

Functional Outcomes of Minimally Invasive Percutaneous Surgical Correction of Late-Presenting Severely Deformed Foot in a Patient with Myelomeningocele

Suliman Abdullah Shurbaji¹, Abdulaziz Ahmed Abdulaziz², Obaidallah Buraykan Alsuwat³, Saleh Mohammad Abu Adas¹, Khalid Ayidh Alotaibi⁴, Ali Mohammed Alahmari⁵

¹Orthopedics Department, Security Force Hospital, Makkah, Saudi Arabia; ²Orthopedics Department, King Faisal Medical Complex Taif, Taif, Saudi Arabia; ³Orthopedics Department, King Abdulaziz Specialized Hospital, Taif, Saudi Arabia; ⁴Orthopedics Department, Alhada Armed Force Hospital, Taif, Saudi Arabia; ⁵Orthopedics Department, King Fahad General Hospital, Jeddah, Saudi Arabia

Correspondence: Abdulaziz Ahmed Abdulaziz, Email Azizneyaz@hotmail.com

Background: Congenital talipes equinovarus (CTEV), continues to rank among the most common congenital musculoskeletal deformities. The management of CTEV, particularly when it is part of a syndromic presentation or associated with conditions such as myelomeningocele (MMC), presents a significant challenge due to the deformity's tendency to be stiffer and more complex. Most children with CTEV may require surgical intervention. The current case report highlights the functional outcome of minimally invasive percutaneous surgical correction in a late-presenting, rigid, and severe foot deformity in an MMC patient, aiming to have accepted residual deformity that gave better function with less surgical complication.

Methods: A case involving an eight-year-old girl having a deformity in her left foot secondary to low lumbar level MMC was referred for management. The Pirani score total was 6, signifying a severe deformity according to received initial assessments. Upon review of treatment alternatives, minimally invasive percutaneous surgical correction was performed consisting of percutaneous plantar fascia release followed by Achilles tendon lengthening and flexor digitorum tenotomy. We followed up with the patient for one year for wound healing and functional outcomes. An early weight bearing in cast was achieved 1 week with walker frame. Removal of cast and application of custom walker orthosis for walking on the 6th week post-operation. Following up to one year, she is a walker, and residual deformity of the foot did not affect her mobilization.

Results: As of the one-year follow-up, she is self-ambulatory, thanks to her custom walking orthosis. Residual deformity did not affect her functional outcome. We recommend further follow-up, and future surgery may be necessary if her deformity worsens.

Conclusion: The functional outcome, the social and economic status of the family, and the psychological impact on the patient significantly influence the selection of the most suitable method.

Keywords: congenital talipes equinovarus (CTEV), myelomeningocele (MMC), minimally invasive surgery, percutaneous correction, functional outcome, residual deformity

Background

Congenital talipes equinovarus (CTEV) represents a broad class of defects, with an estimated minimum overall prevalence amongst live births in the total range of 150–200 thousand globally per annum.¹ The midfoot cavus, forefoot adduction, hindfoot varus, and ankle equinus are the 4 key abnormalities that define this deformity.^{1–3} MMC is a neural tube that has a resulting defect in an exposed spinal cord and meninges, frequently accompanied by severe musculoskeletal deformities; clubfoot being the most common.⁴ Clubfoot strikes about 40% of kids with MMC.⁴ The management is particularly challenging in cases where CTEV is associated with syndromes like myelomeningocele (MMC).^{5–7}

In idiopathic cases, conservative treatments like serial manipulation and casting seem to be enough. On the other hand, non-idiopathic CTEV is usually worse and stiffer, so surgery is often needed.^{2,8} Non-idiopathic CTEV is hard to keep an eye on, especially in the context of MMC, because it can cause both sensory and motor problems.⁹ There have been several surgical methods applied over the years (Ilizarov method, posteromedial soft tissue release, talectomy).^{10,11} However, with each of these approaches come complications and challenges.^{10,11} The purpose of this case report is to describe the functional outcome of minimally invasive percutaneous surgical correction in a late-presenting severe rigid CTEV with associated myelomeningocele.

