

Mid-Term Follow-Up Results of Surgical Reconstruction for Congenital Hallux Varus with Polysyndactyly in Children

Střednědobé výsledky sledování chirurgické rekonstrukce vrozeného hallux varus s polysyndaktylií u dětí

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ABSTRACT

Purpose of the study

Congenital hallux varus associated with preaxial polysyndactyly of the foot is a rare deformity for which standardized treatment protocols and outcome data remain limited. The purpose of this study was to evaluate the mid-term clinical and radiographic outcomes of early surgical reconstruction in a consecutive pediatric series.

Material and methods

Between 2015 and 2023, eight affected feet in seven children with congenital preaxial polysyndactyly and hallux varus were surgically treated at a single tertiary pediatric orthopedic center. The

diagnosis was established at birth. The mean age at surgery was 31.62 ± 36.64 months. All patients exhibited varus deviation of the first ray, duplication of the distal phalanx, complete or partial duplication of the proximal phalanx, soft-tissue syndactyly, duplicated or shared nail plates, and a hypoplastic medial ray. Surgical treatment consisted of resection of the hypoplastic medial hallux, abductor hallucis tenotomy, excision of chondrofibrous bands when present, subtotal periosteal stripping of the first metatarsal, and medial open-wedge osteotomy of the first metatarsal or proximal phalanx in selected cases. Outcomes were assessed clinically and radiographically, and graded using the Phelps and Grogan classification.

Results

At a mean follow-up of 45.14 ± 18.79 months (range, 24 to 82 months), satisfactory outcomes were achieved in

87.5% of the treated feet. Significant correction of the hallux varus deformity was obtained, with preservation of motion of the first metatarsophalangeal and interphalangeal joints. No patient required secondary surgical procedures. One patient who did not undergo initial metatarsal osteotomy demonstrated progressive recurrent varus during follow-up.

Conclusions

Early surgical correction of congenital hallux varus polysyndactyly (between 12 and 18 months of age) yields favorable mid-term outcomes. Medial open-wedge osteotomy of the first metatarsal represents a critical component for durable correction and should be considered even in low-grade deformities.

Key words: congenital hallux varus, preaxial polysyndactyly, pediatric foot deformity, McElvenny procedure, first metatarsal osteotomy.

INTRODUCTION

Congenital hallux varus duplex is a rare form of preaxial polydactyly of the foot, with a reported incidence of approximately 0.4 per 10,000 live births and no known sex predilection (20). The deformity is characterized by duplication of the hallux,

aberrant secondary ossification centers of the first metatarsal, hypertrophy or hyperactivity of the abductor hallucis muscle, and, in many cases, abnormal or shared nail. Varus deviation typically originates at the first metatarsophalangeal joint.



Fig. 1. Type III S1 HM D preaxial polysyndactyly. a, b – preoperative radiograph and clinical photograph demonstrating clinical picture of duplication with two nail plates; c – surgical procedure performed at 12 months of age, including amputation of the medial hypoplastic toe, excision of the chondrofibrous band, and subtotal (two-thirds) medial periosteal stripping of the first metatarsal; d, e – final follow-up at 82 months. Outcome according to the Phelps and Grogan classification: Grade 1. No residual hallux varus deformity is present. Hypoplasia of the first metatarsal measuring 2.8 mm is noted.

Although most cases are isolated, congenital hallux varus may be associated with other anomalies, including hand polysyndactyly, or occur as part of syndromic conditions such as neurofibromatosis type I, tibial hemimelia, Goltz syndrome, or Kleiner-Holmes syndrome (1, 6, 17). The deformity is apparent at birth and progressively leads to forefoot widening, gait disturbances, difficulty with footwear, and cosmetic concerns. During adolescence, psychosocial effects may become prominent due to visible foot deformity - difficulties wearing open-toed shoes, reluctance to walk barefoot, and avoidance of activities like visiting beaches or swimming pools.

Surgical reconstruction is considered the treatment of choice, and multiple operative techniques have been described (4, 7, 11, 13, 14, 19). However, the existing literature is dominated by case reports and small series, with limited mid- or long-term follow-up (6, 12, 18, 19). Larger clinical series remain scarce (8, 15).

