred technique. We feel the key to success is to perform the correct additional procedures such as midfoot wedge tarsectomy, forefoot balancing and tendon transfers.

With this in mind, satisfying results can be achieved in this grateful patient cohort.

CLINICS CARE POINTS

- Thorough assessment of osseous deformity, degeneration and tendon balance is essential.
- Plan correction from proximal to distal.
- Consider apex of deformity in antero-posterior and sagittal plane.

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