Treatment of Residual Forefoot Adduction Deformity

Mohsen Mohamed Mar'ei [(1)], Reda Hussein Elkady [(1)], Salah Salah Hassan Eltayyar (2), Sameh Mohamed Holil [(1)]

[(1)]Department of Orthopedic, Surgery, Faculty of Medicine, Zagazig University, Egypt

[(2)] M.B.B.Ch Faculty of medicine, Al Azhar University Damitta, Mansoura Health Insurance Hospital

Corresponding Author: Salah Salah Hassan Eltayyar

E-Mail: salahysalah46@gmail.com

Article History: Received: 19.06.2023 **Revised:**03.07.2023 **Accepted:** 14.07.2023

Abstract:

Congenital pathologies of the forefoot encompass two broad entities with vastly different treatments and prognosis: malformations, which occur during the embryonic period and cause anatomical defects, and deformations, which occur during the fetal period on a foot that is configured normally. These deformities are more easily cured when they occur later during the fetal period. When the anomaly is bilateral, a genetic origin must be considered. There are two main entities under the term “deformity”: metatarsus adductus and skewfoot (aka “Z”-foot or serpentine foot). Within malformations are brachydactyly (transverse defects), longitudinal defects, syndactyly, polydactyly, clinodactyly and macrodactyly. Among other forefoot abnormalities are hallux valgus, which rarely presents in congenital form, and for which conservative treatment is sometimes sufficient. Also in this group are sequelae of amniotic band constriction, forefoot anomalies secondary to the treatment of congenital pathologies (talipes equinovarus and congenital vertical talus) and nail-related pathologies (ingrown toe nail and incorrect nail position).

Keywords: Residual, Forefoot, Adduction, Deformity.

DOI: 10.53555/ecb/2023.12.1151

Introduction:

Several modalities have been established for correction of residual forefoot adduction in idiopathic clubfoot, both conservative and surgical measures.

Conservative measures

A minimal degree of residual metatarsus adductus does not impair function or interfere with normal shoe wear and does not deserve exposure to the potential risks and complications of elective foot surgery. Passive stretching exercises and manipulation may be done. The hindfoot is stabilized with the tibia while the forefoot is abducted. Casting or shoe therapy may be done **(1).**

Surgical measures

As a rule, the osseous procedures are performed in conjunction with, or are preceded by, soft tissue release. Even in advanced rigid clubfoot, in which one step procedures are generally avoided, the initial phase of surgery routinely includes soft tissue release. Such soft tissue release do not generally, affect significant correction in these initial stages of repair in the adult, or rigid neglected feet, but they do allow critical soft tissue structures (i.e., vascular and nerve elements) to stretch, elongate, and relax before the dramatic correction that osseous surgery affords. For persistent or

residual adduction of the forefoot after clubfoot repair, both osseous and soft tissue maneuvers are used**(2)**.

Soft tissue procedures

Correction of resistant metatarsus adductus or residual clubfoot adduction deformity through a dorsal incision, complete capsulatomies and ligament releases of the tarsometatarsal joint were performed. Abductor hallucis release was traditionally recommended for hallux varus and medial ray adduction deformity. The release showed be performed between the ages of 18 months and 4 years of age. Because of reports of frequent postoperative stiffness and pain, this procedure is not recommended **(2).**

Residual dynamic deformity

Transfer of tibialis anterior insertion – either the entire tendon or asa split transfer to the lateral cuneiform – is indicated when there is dynamic adduction and supination deformity, especially in swing phase, that produces weightbearing on the lateral aspect of the foot at initial stance. The extensive use of the tibialis anterior tendon transfer at the Baja clinics demonstrated that the procedure is best used for removing the tendon as a deforming force, rather than for augmentation of dorsiflexion and eversion. Transfer of the tibialis anterior tendon is most successful when performed between the third and sixth years of age **(2)**.

Osseous procedures

Metatarsal osteotomies

From 6 to 8 years of age, osseous adaptation and squaring of the metatarsal bases have started and are present to varying degrees. Consequently, soft tissue tarsometatarsal releases no longer provide adequate correction. described basal crescentic cuts for the correction of persistent adduction of the metatarsals. Metararisal osteotomies are indicated when the adduction deformity originates distal to the navicular. Care must be taken to avoid injury to the physis of the first metatarsal by osteotomy or by periosteal stripping; otherwise, shortening of the first metatarsal will result**(3)**.