Case Report

A female patient aged eight with a prior diagnosis of low lumbar level MMC (according to Sharrard's classification⁹) was directed to the Pediatric Orthopedic Clinic at Security Forces Hospital in Makkah for the management of a severe left foot deformity. The patient was born via normal vaginal delivery and underwent lipomyelomeningocele repair and untethering shortly after birth. Her first visit to the clinic was at the age of seven, where she presented as a conversational and intelligent child lacking facial dysmorphic features.

A general examination revealed unremarkable findings in the chest and upper extremities, with bilateral muscle power of 5/5. Her back bore a surgical scar from the previous lipomyelomeningocele repair. Both hips and knees exhibited complete range of motion and 5/5 muscle power. The Pirani score assessed the left foot and yielded a total score of 6, indicating a severe deformity.⁵ The patient was wheelchair-bound, capable of standing but difficult to walk.

The patient can't walk few steps without a walker due to pain and a deformity in the dorsum of the foot, which resulted in a pressure ulcer. The examination revealed a chronic ulcer (5 cm, classified as stage 3 by the (National Pressure Injury Advisory Panel¹²) on the dorsolateral foot. The findings of the neurological examination noted no sensation below the knees and equivocal motor function in both feet. Pulses were palpable (Figures 1 and 2).

The management option was discussed in detail with the patient's family, including a trial of serial casting and Taylor spatial frame gradual correction, but the family was concerned about commitment and hospital visit due to their socioeconomic status. Other surgical options were discussed: talectomy and posteromedial lateral release, and their complications. After careful examination of the foot, it showed severe deformity due to muscle imbalance and rigidity due to long standing, causing her pressure ulcer. After discussion with the family, a minimally invasive choice was



Figure 1 (A) Clinical presentation of left foot before surgery with severe deformity associated with myelomeningocele. (B) image shows the fixed equinus and cavus deformity with typical skin changes like chronic ulcer evident.

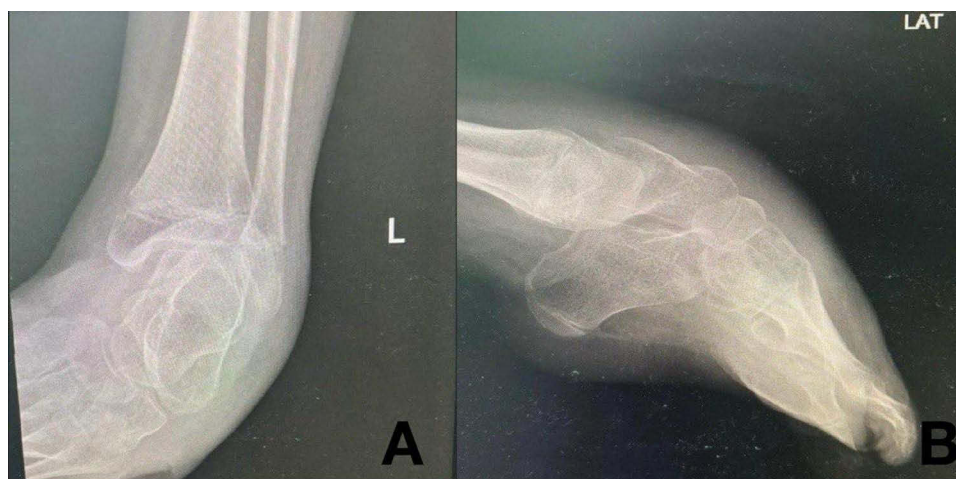


Figure 2 (A and B) Preoperative Radiographic Analysis of the Deformed Left Foot. It illustrates x-ray images of the patient's left foot before surgery. (A) is an AP x ray view. (B) is lateral X ray view.

chosen. An operative procedure was conducted under general anesthesia in a sterile environment. The placement of the patient was supine, and preoperative antibiotics were administered then percutaneous surgical correction was performed consisting of percutaneous plantar fascia release followed by Achilles tendon lengthening and flexor digitorum tenotomy. (Figures 3 and 4) The ulcer was approximated by bonding the skin to itself using a shoelace technique, and post-operatively the patient was put into the below-knee walking cast.

