

CONGENITAL HALLUX VARUS DUPLEX: RECONSTRUCTIVE SURGERY FOR CORRECTION OF THE DEFORMITY

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Abstract— Aim: Description and analysis of reconstruction techniques used in a rare case of a congenital deformity of the foot: hallux varus duplex.

Materials and methods: A case of a child at the age of 1 year and 8 months with a secondary single-sided hallux varus has been treated at the University Hospital of Active Treatment in Orthopaedics “Prof. B. Boytchev.” The deformity is caused by two anomalies: polysyndactyly and the presence of a medially located, additional secondary ossification center of the first metatarsal bone. The diagnosis is clinical at time of birth and radiologic at the age of 1 year, when the ossification center is already visible. The operative treatment is a combined technique of the reconstructive methods of McElvenny and Farmer, with modification of the same accordingly to the specific case. The assessment of the postoperative results is on the basis of changes in the angle, formed by the longitudinal axes of the first proximal phalanx and the fifth metatarsal bone, and with a scale from 1 to 10 for grading the aesthetic and functional effect of the operation (according to the parents of the child).

Results: The follow-up of the patient was carried out during the stay at the clinic, on the 2nd and 3rd week, on the 6th and 12th months post-operatively. A correction of the medial deviation of the toe was achieved. The angle between the proximal phalanx and the fifth metatarsal bone decreased from 66.7° to 12.5° on the 12th post-operative month. The parents graded the success of the surgery as 8 out of 10 points on the scale given, which shows a very good subjective result of the treatment.

Conclusion: In the case described, the combined techniques of reconstruction of the toe are effective in correcting the angle of the deformation caused by the preaxial polysyndactyly. Our end result is similar to the results of other authors using the same operative techniques in different combinations and/or alone. We recommend that the operation should be performed at the age between 9 and 12 months with the combined techniques of McElvenny and Farmer.

Keywords— congenital hallux varus duplex, additional medial ossification center of the first metatarsal bone, McElvenny and Farmer operative techniques.

1. Introduction

The congenital type hallux varus duplex is a rare deformity, in which the toe is partially divided and positioned medially. The varus angulation begins at the first metatarsophalangeal joint. The deformity is divided in two groups: primary and secondary. Primary hallux varus appears due to a shortened, over-active abductor hallucis muscle¹⁵. Secondary hallux varus is the result of several other anomalies, such as: metatarsus adductus, polysyndactyly¹⁶ of the toe and a secondary ossification of the first metatarsal bone (longitudinal epiphyseal bracket)¹, and in cases with generalized syndromes and connective tissue diseases^{8,13}. Operative treatment in secondary medial deviation is difficult due to the present polysyndactyly and the pathological ossification center located medially on the first metatarsal bone. In cases where the given ossification center is not surgically excised, the deviation has the potential to reappear. The present study shows the experience of the University Hospital of Orthopaedics “Prof. B. Boytchev” in this area of pathology and treatment.

2. Clinical case

The case is that of a boy at the age of 1 year and 8 months from a normal pregnancy and second birth. The deformation of the toe is discovered immediately after birth and at a physical examination at the age of 1 year and 6 months, the child is indicated for operative treatment. Up to this point, the child hadn't yet started walking. Clinically, the toe shows preaxial polydactyly type II by the classification of Wassel (1969) (Fig. 1A) with soft-tissue syndactyly and at the physical examination, the toe is rigid and does not allow for conservative treatment. In this case, the deformity is combined. There are two reasons behind the medial deviation of the toe: polysyndactyly of the toe and an additional ossification center along the diaphysis of the first metatarsal bone (longitudinal epiphyseal bracket). On radiography, the angle of the medial deviation of the first proximal phalanx and the fifth metatarsal bone is 66.7° (Fig. 1A). The angle used when measuring the medial deviation of the toe is recommended by Mubarak et al. (1992) due to the extreme deformity of the first metatarsal bone, with the secondary ossification center, which causes thickening and medial deviation of the whole metatarsal bone. This causes difficulty in measuring other radiological angle parameters.⁷ In the case which is discussed, the first metatarsal bone is treated only due to the presence of the longitudinal epiphyseal bracket, as the deviation itself is not changed. On radiography of the lower extremities, the patient presents with hemimelia of the left tibia type 1A by the classification of Paley and type II by the classification of Weber⁹.

