Amalgamating Osteotomy: A Novel Surgical Technique for the Reconstruction of Bilateral Preaxial Polydactyly of the Foot*

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Abstract

Introduction: Polydactyly of the foot is not uncommon, with the preaxial type or hallux duplication comprising 15% of cases.2 Metatarsal type preaxial polydactyly (MTPP) accounts for an estimated third of all reported preaxial polydactyly cases. Traditional surgical procedures for this condition frequently have drawbacks that include varying degrees of hallux varus and a bigger forefoot.[1] Due to these disadvantages, developed a simple and effective technique for the reconstruction of MTPP.

Case Report: Amalgamating osteotomy procedures were done for bilateral MTPP in an 18-month old girl who had been experiencing shoe ware difficulty. An excellent and pain-free functional outcome was achieved with good cosmetic appearance and an improved ability to wear various kinds of footwear.

Conclusion: Amalgamating osteotomy could be the procedure of choice for the reconstruction of metatarsal type preaxial polydactyly. Case series and long-term follow-ups should be done to compare outcomes with other surgical techniques.

Keywords: polydactyly, foot deformity, amalgamating osteotomy, foot reconstructive surgery

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INTRODUCTION

Polydactyly of the foot is characterized by extra toes, with the duplication either at the phalangeal level only or may include the metatarsal. Polydactyly may be preaxial (medial), central, or postaxial (lateral).[2] Due to the added number of toes, difficulty with shoe wear, pain, and even soft tissue trauma may be present and surgical treatment is often advised.[3]

Compared to duplication of the digit only, surgical treatment of polydactyly with digit plus metatarsal involvement may pose more difficulties.[3] Cases of metatarsal type preaxial polydactyly (MTPP) are particularly challenging, as measures to prevent residual hallux varus and maintain a stable 1st metatarsotarsal joint and medial longitudinal arch should be considered.1 Unfortunately, traditional surgical reconstruction techniques for MTPP have shown inconsistent results, occasionally leading to additional surgery or an unsatisfactory clinical outcome.[4 5 6]

Amalgamating osteotomy, a new surgical treatment for MTPP, takes these important factors into consideration and allows for uncomplicated longitudinal growth in the pediatric population.1 More importantly, it is a simple bone and soft tissue procedure that can easily be taught to and practiced by most surgeons around the world. A thorough search of published reports shows that this procedure could be the first of its kind done in the Philippines.

MATERIALS AND METHODS

This was a case report of a noble surgical procedure, amalgamating osteotomy as described by Boyle et.al., in the treatment of a child with MTPP; included are the description and illustration of the surgical technique and clinical outcome of the patient after a year of surgery.

Surgical Technique

The amalgamating osteotomy is indicated in children who present with MTPP with a hypoplastic lateral metatarsal, a stable medial MTT joint, and a cosmetically near- normal lateral hallux.[1]

A zigzag incision is placed on the medial border of the foot (fig. C1), around the medial hallux to construct a nonlinear scar that will not retract and potentially cause hallux varus. Full-thickness subcutaneous dorsal and plantar flaps are elevated. Abductor hallucis is detached distally from the medial hallux and maintained as a muscular flap (fig. C2). The extensor hallucis longus tendon to the medial hallux is transected, and the space between the medial and lateral hallux metatarsals is developed; the metatarsal heads may have a cartilaginous connection not evident on preoperative radiographs. The tarsometatarsal ligaments of the hypoplastic lateral hallux metatarsal are transected. The medial hallux metatarsal is then osteotomized obliquely and distal to the physis (fig. C3). The medial neurovascular bundle is ligated and divided, the medial flexor tendons are divided, and the medial hallux is dissected free from the lateral common digital nerve and discarded. A plantar flap of medial skin is preserved to facilitate later wound closure. The lateral hallux metatarsal is then osteotomized obliquely (fig. C4) at a position that matches the medial metatarsal osteotomy and produces a cosmetic first metatarsal length when the 2 metatarsal remnants are combined (fig. C6). The distal portion of the lateral hallux metatarsal is then impaled into the medullary canal of the medial metatarsal remnant, with the amalgamating osteotomy stabilized with a single Kirschner wire (fig. C7). The periosteum is closed over the osteotomy site and the abductor hallucis is transferred to the remaining hallux. The skin flaps are closed (fig. C8) and an above knee mold is applied. The cast and wire are removed 8 weeks postoperatively.

