


Double Arthrodesis, Postero-Medial Release and Posterior Tibial Transfer in One Step in Paralytic Inveterate Equine Varus Foot

Kalifa Coulibaly^{1*} , Cheick Oumar Sanogo¹, Sory Ibrahim Tambassi¹, Aboubacar Diallo¹, Soumana Traore¹, Laye Toure²

¹Orthopaedic Trauma Department, Kati University Hospital, Koulikoro, Mali

²Orthopedic Trauma Department, Sikasso Regional Hospital, Sikasso, Mali

Email: *kalifacoulibaly49@yahoo.fr

How to cite this paper: Coulibaly, K., Sanogo, C.O., Tambassi, S.I., Diallo, A., Traore, S. and Toure, L. (2023) Double Arthrodesis, Postero-Medial Release and Posterior Tibial Transfer in One Step in Paralytic Inveterate Equine Varus Foot. *Surgical Science*, 14, 122-130.

<https://doi.org/10.4236/ss.2023.142016>

Received: January 23, 2023

Accepted: February 20, 2023

Published: February 23, 2023

Copyright © 2023 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

Abstract

Introduction: Varus equine foot deformity is common in developing countries. The management of these deformities is surgical in adults. Several surgical techniques have been described with more or less satisfactory results. To our knowledge, no study has been performed on the simultaneous association of double arthrodesis, posteromedial release, and posterior tibial transfer in a single operation in inveterate paralytic varus equines feet. The purpose of this work was to evaluate the results obtained. **Patients and Method:** This was a retrospective descriptive study from January 01, 2018 to December 31, 2021. It concerned inveterate paralytic varus equines feet operated on by the simultaneous association in a single operative time of double arthrodesis of the foot, posteromedial release of the back foot and transfer of the posterior tibial muscle to the lateral cuneiform. We identified seven patients with a mean age of 22.1 years with extremes of 11 years and 36 years. There were three males and four females. The cause of the deformity was neurological in all cases. All patients had painful walking discomfort and shoeing difficulties. The average time to management was 13.3 years with extremes of 4 and 25 years. The chronology of the interventional steps was posteromedial release, arthrodesis, and transfer of the posterior tibial muscle to the lateral cuneiform. The average postoperative follow-up was 21.7 months with extremes of 6 and 48 months. The parameters studied were the duration of the procedure, complications related to the procedure, muscle strength at the last recoil, consolidation of the arthrodesis, residual pain, patient activity, gait perimeter, stepping, ankle mobility, residual deformity, footwear, protrusion of the transferred tendon, and the possibility of walking on the heel. Final results were graded

according to the Angus and Cowell criteria. **Results:** No intraoperative complications were noted. An early superficial infection of the surgical site was noted. It was treated with local care and healed without sequel. Residual pain was present in one case. Tibiotalar osteoarthritis was observed in one case, which required a tibiotalar arthrodesis. At the last follow-up, consolidation of the arthrodesis was effective in all patients. The posterior tibial muscle was side 5 (n = 4) and 4 (n = 3). The patients' activity was normal without assistance in all cases. The walking perimeter was greater than 1 km in six patients. Patient activity was normal without assistance in all cases. Stepping was absent in all patients. No difficulty with footwear was noted. According to the Angus and Cowell criteria, the result was good (n = 6), *i.e.* 85.7% and bad (n = 1), *i.e.* 14.3% of cases. **Conclusion:** This study suggests that double arthrodesis associated with posteromedial release and transfer of the posterior tibial in one step in inveterate paralytic varus equines feet, gives satisfactory results. It allows for easy shoeing and plantigrade walking without stepping. Complications are essentially represented by the absence of fusion of the arthrodesis and tibiotalar arthrosis.

Keywords

Arthrodesis, Foot, Ankle, Posterior Tibial Muscle, Equine Varus

1. Introduction

Equine varus foot deformities are common in Africa [1] [2] and in developing countries [3] [4]. The origin of these deformities is congenital or acquired. The latter is mainly due in Africa to intragluteal injection of quinine salt or to poliomyelitis. Neurological damage is almost constant in acquired forms. It is manifested by the paralysis of the elevator muscles of the foot, the clinical translation of which is stepping. Several surgical techniques have been presented for the varus equines foot. Double arthrodesis alone was proposed by Birtho and Perry, but the results at the last follow-up were not satisfactory, even though the post-operative aesthetic appearance of the foot was satisfactory for the patients [5] [6]. Double arthrodesis associated with posteromedial release without posterior tibial transfer gives good results in terms of indolence, stability, weight-bearing, and plantigrade gait [5] [7] [8]. This technique has no effect on gait stepping [9]. Transfer of the posterior tibial to the lateral cuneiform ensures effective elevation of the foot after prior correction of existing deformities [10]. Two-stage surgery in paralytic varus equines feet has been reported with satisfactory results [11]. To our knowledge, no study has been performed on the combination of the three steps in a single operation. The initial hypothesis was that double arthrodesis, posteromedial release, and posterior tibial transfer could be performed simultaneously in inveterate varus equines feet in a single operation. The purpose of this work was to evaluate the results obtained.