The purpose of the present study was to analyze the mid-term outcomes of surgical correction of congenital hallux varus polysyndactyly performed in early childhood at the Pediatric Orthopedics Clinic of the Medical University of Sofia, Bulgaria.

MATERIAL AND METHODS

This retrospective study included eight affected feet in seven children (five girls, including one with bilateral involvement, and two boys) treated between 2015 and 2023. The mean age at surgery was 31.62 ± 36.64 months. In the majority of cases, surgical intervention was performed between 11 and 18 months of age, prior to or shortly after the onset of independent ambulation. One patient underwent surgery at 10 years of age, which increased the mean age of the cohort.

According to the Rotterdam Foot Classification (15), three feet were classified as Type IV S1 HM D, characterized by varus deviation of the hallux, complete duplication of the distal and proximal phalanges, soft-tissue syndactyly, and two separate nail plates. The remaining five feet were classified as Type III S1 HM D, with complete duplication of the distal phalanx and partial duplication of the proximal phalanx. In only two cases, a shared nail plate was identified. A hypoplastic medial ray was present in all cases. Proximal phalangeal duplication was radiographically evident in only two feet, with the remaining duplications confirmed intraoperatively.

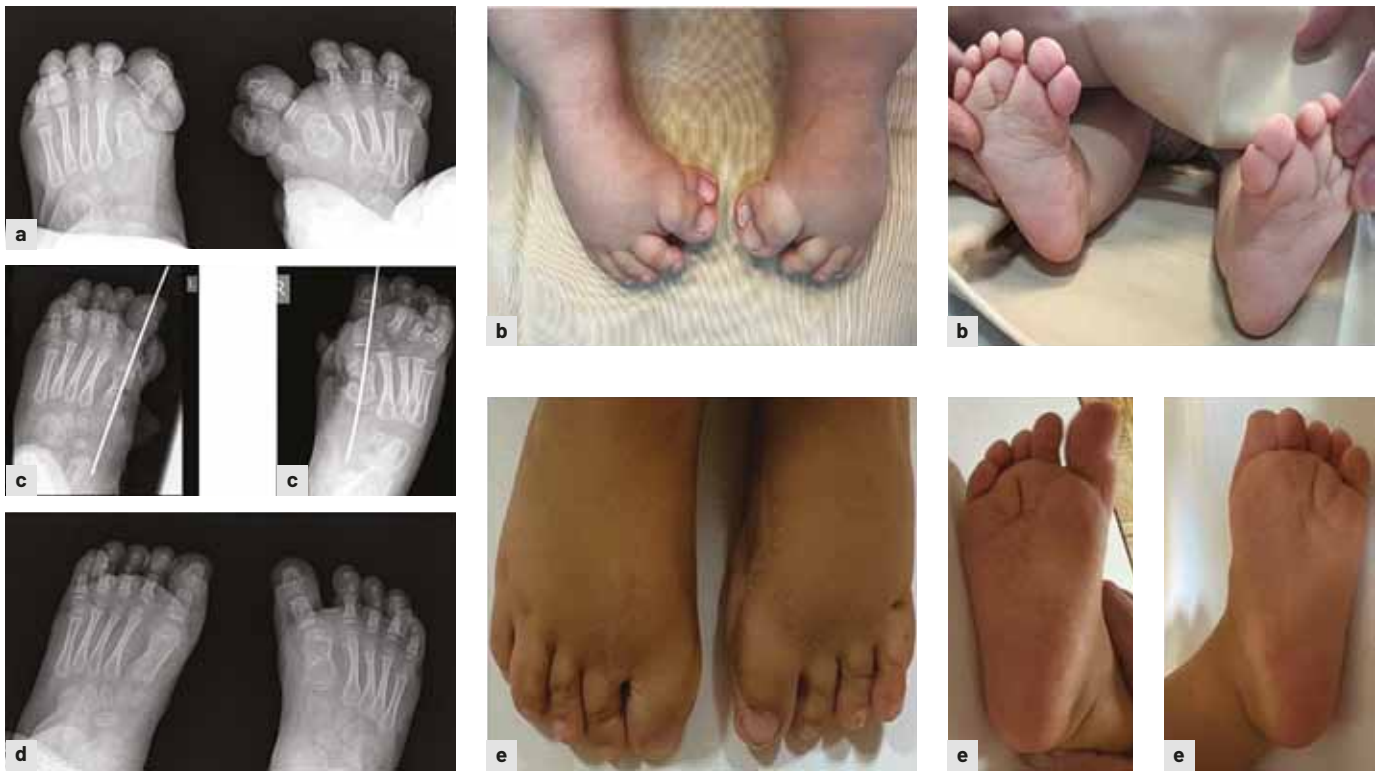


Fig. 2. Bilateral Type IV S1 HM D preaxial polysyndactyly. a, b – preoperative radiographs and clinical photographs showing clinical picture of duplication with two nail plates and complete duplication of the proximal phalanges; c – bilateral surgical procedures performed at 18 months of age, including amputation of the medial hypoplastic toe, excision of an intraoperatively identified epiphyseal bracket on the right side, subtotal (two-thirds) medial periosteal stripping of the first metatarsal, medial open-wedge osteotomy of the first metatarsal; d, e – follow-up at 27 months. Outcome according to the Phelps and Grogan classification: Grade 1 for the left foot and Grade 2 for the right foot.

The degree of medial deviation was quantified by measuring the angle between the longitudinal axis of the first proximal phalanx and the fifth metatarsal on anteroposterior radiographs. Based on analogy with the metatarsophalangeal angle, values $<15^\circ$ were considered normal (9). The mean pre-operative angle was $59.6^\circ \pm 11.55^\circ$.

One patient had associated ipsilateral tibial hemimelia (Paley Type IIA). Genetic evaluation performed in three patients revealed no detectable abnormalities.