The patient remained hospitalized postoperatively until the bone culture results revealed an MRSA infection. Doctors treated her with Cefazolin and Ampicillin and on the third day post operative patient was discharged with a below-knee walking cast with instructions for wound care. At the one-week mark, she had already begun mobilizing with a walker assistance cane. Follow-up of the 6th week cast was removed, and application of the custom-made orthosis was applied immediately.

Her hindfoot was corrected with residual deformity of forefoot adduction and supination since the deformity could not be corrected during surgery due to its complexity, which not affecting her mobility.

The residual deformity did not increase after a year of follow-up. (Figure 5)



Figure 3 (A and B) Intraoperative View During Percutaneous planter fascia release and percutaneous Achilles Tendon Lengthening.

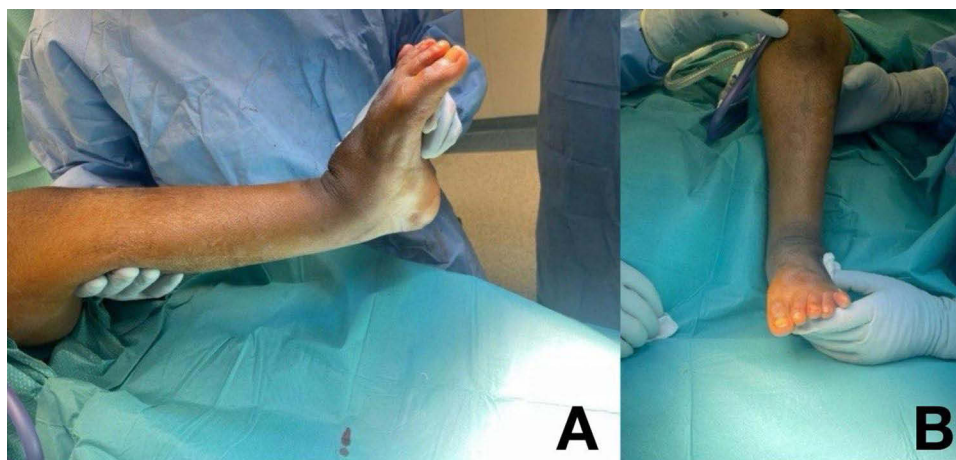


Figure 4 (A and B) Intraoperative View after Percutaneous Achilles Tendon Lengthening and Percutaneous plantar fascia release.

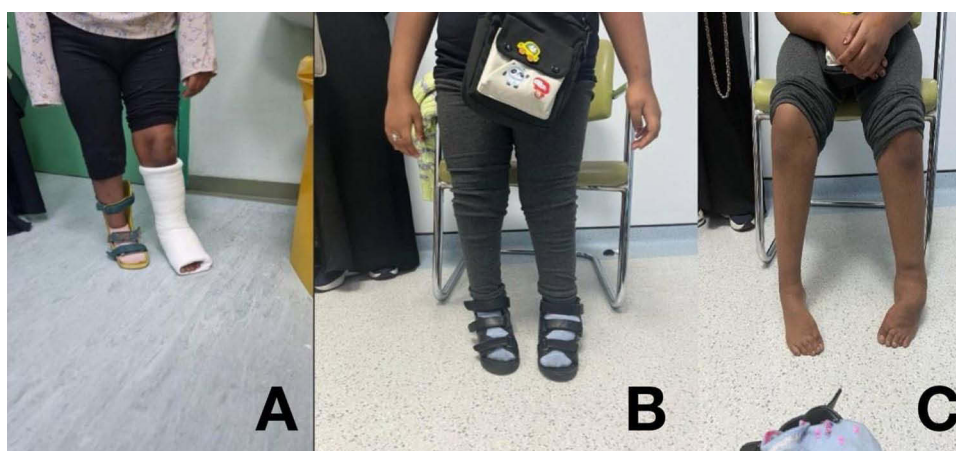


Figure 5 (A) One week after surgery. **(B and C)** one year After Surgery.