Operative technique. The operation is performed with the help of a tourniquet and with spinal anaesthesia. A longitudinal skin incision is made medially to the metatarsophalangeal joint 4cm long, as well as a leaf-shaped incision, so that proper visualization can be achieved of the first metatarsophalangeal joint and the polysyndactyly corrected. Intraoperatively, a cartilaginous covering of the first metatarsal bone with the appearance of a longitudinal epiphyseal bracket was visualized. The secondary ossification center of the first metatarsal bone was removed by the technique of McElvenny,

a capsulotomy of the first metatarsophalangeal joint was performed, the partial polysyndactyly in the region of the first distal phalanx was carried out, and the metatarsophalangeal joint was transfixed with a Kirschner wire by the technique of Bösch¹². The common nail plate was cut and partially removed medially, and the deformity was corrected with an advancement flap. The toe was reconstructed with a rotation skin flap by the technique of Farmer, as partial syndactylization of the first and second toes was not performed. The duration of the surgery was 95min.

Sterile dressings were performed every other day after the surgical intervention during the first two weeks, and the sutures were removed at the 14th postoperative day. The Kirschner wire was removed on the 21st day after the surgery. Skin blood supply and sensitivity in the area of the wound was carefully observed and there were no areas of necrotic tissue or changes in the sensory innervation of the toe.



Fig. 1: (A) Preoperative photograph, showing the deformity hallux varus duplex with the classical medial deviation and polysyndactyly type II by Wassel. (C) Postoperative results 1 year later with correction of the deviation to an anatomical status. (B) Photography of the fold formed in the area of the first metatarsophalangeal joint after soft tissue reconstruction with the skin flaps.

3. Results

In the early postoperative period, there has been no evidence of infection, as well as other postoperative complications, like wound dehiscence. The operated limb has been followed- up functionally and visually on the 3rd, 6th and 12th month, as photographs and radiographs in two projections were taken. Pre-operatively, the angle between the proximal phalanx and the fifth metatarsal bone on the radiograph was 66.7°. On the 6th month after the surgery, the angle has been measured as 21.8° (Fig. 2B). On

the 12th month after the operation, the cosmetic results have been found to be progressive and the angle of deviation showed a result of 12.5° (Fig. 2C and 2D). One year after surgery, the parents have assessed the correction as 8 out of 10 on the 10-point scale – a questionnaire that has been composed to assess the function and the aesthetics of the foot.



Fig. 2: (A) Preoperative radiography of the left foot, showing hallux duplex with a medial deviation and deformity of the first metatarsal bone, similar to a longitudinal epiphyseal bracket. (B) Radiography of the feet 6 months after operative intervention. (C) and (D) Radiographies in AP and LAT 1 year after the surgery, showing long-term correction of the deviation, despite the remaining deformity of the first metatarsal bone.

4. Discussion

The congenital deformity of the foot hallux varus duplex is caused by various etiological factors. In the current article, a secondary type hallux varus is discussed, in which the medial deviation of the toe is caused by two etiological factors: a longitudinal epiphyseal bracket of the first metatarsal bone and polysyndactyly of the toe in the region of the distal phalanx. Unfortunately, world-wide medical literature does not have

data of the incidence of the same type of congenital deformity. In the library of USHATO “Prof. B. Boytchev”, we found 9 more of the same type of deformities for the last 15 years, which are still in the process of observation.

Diagnosis of the congenital type hallux varus duplex is performed at birth, by precise diagnosis is carried out with the help of a physical examination and radiography of the feet of the child after the first year of age.

Radiological diagnostics give a very clear idea of the congenital deformity, as well as in the cases of other associated present anomalies. In radiography of the feet we receive information of the underlying cause of the medial deviation of the toe, such as a delta phalanx, an epiphyseal bracket and others. According to Shim et al. (2014), the presence of an epiphyseal bracket covering the first metatarsal bone is visible on radiography during the second year of age in the child, due to the fact that the centers of ossification are still not developed. In the case described in our clinic, the longitudinal epiphyseal bracket is observed in an earlier age, as the X-ray imaging is done when the child is at the age of 1 year. The radiological study is most correct when the imaging is performed with weight-bearing positioning in lateral and frontal views.

The clinical examination is most often performed immediately after birth. During the examination, we define whether the deformity is present and if it can undergo conservative treatment. The patient is followed-up for 1 to 2 years up until the age in which the child is indicated for surgery from a general clinical and orthopaedic perspective. The recommended age of operation is in the age interval of 1 to 3 years according to Shim et al.¹¹.