Surgical technique

All patients underwent resection of the hypoplastic medial hallux through an elliptical incision, capsulotomy of the first metatarsophalangeal joint, and tenotomy of the abductor hallucis muscle. Subtotal periosteal stripping of the first metatarsal was performed in all cases to release the pathological cartilaginous tether, following the principles described by McElvenny (7). A chondrofibrous band of cartilaginous consistency was identified and excised in four feet.

A medial open-wedge osteotomy of the first metatarsal or proximal phalanx was performed in five feet to correct

residual varus deviation. Temporary transfixation of the metatarsophalangeal joint with a Kirschner wire was maintained for four weeks, in accordance with the Bösch technique (16). In cases with a shared nail plate, the nail was surgically divided and the medial portion excised, with soft-tissue reconstruction using a sliding skin flap.

Hallux reconstruction was performed using a rotational skin flap as described by Farmer (4). Partial syndactylization of the first and second toes was carried out in two feet only. The primary indications for surgery were severe cosmetic deformity and inability to wear standard footwear.

RESULTS

The mean duration of follow-up was 45.14 ± 18.79 months (range, 24 to 82 months). None of the patients had reached skeletal maturity at the time of final evaluation. No perioperative complications, reoperations, or secondary corrective procedures were required.

Postoperatively, varus deformity was significantly corrected in all feet, with a mean angular improvement of 44.5° . The



Fig. 3. Type III S1 HM D preaxial polysyndactyly. **a** – preoperative x-ray and clinical pictures demonstrating duplication with a single nail plate; **b** – surgical procedure performed at 16 months of age, including amputation of the medial hypoplastic toe, excision of the chondrofibrous band, and partial (one-half) medial periosteal stripping of the first metatarsal; **c** – twelve months postoperatively, showing varus deformity of the first metatarsal with a first intermetatarsal angle of 14°; **d** – final follow-up at 40 months. Outcome according to the Phelps and Grogan classification: Grade 1. Progressive increase of the first intermetatarsal angle to 24° is observed.

mean postoperative angle (measured after Mubarak method) was $14.75^\circ \pm 5.23^\circ$ ($p < 0.001$). In one foot, overcorrection beyond the accepted anatomical range resulted in mild discomfort during shoe wear. (Fig. 2).