2. Patients and Method

Patients: This was a retrospective descriptive study from January 01, 2018 to December 31, 2021. It concerned inveterate paralytic varus equines feet operated on by the simultaneous association in a single operative time of Double arthrodesis of the foot, posteromedial release of the hind foot and transfer of the posterior tibial muscle to the lateral cuneiform. We identified seven patients with a mean age of 22.1 years with extremes of 11 years and 36 years. There were three males and four females. The cause of the deformity was neurological in all cases. The average time to management was 13.3 years with extremes of 4 and 25 years. The average postoperative follow-up was 21.7 months with extremes of 6 and 48 months. The lesions of neurological origin were related to the intragluteal injection with sciatic nerve deficit in all cases. The seven feet were free of any surgery. All patients had painful discomfort when walking and difficulty in putting on shoes. Five patients walked on the lateral border of the foot and two patients walked on the dorsum of the foot (**Figure 1**). The anterior and lateral compartment muscles were paralyzed. The muscles of the posterior compartment were intact. The characteristics of the patients are summarized in **Table 1**. The parameters studied were duration of surgery, complications related

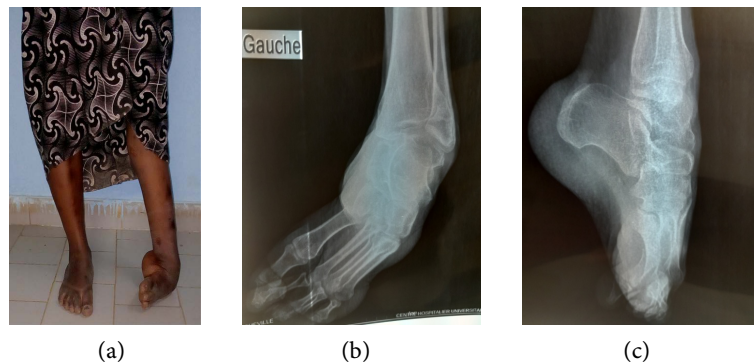


Figure 1. Inveterate paralytic varus equinus foot before surgery: ((a): front view; (b): front radiograph; (c): profile radiograph).

Table 1. Characteristics of the population.

Patients	Age (years)	Sex	Side	Etiology	Time to management (years)	Muscle strength			Duration of follow-up (months)
						Tibial antérieur	Muscles fibulaires	Tibial postérieur	
1	20	F	G	Intragluteal injection	18	0	0	5	6
2	18	H	G	Intragluteal injection	12	0	0	5	48
3	11	F	D	Intragluteal injection	9	0	0	4	20
4	36	F	G	Intragluteal injection	25	0	0	5	48
5	29	H	G	Intragluteal injection	20	0	0	4	6
6	16	H	G	Intragluteal injection	5	0	0	5	12
7	25	F	D	Intragluteal injection	4	0	0	5	12

to the surgery, muscle strength at the last recoil, consolidation of the arthrodesis, residual pain, patient activity, gait perimeter, stepping, ankle mobility, residual deformity, footwear, protrusion of the transferred tendon, and possibility of heel walking.