Reconstructive surgery for the deformity is performed due for two reasons: functional difficulty and cosmetic differences. Reconstruction of the first ray helps the child start walking with standard shoes and gives an opportunity for the foot to grow with a cosmetically normal appearance as well³.

According to Shim et al.¹¹, the operative interventions for correction of the congenital type hallux varus duplex has 4 general aims: correction of the polysyndactyly, correction of the soft tissue, reconstruction of the congruency of the metatarsophalangeal joint, and removal of the cartilaginous bracket covering the first metatarsal bone, in the presence of such a formation. Their results show that the most successful correction of congenital hallux varus is in the cases with a combined operative intervention: bony and soft-tissue reconstruction. The two operative interventions most often used in secondary hallux varus are those of McElvenny and Farmer, as both include the combined bony with soft-tissue correction of the first ray.

The operative technique of McElvenny includes extraction of the accessory bones and bony formations, sesamoidectomy, capsulotomy and transfixing of the metatarsophalangeal joint with a Kirschner wire, as well as partial syndactylization of the first and second toes of the foot^{5,11}.

The operative procedure of Farmer is comprised of a correction of the contractures of the soft tissue structures and a rotation skin flap, as well as syndactylization of the first and second toes^{2,11,14}.

Results discovered in medical literature show that with the help of a combined operative technique, many authors have had better outcomes, in comparison to their cases only comprising of metatarsal osteotomy. In the series of Shim et al.¹¹, in 3 out of 10

cases, solely soft-tissue techniques have been used and in 2 of these, they have required re-operation. In other 3 cases, they performed only osteotomies, but their results were both clinically and cosmetically bad. In 4 of their cases, in which they used combined operative techniques, the results were very good or excellent clinically and cosmetically.

According to Mills and Menelaus (1989), the techniques of McElvenny and Farmer received good outcomes in 12 out of 17 cases, whilst in other 3 cases, treated with only bony reconstruction, the results were unsatisfactory⁶.

In the clinic, the operation was performed by using the combined techniques of McElvenny and Farmer, as the principles and goals of the reaching stabilization of the toe to a neutral position, as well as performing a plastic and reconstructive operation to bring the deformity to an anatomical normality, were followed. There were two skin incisions performed along the dorsal surface along the length of the first metatarsal bone and medially to the metatarsophalangeal joint of the toe. Through the first incision, there was access to the first metatarsal bone, where an osteotomy was performed and the bony-cartilaginous formation was extracted from the bone. The metatarsophalangeal joint was liberated via capsuloplastics and was fixed in neutral position with the help of Kirschner wire. The second stage of the surgery, in which the polysyndactyly was corrected, skin plastics with a rotational skin flap from the toe was performed, so that the deformity caused by the correction of the joint is covered. The skin flap used was not taken from the web space of the first and second toes, as is described in the technique of Farmer. This was not performed because when receiving a flap from the web space, it would require the team to perform the partial syndactylization of the first and second toes. This is also described in the protocol of McElvenny as an additional modified procedure to obtain a long-term correction of the varus deviation. Straying from the two operative techniques described above, a decision was made intraoperatively to not perform the partial syndactylization with the rotation flap, due to unpredictable results for the aesthetically normal and/or satisfactory growth of the foot of the child. Furthermore, the syndactylization in turn can cause discomfort in footwear and requires a secondary operative intervention for its removal.

We take into consideration the age of the patient as well, which influences the positive development of the foot, as the recommended age for operative interventions in deformities of the toes are in the range of 9 to 12 months, which is considered an early operative intervention before the start of walking (4), whilst the child appears at the clinic for surgery at the age of 1 year and 8 months.

The final result in our patient confirms the effectiveness of the therapeutic algorithm, for which we recommend the same technique (Fig. 1B and 1C). Concerning the grading and subjective assessment, the parents have given their answers to the questionnaire, that the child has started walking with normal shoes at about 3 months after the surgery, that they are satisfied with the cosmetic outcomes, as they graded the foot status with 8 out of 10 points, for which we accept that the result of the surgery is good and successful.

5. Conclusion

The congenital deformity hallux varus duplex is influenced most successfully by a reconstructive operative intervention, aiming at straightening the toe to a neutral position in the long term, by combining the two operative methods of McElvenny and Farmer. In the case of a secondary congenital hallux varus duplex described, good results are observed after performing the combined reconstructive technique for soft tissue and bone correction, even if the age group of the child deviates from the usual age required for surgery.

6. References

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