Full range of motion of the first metatarsophalangeal and interphalangeal joints was preserved in all cases. Cosmetic appearance improved markedly, including the development of pronounced first metatarsophalangeal crease. All parents reported satisfaction with the functional and aesthetic outcomes, including the absence of pain, ease of footwear use, no callus formation, minimal residual deformity, and cosmetically satisfactory results (Fig. 1).

According to the Phelps and Grogan classification (10), seven of eight feet (87.5%) improved from a preoperative Grade 3 to a postoperative Grade 1. Statistical analysis using the Wilcoxon signed-rank test demonstrated significant improvement in subjective outcome scores ($p = 0.007$).

Radiographic follow-up at 24 months demonstrated hypoplasia of the first metatarsal in all feet. In unilateral cases, the mean length discrepancy compared with the contralateral side was 3.61 ± 7.5 mm, with a maximum of 15 mm in one patient. This discrepancy was present preoperatively and

did not progress throughout the study period ($p = 11.33$). Additionally, it was not linked to the periosteal stripping of the first metatarsal bone or the removal of the chondrofibrous band.

One patient who did not undergo initial metatarsal osteotomy developed progressive postoperative varus of the first metatarsal, with an increase in the first intermetatarsal angle of approximately 4° per year. (Fig. 3). At the most recent follow-up, the deformity had not compromised foot tripod stability or footwear tolerance, although corrective osteotomy is being considered.

DISCUSSION

Only a limited number of clinical series have reported outcomes of surgical treatment for congenital hallux varus polysyndactyly with sufficient number of cases or follow-up to allow meaningful conclusions (8,15). Despite the small sample size (only 8 cases), our results are consistent with those reported by Shim et al. and Sabapathy et al. (11, 15) and support an individualized surgical approach based on the underlying anatomical pathology.

We consider the Rotterdam Foot Classification to be a reliable system for both classification and preoperative planning. Early correction, ideally before the onset of independent walking, remains a central principle of our treatment philosophy. Determining the optimal age for surgical intervention involves balancing two perspectives: that of the family and that of the treating medical team.

Parents, concerned about the cosmetic appearance of the foot, often advocate for surgery as early as possible to eliminate the visible difference from other children. On the other hand, pediatric anesthesiologists, considering the anatomical and physiological characteristics of newborns, infants, and toddlers, typically recommend delaying surgery to a later age when anesthesia for elective procedures poses fewer risks.

From an orthopedic perspective, medial deviation of the first ray disrupts foot biomechanics, alters load distribution, and interferes with normal gait development. In addition, difficulty wearing footwear and visible deformity have important psychosocial implications, underscoring the need for timely correction.

In our series, over 50% of the children underwent surgery either before the onset of walking or shortly thereafter, within 18 months of age. No anesthetic or postoperative complications were observed. For bony procedures, we believe it is preferable to wait until after the first year, when ossification centers are formed, as this allows clearer visualization of the physis and any secondary ossification centers that may develop.

Consistent with previous reports (3, 5, 14, 15) we emphasize the importance of addressing the pathological cartilaginous tether of the first metatarsal when present. A visible epiphyseal bar was detected in three cases within the series. Subtotal periosteal stripping allowed continued transverse growth of the metatarsal, likely due to periosteal regeneration.

Our findings demonstrate that corrective osteotomy of the first metatarsal or proximal phalanx is essential for durable correction. In contrast to other authors (15), we did not use bone grafts for medial open-wedge osteotomy and observed no cases of delayed union. Progressive varus was observed only in the foot in which osteotomy was omitted.

Partial syndactylization was deliberately avoided in six cases. We believe that partial syndactylization yields unpredictable outcomes regarding the long-term aesthetic appearance and satisfactory growth of the child's foot. Furthermore, syndactylization may later cause discomfort while wearing footwear and potentially necessitate secondary surgical intervention for its removal.

Limitations

This study is limited by the small number of patients and the absence of long-term follow-up to skeletal maturity. Consequently, late recurrence or growth-related changes cannot be fully assessed.