FIGURE C.

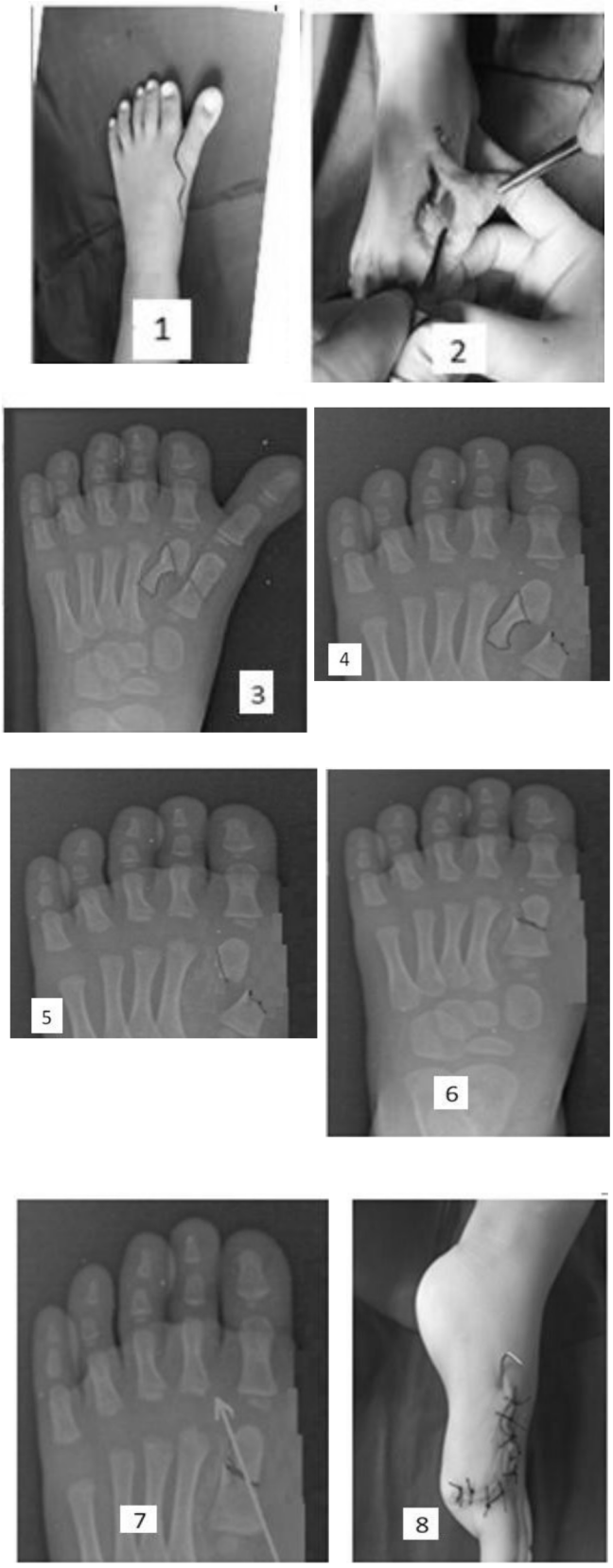

FIGURE C. Stepwise illustration to show how amalgamating osteotomy is done: 1. Medial zigzag incision to expose the duplicated metatarsals; 2. Flap made from the remaining soft tissues; 3. Red lines demonstrate suitable metatarsal osteotomy locations; osteotomize and excise medial hallux and distal medial ray; 4. Osteotomize and excise proximal part of the hypoplastic ray; 5. Remnants of medial and lateral 1st ray after excision; 6. Amalgamate or unite the remnants of both medial and lateral 1st rays. 7. Kirschner wire inserted between the amalgamated remnants; 8. Flap closed layer by layer.