2.1. Method

Therapeutic protocol [5] [10]: patients were positioned in the supine position. The procedures were performed under loco regional anesthesia in all patients. The chronology of the interventional steps was posteromedial release, arthrodesis, and transfer of the posterior tibial muscle to the lateral cuneiform. A biot was placed under the contralateral buttock during the posteromedial release. It was under the homolateral buttock during arthrodesis. The biot was removed during posterior tibial muscle transfer and plastering. A pneumatic tourniquet was placed at the root of the limb. It was released at two o'clock and reinflated 30 minutes later if necessary. The operator stood on the opposite side of the limb to be operated on during the posteromedial release. He stood on the homolateral side during arthrodesis and posterior tibial muscle transfer. The posteromedial release included Achilles tendon lengthening, posterior capsulotomy, medial foot release, and plantar release. Arthrodesis was performed using the classic Méary technique. The tibio-tarsal joint was respected. A double subtalar, talonavicular, and calcaneocuboid arthrodesis was performed. It included a cuneiform tarsectomy centered on the tarsal spaces. For the transfer of the posterior tibial muscle, two incisions were necessary. A 10-cm incision was made one handbreadth above the ankle and two fingerbreadths outside the tibial crest. A large window was made in the interosseous membrane; as high as the skin incision would allow, taking care of the anterior tibial bundle. The posterior tibial muscle was passed through this window and recovered in the anterior incision. A vertical incision of 4 cm was made on the dorsum of the foot in line with the third metatarsal on the dorsal side of the lateral cuneiform. At the square tip, a pathway descending vertically to the sole of the foot through the lateral cuneiform was made. The upper part of the path was widened to facilitate the passage of the transfer. The tendon of the posterior leg was passed subcutaneously and then into the tunnel. Using a straight needle, the lacing wires were brought to the sole of the foot by pulling on the transfer and carrying the ankle at a right angle. Fixation of the tendon in this tunnel was provided either with a Blunt staple or with a padded shirt button at the sole of the foot. The tendon was attached to the capsuloperiosteal flap at the point of penetration on the cuneiform. The pneumatic tourniquet was released prior to closure to complete hemostasis. The patency of the posterior tibial artery was checked. The external incision was sutured without difficulty in six patients. The skin was partially closed because of skin tension in one case. A plaster cast was made for 60 days with windows on the sixth day opposite the surgical wounds for local care. Active and passive rehabilitation was started as soon as the cast was removed. Support was allowed from the third

month after surgery, after the arthrodesis had consolidated.

2.2. Criteria for Assessing Results

The results were assessed according to the morphological, functional, and radiological aspects of the foot, according to the criteria of Angus and Cowell [12] (Table 2). Good and average results were considered satisfactory. Poor results were considered unsatisfactory.

2.3. Ethical Considerations

This study was conducted in accordance with the protocol of good clinical practice and the principles of the Declaration of Helsinki. The investigators observed complete anonymity of the information obtained during the study.

3. Results

The average duration of the procedures was 130 minutes with extremes of 90 and 180 minutes. No intraoperative complications were noted. An early superficial infection of the surgical site was noted. It was treated with local care and healed without sequel. At the last follow-up, the consolidation of the arthrodesis was effective in all patients. The posterior tibial muscle was side 5 ($n = 3$) and 4 ($n = 4$). Residual pain was present in one case. Patient activity was normal without assistance in all cases. Walking distance was greater than 1 km ($n = 6$) and between 500 and 100 meters ($n = 1$). Mean ankle dorsal flexion was 20° (12° and 30°). Mean ankle extension was 25° (0° and 60°). Valgus hypercorrection was observed in one case. Gait was plantigrade in all patients (Figure 2). Stepping was absent in all patients. Heel walking was possible in all patients (Figure 3). No difficulty with footwear was noted. Exaggerated protrusion of the transferred tendon was noted in one case. Tibiotalar osteoarthritis was observed in one case that required tibiotalar arthrodesis. According to the Angus and Cowell criteria, the outcome was good ($n = 6$), or 85.7%, and poor ($n = 1$), or 14.3% of cases. The final results are summarized in Table 3.

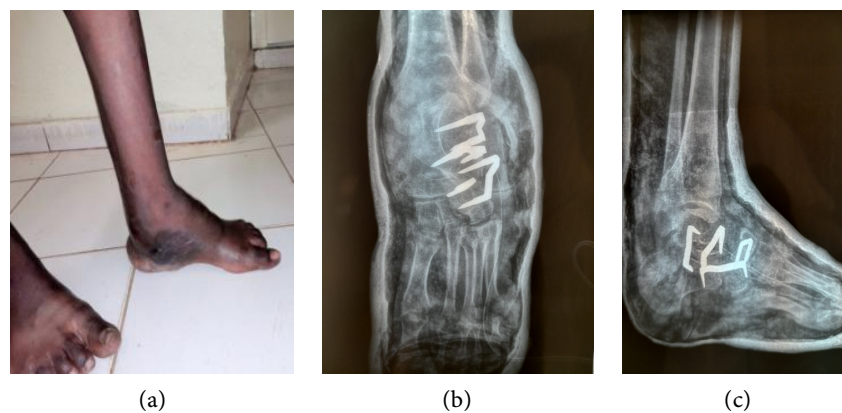


Figure 2. Inveterate paralytic varus equinus foot after surgery ((a): front view; (b): front radiograph; (c): profile radiograph).

Table 2. Angus and Cowell criteria.