Tarsal Osteotomies

Lateral column shortening may be achieved in several ways. Calcaneocuboid joint fusion, it is indicated in paralytic clubfoot in which stability of the lateral column of the foot is desired. It is contraindicated in a child younger than eight years of age because of potential complications of over correction and valgus deformity **(3)**.

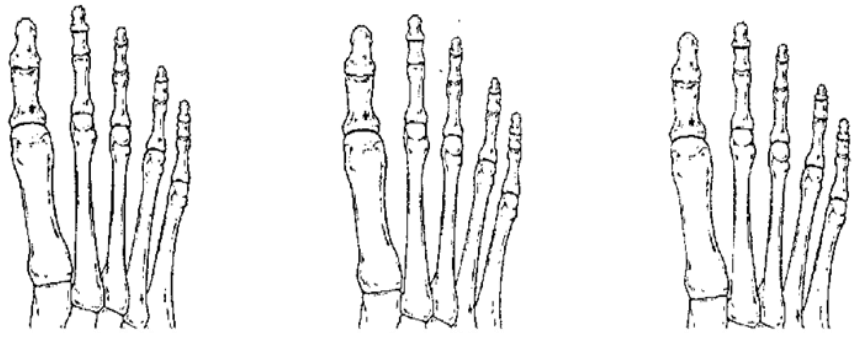

Figure 1: Lateral column shortening procedures (3).

Calcaneal osteotomy may be used for correction of residual heel varus in clubfoot. This opening wedge procedure has the advantage of elongating the usually small, underdeveloped heel found in residual clubfoot deformity but occasionally is followed by sloughing of tight skin along the incision over the calcaneus. Consequently, a modified Dwyer lateral closing wedge osteotomy performed through the lateral incision. This operation should be performed for children over 3 years of age.**(4)**

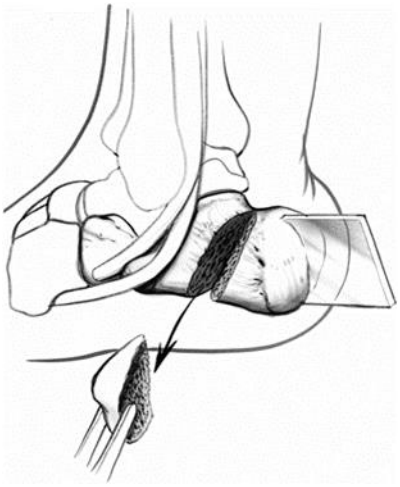

Figure 1: Lateral closing wedge calcaneal osteotomy (4).

An autogenous bone graft is inserted into an osteotomy through the medial cuneiform. In a frequently used modification of the fowler operation, Closing wedge osteotomy of the cuboid and then uses this bone wedge as the opening graft in a medial cuneiform osteotomy (double osteotomy). Such a procedure is useful in the older child (3 to 10 years) with a residual adduction or varus deformity of the forefoot or midfoot. A wedge of bone is removed from cuboid. The apex is directed toward the medial cuneiform cut. The removed bone is used for medial opening wedge of the medial cuneiform "double osteotomy**" (5).**

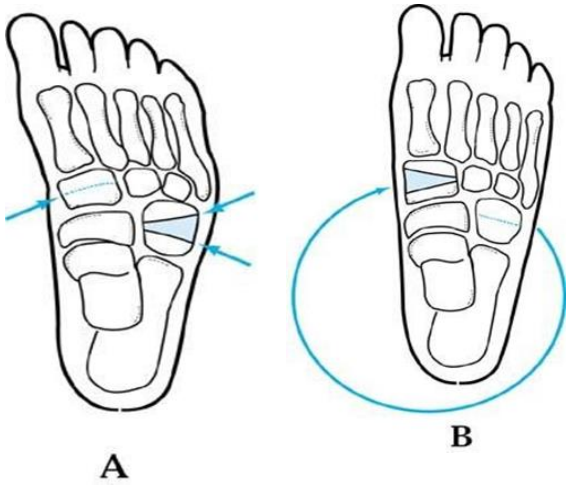

Figure 32: A: Drawing of the foot showing the wedge to be removedfrom the cuboid and the osteotomy of the medial cuneiform. Drawing of the foot with the wedge inserted at the medial cuneiform and the cuboid osteotomy being close (5).