CONCLUSIONS

Combined soft-tissue and osseous reconstruction using Farmer and McElvenny principles, together with medial open-wedge osteotomy of the first metatarsal or proximal phalanx, provides reliable mid-term correction of congenital hallux varus polysyndactyly. Early intervention, preferably between 11 and 18 months of age, is recommended. Given the high risk of progression, medial open-wedge osteotomy should be considered an essential component of primary surgical treatment. ■

References

1. Burger EB, Baas M, Hovius SER, Hoogebloom AJM, van Nieuwenhoven CA. Preaxial polydactyly of the foot. *Acta Orthop*. 2018; 89:113–118.
2. Burger EB, Hovius SE, Burger BJ, van Nieuwenhoven CA. The Rotterdam Foot Classification: a classification system for medial polydactyly of the foot. *J Bone Joint Surg Am*. 2016; 98:1298–1306.
3. Choo AD, Mubarak SJ. Longitudinal epiphyseal bracket. *J Child Orthop*. 2013;7:449–454.
4. Farmer AW. Congenital hallux varus. *Am J Surg*. 1958;95:274–278.
5. Kadioğlu B, Güven M, Akman B, Özkan NK. Longitudinal epiphyseal bracket as an overlooked etiology of congenital-residual hallux varus: a case report. *J Am Podiatr Med Assoc*. 2021;111:16.
6. Manni A, Zouirech Y, Rouijel B, Hosni S, El Madhi T. Congenital hallux varus in children: a case of bilateral presentation. *Cureus*. 2025;17:e77844.
7. McElvenny RT. Hallux varus. *Q Bull Northwest Univ Med Sch*. 1941;15:277–280.
8. Mills JA, Menelaus MB. Hallux varus. *J Bone Joint Surg Br*. 1989;71:437–440.
9. Mubarak SJ, O'Brien TJ, Davids JR. Metatarsal epiphyseal bracket: treatment by central physiolysis. *J Pediatr Orthop*. 1993; 13:5–8.
10. Phelps DA, Grogan DP. Polydactyly of the foot. *J Pediatr Orthop*. 1985;5:446–451.
11. Sabapathy SR, Mohan M, Bandi S. Correction of congenital hallux varus deformity using modified Farmer's technique: a case series. *J Foot Ankle Surg (Asia-Pacific)*. 2025;12:103–107.
12. Saiouf Y, Al Aji N, Ali Nizam N, Ibrahim A, Laila A. Bilateral congenital hallux varus with metatarsus adductus in a 6-year-old girl: A case report. *World J Clin Cases*. 2025;13:105327.
13. Samelis PV, Kolovos P, Nikolaou S, Samelis VP, Markeas NG. Primary congenital hallux varus: a step-cut surgical approach. *Cureus*. 2022;14:e28075.
14. Shea KG, Mubarak SJ, Alamin T. Pre-ossified longitudinal epiphyseal bracket of the foot: treatment by partial bracket

- excision before ossification. *J Pediatr Orthop*. 2001;21:360–365.
15. Shim JS, Lim TK, Koh KH, Lee DK. Surgical treatment of congenital hallux varus. *Clin Orthop Surg*. 2014;6:216–222.
16. Sié EJ, Kacou AD, Traoré A, Mobiot C, Lambin Y. Bösch technique for hallux valgus surgery in a tropical setting. *J Clin Orthop Trauma*. 2013;4:123–128.
17. Silverstein ML, Burke LW, Laub DR Jr. Two cases of preaxial polydactyly of the foot: important implications for plastic surgeons. *Plast Reconstr Surg Glob Open*. 2021;9:e3358.
18. Sulaiman AR, Munajat I, M-Yusuf H, Nik-Jaffar N, Zarullail NH, Mohd EF, Johari NA. Reconstruction of secondary type congenital hallux varus with modification of the Farmer technique for cover of skin defect: report of three cases. *Malays Orthop J*. 2019;13:72–76.
19. Toriyama K, Kamei Y, Morishita T, Matsuo K, Torii S. Z-plasty of dorsal and plantar flaps for hallux varus with preaxial polydactyly of the foot. *Plast Reconstr Surg*. 2006;117:112–115.
20. Vasluian E, van der Sluis CK, van Essen AJ, Bergman JE, Dijkstra PU, Reinders-Messelink HA, de Walle HE. Birth prevalence for congenital limb defects in the northern Netherlands: a 30-year population-based study. *BMC Musculoskelet Disord*. 2013; 14: 323.