Results	Criteria
Good	No or minimal pain after exercise
	No or minimal deformation
	No calluses
	No pseudoarthrosis
	No arthrosis
	No stepping
Average	Lifter muscles on the side of 5 - 4
	Walking on the heel possible
	Pain after moderate effort
	Discreet deformity
	A callus
	Pseudoarthrosed interline
Poor	Moderate osteoarthritis
	No stepping
	Lifter muscles on the side at 3
	Walking on the heel possible
	Pain while standing or resting
	Significant deformity
Poor	Multiple calluses
	Multiple pseudoarthroses
	Significant osteoarthritis
	Significant stepping when walking
	Lifter muscles on the side less than 3
	Walking on the heel impossible

Table 3. Final results at last retreat.

Patients	Intraoperative complications	Arthrodesis consolidations	Strength of posterior tibial muscle	Postoperative complications	Associated procedures	Angus and Cowell criteria
1	No	Yes	4	Tibiotalar osteoarthritis	Tibial-Talar Arthrodesis	Poor
2	No	Yes	4	No	No	Good
3	No	Yes	4	No	No	Good
4	No	Yes	5	No	No	Good
5	No	Yes	5	No	No	Good
6	No	Yes	5	No	No	Good
7	No	Yes	4	Superficial infection	Local care	Good



Figure 3. Transfer result after 4 months of surgery with the possibility of walking on the heel.

4. Discussion

This work describes double foot arthrodesis, posteromedial foot release, and posterior tibial muscle transfer in a single operative time in paralytic inveterate equine varus feet. The initial hypothesis was verified. It is indeed possible to perform all three steps in a single operation. The correction of the foot deformities and the raising of the foot could be obtained without any immediate complications. The final results were satisfactory (6/7). The three stages of this surgery required a fairly long intervention time. All arthrodesis were fused. Talonavicular and calcaneocuboid pseudarthrosis after Double Arthrodesis have been reported [9]. To improve the results of Double Arthrodesis, minimal bone resection, use of a subtalar bone graft and rigid fixation are required [9]. Double arthrodesis combined with posteromedial release without posterior tibial muscle transfer gives good results in terms of indolence, stability, weight-bearing, and plantigrade walking [5] [7] [8]. This technique has no effect on gait stepping [9]. Double arthrodesis associated with posteromedial foot release and secondary transfer of the posterior tibial muscle has been reported with satisfactory results [11]. This two-stage technique is not only costly for the patient, but also presents risks of complications related to the surgery. Surgical treatment of elevator paralysis is an operation that gives satisfactory results both in terms of correction of the deformities and resuscitation of the elevators by the posterior tibial. Resuscitation of the elevator apparatus with the posterior tibial muscle is only effective if the muscle is rated 5 or 4 [11]. Muscles with a rating of less than 4 do not give a good functional result [11]. When transferring the posterior tibial muscle to the dorsum of the foot for elevator pollicis paralysis, it is often technically difficult to securely fix the graft and implant it precisely in the axis of foot lift, without spurious inversion or eversion [13]. Fixation of the transplant through the interosseous membrane to the lateral cuneus using a Blunt staple or a plantar padded shirt button gave us satisfactory results. Transfer of the posterior tibial

muscle onto the anterior tibial tendon, after the latter has been rerouted from its anatomical path, passing under the proximal part of the first two metatarsals to emerge at the dorsal aspect of the foot through the base of the second intermetatarsal space, has been described [13]. The transferred posterior tibial muscle loses its initial strength due to prolonged immobilization in order to achieve fusion of the arthrodesis. Active and passive mobilization after removal of the cast allows the transferred muscle to recover its initial strength in a more or less long time. This mobilization must be continued for several weeks depending on the evolution of the functional result. After six months, it no longer seems necessary. At the last follow-up, the strength of the posterior tibial muscle was satisfactory in all patients, with the complete disappearance of stepping on walking. No foot deformity attributable to posterior tibial transfer was noted. The tendency to a hollow foot has been reported [14]. Residual pain is very often due to a failure to correct the various foot deformities, a failure to fuse the arthrodesis, or tibiotalar arthrosis. Our only case of residual pain was due to valgus hypercorrection that resulted in advanced tibiotalar osteoarthritis. This patient finally benefited from a tibiotalar arthrodesis. The late complications reported after this surgery was essentially represented by the absence of fusion of one or more arthrodesis and tibiotalar arthrosis. Our study has some limitations. It is retrospective with a small number of patients. However, the series is homogeneous in terms of etiology (neurological foot 7/7) and the young age of the population. The three stages of foot deformity correction were performed in one operation. Multicenter studies with large numbers and extensive follow-up are needed to compare our results.