Postoperative Outcomes

In this case report, similar to the study by Boyle et. al in 2016, clinical outcomes for our patient were evaluated using Phelps and Grogan outcome scale. Under this scale, an excellent foot has no pain, no shoe wear issues, no significant residual deformity, and a cosmetically acceptable appearance; a good foot has occasional pain, difficulty with some shoe styles, or minimal residual toe deformity; a poor foot has constant pain, marked shoe-wear difficulty, or substantial deformity of the residual toes.

CASE REPORT

This is the case of an 18-month old girl, the youngest among four children of healthy, non-consanguineous parents. At least three generations of the family on the paternal side has either hand or foot polydactyly or other isolated hand or foot malformations. Her father and siblings also have hand or foot polydactyly but no other associated malformations. Since local belief considers polydactyly as a sign of good fortune, and perhaps since no accessible treatment was then available, no one else in the family has undergone surgery for the condition.

Patient PZ was brought by her parents to the Orthopedics outpatient clinic last October 2017 with the hope of possible treatment for her polydactyly. The parents wanted PZ to undergo reconstructive surgery to prevent possible bullying and psychological consequences later on. They noticed that since PZ started walking at 9 months of age, she has had difficulty wearing shoes, often complaining of intense pain, swelling and sometimes skin trauma. Furthermore, it was noted that the patient has been experiencing repeated falls especially during fast strides as her right and left big toes come in contact during these times, causing her to lose balance and fall.

Physical examination revealed bilateral foot polydactyly, with 6 toes on each foot (fig. A). Other than these findings there were no other malformations or abnormal conditions noted after intensive investigation.

FIGURE A. Right and left foot of PZ, an 18-month old female, showing 6 toes on each foot with an obvious medial hallux varus and a cosmetically near-normal lateral hallux.

X-rays of the right and left foot (fig. B) show an extra digit with an underdeveloped metatarsal between the normal 1st and 2nd digits. Its accompanying phalanges appear to be duplications of the normal 2nd digit. Findings are the same on both sides. Bone density is normal.

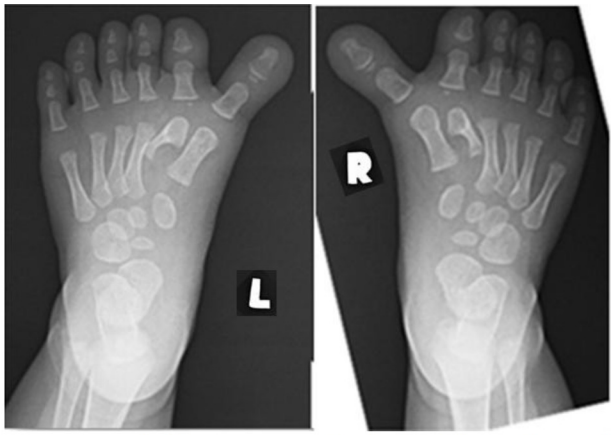

FIGURE B: Initial anteroposterior (AP) plain radiograph of the right and left foot of PZ, an 18-month old female, showing bilateral hypoplastic lateral 1st metatarsal and a bilateral varus deformity of medial 1st metatarsal

RESULTS AND DISCUSSION

Patient PZ underwent the first amalgamating osteotomy for MTTP in the Philippines last November 2017. Patient was 18-month old at the time of operation which included the left and right foot. PZ had preaxial MTPP of both feet with near-normal lateral hallucis. Other PE findings were unremarkable. On plain radiography, she has bilateral stable first MTT joints and hypoplastic lateral rays.