This technique permits maximum lengthening and angular correction of the medial cuneiform as well as additional bone removal from the cuboid if needed later. The cuboid is approached by a dorso lateral curvilinear incision from the calcaneus to the fourth metatarsal shaft. The sural nerve may be encountered during minimal traumatic anatomic dissection and should be retracted. A laterally based wedge or truncaterd wedge is removed from the cuboid with a sharp osteotome or power saw. The size of the wedge should be conservative, to avoid difficulty with approximation of the cut surfaces later. The removed bone wedge is used as the opening graft in the medial cuneiform osteotomy.(6)

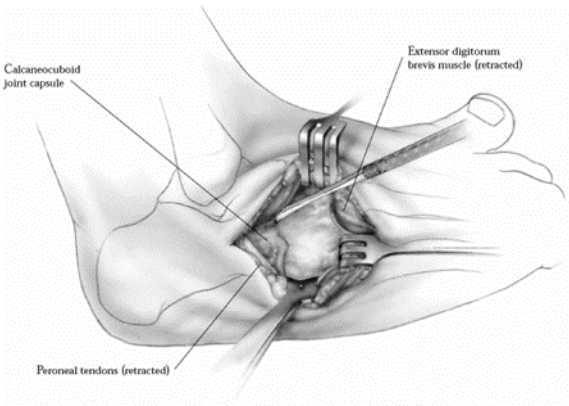

Figure 4: A lateral skin incision is made from the cuboid with cuboid is incised.(6)

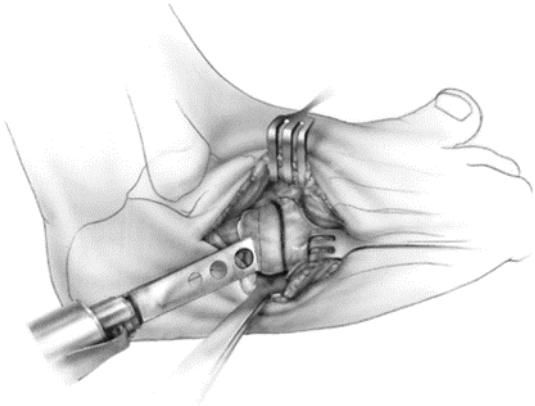

Figure 53: A laterally based wedge over the cuboid. The periosteum of the power saw.(6)

The medial column is then approached by a dorsomedial curvilinear incision or through the previous scar; it begins immediately posterior to the tuberosity of the navicular and extends distally to end at the proximal one fourth of the first metatarsal. The plantar aspect of the tibialis anterior tendon must be mobilized and reflected or partially detached. A vertical osteotomy of the medial cuneiform is done with a sharp osteotome or power saw. A baby lamina spreader is then used to open the osteotomy. The cuboid is then reinspected, and more bone is removed if necessary **(7).**

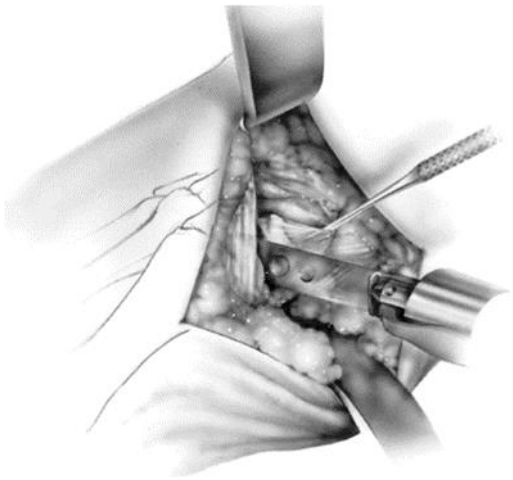

Figure 64: **A straight linear incision is osteotomy made directlyover the medial.(7)**