Discussion

About 40% of MMC patients have an inflexible teratologic clubfoot.⁴ Previous studies have reported poor results using conservative approaches for such severe deformities, which frequently oppose non-surgical treatment.¹³ Generally, severe deformities like those seen in MMC are more likely to require surgery and are resistant to conservative measures. However, the emergence of non-surgical alternatives for treatment has reduced the necessity for surgical procedures in clubfoot.¹³ Several studies have found an increased risk of relapse when the initial trial of Ponseti casting fails, with failure rates reaching 90%.^{14,15}

One study in the literature described the application of aimed minimally invasive percutaneous posteromedial release in stiff and severe deformity feet in MMC.¹⁶ However, various techniques and alterations of the posteromedial release were found in several papers in the literature.^{4,9,13,17,18} Flynn and his group developed a surgical method of drastic posteromedial emission with no inner stabilization of the subtalar joints or talonavicular, reporting poor results in 12.5% of patients and good outcomes in 62.5% of patients.⁴ Sharrard and Grosfield involved 78 equinovarus feet in their study that needed 30 tendon transfers, 38 bony procedures, and 122 soft tissue operations. There were five superficial infections and seven skin breakdowns, with a rate of failure of 22% requiring operative changes.⁹ Walker treated hindfoot deformities using a combination of splinting, stretching, and small posterior emits, achieving good results in 60% of cases.¹⁹ Alsiddiky A et al described a method of percutaneous soft tissue emission in MMC cases with bilaterally rigid deformity feet.¹⁶

Traditional surgical techniques of correction of rigid clubfoot deformities in MMC patients include extensive soft tissue releases, and bony procedures such as talectomy, and osteotomies. Such procedures often result in severe scarring, long recovery times, and greater risks of such complications as wound infections, neurovascular damage, and stiffness of the foot.^{10,11} Although capable of correcting severe deformity with success, the invasiveness of these procedures renders long-term functional impairment increasingly likely.

Minimally invasive surgeries, such as percutaneous plantar fascia release, Achilles tendon lengthening, and flexor digitorum tenotomy, have been developed to reduce surgical morbidity and achieve acceptable deformity correction. Percutaneous soft tissue release in MMC patients with bilaterally rigid deformity feet was reported by Alsiddiky et al, with improved functional outcomes and fewer complications compared to traditional open surgery.¹⁶ Walker treated hindfoot deformities with a protocol of splinting, stretching, and limited posterior releases and achieved good results in 60% of patients.^{19–22} These findings suggest that less invasive procedures can offer an acceptable alternative for those patients who are unable to undergo more extensive surgery due to their general medical condition or socioeconomic situation.

These results are corroborated by the current case, which demonstrates that minimally invasive percutaneous surgical correction resulted in adequate hindfoot deformity correction with acceptable residual deformity. The intervention reduced post-surgical complications, encouraged early mobilization, and decreased the woes of prolonged hospitalization and rehabilitation. Unlike traditional methods, which often consist of multiple staged procedures, the minimally invasive intervention in the current case enabled early weight-bearing and earlier advancement to orthotic-assisted ambulation.

Conclusions

Treatment of severe, stiff CTEV in the context of myelomeningocele is complicated due to the complexity of the deformity and its resistance to conservative treatment. In this case, an invasive percutaneous surgical method was chosen to achieve a functionally acceptable reduction with minimal surgical morbidity. One-year follow-up revealed that the patient achieved self-ambulation using a custom walking orthosis, and the residual forefoot deformity had minimal impact on mobility. Children with MMC (low level) have the potential to be community-ambulatory and are expected to develop foot deformity as they grow; their functional demand increases without muscle balance to cope with it. Rehabilitation and physiotherapy should address the functional status and psychological impact on the patient and family. Once a foot deformity starts, it should be immediately addressed, like in our case; it was not added to the progression until the patient was wheel chair bound. The socioeconomic status of the family plays a major role in choosing treatment options.

Deformity correction aiming to reach a better functional outcome with minimal intervention and accepting residual deformity without affecting mobility is showing a promising result to achieve a great function.

Ethical Approval

No institutional review board approval was required.

Informed Consent for Publication

Written informed consent was obtained from the patient's parent's for publication of this case report and accompanying images. A copy of the written consent form is available for review by the Editor-in-Chief of this journal upon request.

Author Contributions

All authors contributed to the data analysis, drafting or revising the article, have agreed on the journal to which the article will be submitted, gave final approval or the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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