PZ underwent reconstructive surgery for her MTPP using amalgamating osteotomy as the main technique. Intraoperatively, the patient was placed under general anesthesia and tourniquet was applied to the extremity. Total operative time was 2 and half hours with minimal blood loss. Eight weeks post-surgery, bone healing by callus formation was seen on x-ray (fig. E1). The wound was clean and dry. The pin was removed at this time and the patient was allowed to bear weight as tolerated. Fifteen months after surgery, the patient displayed an excellent functional outcome based on Phelps and Grogan clinical outcome scale. Plain radiographs (fig. E2) showed a remodeled osteotomy, well-aligned first ray, no growth disturbance, no hallux varus. There were no complications, with note of only a minor surgical site scar (fig. G). Patient has no shoe wear problem and has been wearing her different styles of footwear (fig. F) and can walk and run on different terrains (fig. H).

FIGURE E. Plain x-rays AP view of right and left foot. 1, 8th weeks Postoperative radiograph shows that the amalgamated remnants secured with a single Kirschner wire. 2, Radiograph at 65 week, displays healed bone with no hallux varus deformity.

Phelps et. al., (1985), concluded that in patient with preaxial polydactyly, particularly when there is hallux varus, nonoperative management of is generally not effective, shoe wear problems and foot pain are usually present.

Aside from cosmetic issues with potential psychosocial impacts, shoe wear difficulties at the onset of walking age are to be expected. That extra digit and extra ray increases the width of the forefoot making the usual shoes made for 5-toed people very fitting or tight, causing continuous fiction and shearing forces aggravated by walking. This leads to swelling, erythema, abrasion and perhaps even more severe soft tissue trauma. Surgery is indicated in these instances.

Surgical options for patients with preaxial polydactyly with an associated hallux varus deformity include the McElvenny procedure, the Farmer procedure, and amalgamating osteotomy, which were introduced in 1941, 1958, and 2016, respectively.

In both Farmer and McElvenny procedures, the lateral or the near normal hallux is resected then extensive soft tissue reconstruction is done, leaving both metatarsals in place. The difference between the two procedures is the technique used to prevent medial hallux varus. In Farmer, it is the extensive reconstruction of soft tissues, muscle and rotational flap while in McElvenny it is the use of a k-wire that is inserted longitudinally at the 1st metatarsophalangeal joint. As the patient grows, both lateral and medial 1st ray increase in length and width as with the remaining rays, leading to a bigger forefoot and an obvious hallux varus.

These drawbacks have led to the development of a new surgical reconstructive technique for MTPP, the amalgamating osteotomy.1 It provides a technically simple method that takes advantage of combining a stable medial MTT joint with the cosmetically acceptable lateral hallux, thus maintaining the medial longitudinal arch of the foot. The arch is vital for shock absorption during ambulation while limiting the possibility of a potential recurrent hallux deformity and allowing for ongoing longitudinal growth.

Boyle has reported excellent functional results in two patients using the Phelps and Grogan clinical outcome scale. Similarly, in this case report, the use of amalgamating osteotomy in the treatment of bilateral MTPP in a child with hypoplastic lateral metatarsals and clinically acceptable lateral hallucis resulted in an excellent outcome.

CONCLUSION

Metatarsal type preaxial polydactyly and its attendant problems can be managed surgically using a simple and effective amalgamating osteotomy procedure. This may be of particular importance in local settings where the inadequacy of knowledge about the condition and limited resources would preclude the choice of technically demanding surgeries or multiple procedures for residual problems.

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FIGURE F: Patient using varied footwear

FIGURE G: Gross pictures of right and left foot; 1, after removal of pin at 8 weeks post-op showing 5 digits on each foot with scar formed at surgical site; 2, seven months after surgery, no hallux varus deformity noted and an apparent decrease prominence of scar on both feet.

FIGURE H: Patient walking on different terrains