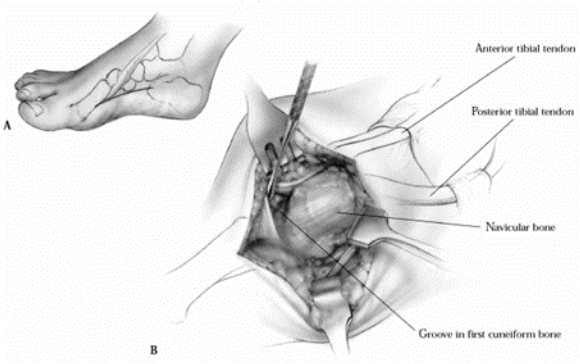

Figure 7: Medial cuneiform osteotomy made directly over themedial is made with a power saw.(7)

The widest possible bone graft is then inserted medially. Each osteotomy may then be internally stabilized if indicated. A staple is suggested laterally and a threaded Kirschner wire medially, to provide compression without bulk and to prevent graft extrusion, respectively. The threads of the Kirschner wire also help to prevent collapse of the graft **(8)**.

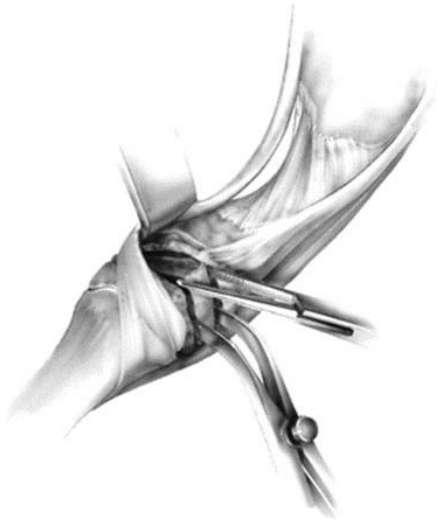

Figure 8: The graft is inserted into the threaded Kirschner wiremedially.(8)

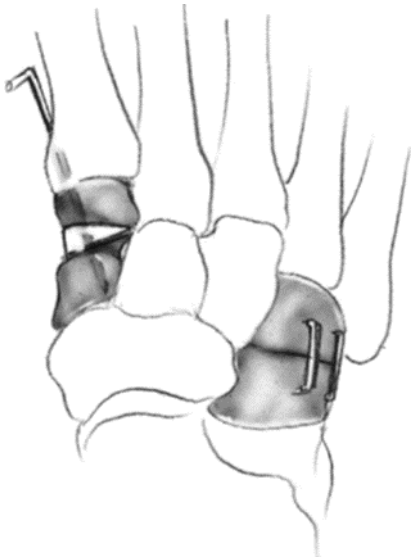

Figure 9: Staples are used laterally and medial cuneiform osteotomy (8)

Postoperative care:

After closing and dressing the wounds, the patient is placed in a non-weight bearing short-leg cast. Immediate postoperative and follow up radiographs are essential. The cast and pins are removed after 6 weeks , when healing is sufficient to resume weight bearing.

Advantages of double osteotomy over metatarsal osteotomy include the procedure avoids the first metatarsal physis completely; (b) the broad contact area and greater blood supply are also advantages for bone healing; and (c) multiplanar correction of deformity may also be easier, if needed, because of the tall profile of the cuneiform i.e. a biplane wedge is used to correct cavovarus deformity. To correct the plantarflexed medial column, the wedge is wider plantarly. To correct the adduction, the wedge is wider medially. Rotation of the forefoot at this midfoot transverse osteotomy allows correction of the supination.

Disadvantages include (a) the presence of the anterior tibial tendon in the operative field, and (b) the inherent risks of bone grafting **(8).**

Salvage procedures

Triple arthrodesis has been used in children older than 10 years and is considered a salvage procedure. Triple arthrodesis remains a valuable stabilizing operation for neglected clubfoot. *Talectomy* has been used for stiff, arthrogrypotic and neuromuscular clubfeet. Talectomy induces laxity in the hindfoot, to allow correction in the sagittal and frontal planes. The procedure preserves the plantigrade attitude of the foot with a stable, congruous foot-to-leg relationship. The foot is significantly shortened, with the potential for persistence of the forefoot deformity. Triple arthrodesis is a preferable procedure **(8).**