5. Conclusion

This study suggests that double arthrodesis associated with posteromedial release and transfer of the posterior tibial in one step in inveterate paralytic varus equines feet, gives satisfactory results. It allows for easy shoeing and plantigrade walking without stepping. Complications are essentially represented by the absence of fusion of the arthrodesis and tibiotalar arthrosis.

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this article.

References

- [1] Thierry, J.-F., Vaujany, P., De Belenet, H. and Merrien, Y. (1996) Pied Tropical. In, *Chirurgie d'urgence en situation précaire*. Editions Pradel, Paris, 600-609.
- [2] Bronfen, C., Marcucci, L., Pierrard, G., Her, B., Cuny, P., Besnard, P., *et al.* (2019) Traitement chirurgical de déformations sévères en varus équin des pieds chez l'enfant et l'adolescent en Afrique. *Revue de Chirurgie Orthopédique et Traumatologique*, **105**, 248-251. <https://doi.org/10.1016/j.rcot.2019.01.019>
- [3] Sales de Gauzy, J. (2016) Orthopédie pédiatrique en mission humanitaire. Cahiers

- d'enseignement de la SoFCOT: Conférences d'enseignement. *Elsevier Masson Paris*, **105**, 165-177.
- [4] Smythe, T., Kuper, H., Macleod, D., Foster, A. and Lavy, C. (2017) Birth Prevalence of Congenital Talipes Equinovarus in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. *Tropical Medicine & International Health*, **22**, 269-285. <https://doi.org/10.1111/tmi.12833>
- [5] Coulibaly, K., Sanogo, C.O., Touré, L., Cissé, M. and Sidibé, S. (2019) Double arthrodèse de l'arrière pied associée à la libération postéro-médiale des parties molles dans le pied varus équin invétéré. *Journal africain de chirurgie orthopédique et traumatologique*, **4**, 62-67.
- [6] Bitariho, D. and Norgrove, P. (2004) Results of Triple Arthrodesis in Uganda. *East and Central African Journal of Surgery*, **9**, 41-44.
- [7] Stegeman, M., Louwerens, J.W.K., der Woude, J.T.V., Hermina, W.C.H. and van Ginneken, B.T.J. (2015) Outcome after Operative Fusion of the Tarsal Joints: A Systematic Review. *The Journal of Foot and Ankle Surgery*, **54**, 636-645. <https://doi.org/10.1053/j.jfas.2014.05.007>
- [8] Louwerens, J.M.K. (2007) Triple Arthrodesis. *Techniques in Foot & Ankle Surgery*, **6**, 227-236. <https://doi.org/10.1097/btf.0b013e8159d314>
- [9] Jarde, O., Abiraad, G., Gabrion, A., Vernois, J. and Massy, S. (2002) L'arthrodèse médio-tarsienne et sous-talienne dans le traitement du pied plat valgus de l'adulte par insuffisance du tendon du tibial postérieur. Résultats d'une série de 20 cas. *Acta Orthopaedica Belgica*, **68**, 56-62.
- [10] Coulibaly, K., Traoré, S., Sanogo, C.O., Diallo, A., Djiré, I., Keïta, G., Diallo, S., Tambassi, S. and Berthé, M. (2022) Transfer of the Posterior Tibialis on the Lateral Cuneiform in Paralysis of the Elevator Muscles of the Foot. *Medicon Medical Sciences*, **2**, 22-27.
- [11] Sidibe, S., Ongoiba, N., Coulibaly, T., Alwata, I., Coulibaly, C.O.T. and Toure, A.A. (1999) Résultats du traitement chirurgical de la paralysie des releveurs du pied. *Médecine d'Afrique Noire*, **46**, 276-278.
- [12] Angus, P.D. and Cowell, H.R. (1986) Triple Arthrodesis. A Critical Long Term Review. *The Journal of Bone and Joint Surgery*, **68**, 260-265. <https://doi.org/10.1302/0301-620X.68B2.3958012>
- [13] Tomeno, B., Anract, P. and Vinh, T.S. (1998) Transfert du muscle tibial postérieur au dos du pied: Un procédé original de fixation du transplant. *Revue de Chirurgie Orthopédique et Réparatrice de l'Appareil Moteur*, **84**, 194-196.
- [14] Nacheff, N.S., Allart, E., Grauwin, M.Y., Rousseaux, M., Thévenon, A. and Fontaine, C. (2019) Transfert du muscle tibial postérieur dans les paralysies des releveurs du pied d'origine centrale: Effets sur la statique du pied à long terme. *Revue de Chirurgie Orthopédique et Traumatologique*, **105**, 77-82. <https://doi.org/10.1016/j.rcot.2018.12.011>