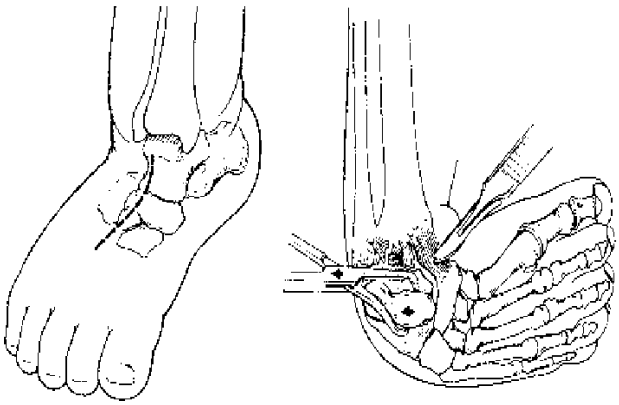

Figure 105: Talectomy. Anterolateral skin incision and total talectomy (8)

The *Ilizarov* apparatus allows for correction of all deformities in all planes simultaneously with a circular frame. *Distraction histogenesis* refers to the use of a distraction force to stimulate the formation of skin, muscle, nerve, vascular structure, connective tissue and bone. Two approaches to the correction of contractures by the Ilizarov methods. *Non-constrained closed technique* depends on soft tissue stretching without osteotomies and has been used in children younger than 8 years old. *Constrained technique* combined with various osteotomies and has been used in children older than 8 years old. However, the potential complications are numerous: pin tract infection, toe flexion contractures, anterior subluxation of the ankle, distal tibial epiphysiolysis, wires cut out, osteoporosis and recurrence of the deformity **(8)**.

References:

1- Leo, D. G., Russell, A., Bridgens, A., Perry, D. C., Eastwood, D., & Gelfer, Y. (2021). Development of a core outcome set for idiopathic clubfoot management. Bone & Joint Open, 2(4), 255–260

2- Wang, Y., Su, Y., Tu, Y., Fang, C., Hong, C., Huang, M., Lin, Y. C., Hsieh, M., Kuan, F., Shih, C., & Lin, C. (2023). Determining the optimal treatment for idiopathic clubfoot. The Journal of Bone and Joint Surgery.

3- Drury, G., Nunn, T., Dandena, F., Smythe, T., & Lavy, C. (2023). Treating Older Children with Clubfoot: Results of a Cross-Sectional Survey of Expert Practitioners. International Journal of Environmental Research and Public Health, 20(19), 6846.

4- Jasper, R., Morcuende, J. A., Mallavarapu, V., Stebral, H. J., De Carvalho, K. a. M., Mansur, N. S. B., Talaski, G. M., Schmidt, E., Dibbern, K., & De César Netto, C. (2023). Efficacy of the Ponseti technique in correcting clubfoot deformity and influence of residual deformity in patient reported outcomes: A Prospective Comparative and Controlled study. Foot & Ankle Orthopaedics, 8(4).

5- Dreise, M. M., Elkins, C., Muhumuza, M. F., Musoke, H., & Smythe, T. (2023). Exploring Bracing Adherence in Ponseti Treatment of Clubfoot: A Comparative study of factors and Outcomes in Uganda. International Journal of Environmental Research and Public Health, 20(14), 6396.

6- Am, A.M.E.; Evans, A.; Chowdhury, M.; Karimi, L.; Rouf, A.; Uddin, S.; Haque, O. Factors Affecting Parents to 'Drop-Out' from Ponseti Method and Children's Clubfoot Relapse. Orthop. Res. Online J. 2020, 6, 1–9

7- Evans, A.M.; Chowdhury, M.; Khan, S. A Community Audit of 300 "Drop-Out" Instances in Children Undergoing Ponseti Clubfoot Care in Bangladesh—What Do the Parents Say? Int. J. Environ. Res. Public Health 2021, 18, 993.

8- Zhao, D.; Li, H.; Zhao, L.; Kuo, K.N.; Yang, X.; Wu, Z.; Liu, J.; Zhu, J. Prognosticating Factors of Relapse in Clubfoot Management by Ponseti Method. J. Pediatr. Orthop. 2018, 38, 514–520.