Triphalangeal Thumb with Polydactyly: An Alternative Surgical Method

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Abstract Triphalangeal thumb (TPT) is congenital hand anomaly which a thumb consists of three phalanges. Thumb appearance can differ widely; the thumb can be longer than usual or it can be deviated in the radio-ulnar plane. Thumb strength and function can be significantly diminished. The goals of surgical treatment are to reduce the elongated thumb length, establish normal thumb function, maintain a stable joint and improve thumb position if necessary. In general, surgical treatment is performed for improvement of thumb function. The case presented here had a TPT with pre-axial polydactyly. The TPT was well developed but it had no movement at the proximal or distal interphalangeal joints. The rudimentary thumb had a well-developed and functioning interphalangeal (IP) joint. So as an alternative surgical technique we planned to transfer the functioning IP joint of rudimentary thumb to the TPT.

Keywords Congenital hand deformity · Triphalangeal thumb · Alternative technique · Triphalangeal thumb surgery · Triphalangeal thumb with polydactyly

Congenital hand anomalies have prevalence at birth of about 5:1,000 [1] and preaxial polydactyly (radial polydactyly) is

the most common anomaly occurring in 1:3,000 births [2]. Triphalangeal thumb (TPT), a thumb with three phalanges, first described by Columbi in 1559 and is regarded as a subtype of preaxial polydactyly with reported prevalence as 1:25,000 [3].

The triphalangeal thumb has a different appearance than normal thumbs. The appearance can differ widely; the thumb can be a longer thumb, it can be deviated in the radio-ulnar plane (clinodactyly), thumb strength can be diminished. Isolated TPT may occur as a sporadic disorder but it is usually inherited in an autosomal dominant manner and it has been reported in association with other congenital anomalies and syndromic malformations [4].

The goals of surgical treatment are; reducing length of the thumb, creating a good functioning, a stable joint and improving the position of the thumb if necessary. In general the surgical treatment is done for improvement of the thumb function [5].

We present a case, 5 year old male, who had a Wassel type 7 polydactyly, bifid proximal phalanx with duplication of the distal phalanx. The ulnar component of the polydactyly was triphalangeal (Fig. 1). In this case, as an alternative surgical method, the interphalangeal (IP) joint of rudimentary thumb was transferred to the ulnar triphalangeal side as a vascularized joint transfer and then rudimentary phalanx was ablated.

Methods

The patient was the first born child of healthy non consanguineous parents. He has no additional congenital anomalies and family history was negative for hand malformations. The patient had a rudimentary radial side polydactyly with a well developed IP joint. The TPT, which was well developed, had a delta phalanx and the proximal interphalangeal joint (PIP) and

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Fig. 1 Five years old male, TPT with polydactyly on his *left* hand

distal interphalangeal joint (DIP) joint of this finger was malformed and nonfunctioning (Fig. 2). TPT was deviated to the ulnar side which was also limiting its function. The thenar muscles were underdeveloped but they were functional. The web space was normal. Carpometacarpal joint and the metacarpophalangeal joint were well developed and they were functional. So to achieve a functional thumb the ulnar deviation was corrected and the IP joint of rudimentary thumb was transferred to the ulnar triphalangeal side as a vascularized joint transfer.

Surgical Technique

The patient was placed in supine position, with the affected extremity resting on a hand table. After inflation of pneumatic

Fig. 2 The patient had a rudimentary ulnar side polydactyly with a well developed interphalangeal (IP) joint. The TPT had a delta phalanx which was well developed but the IP joint was malformed and nonfunctioning

tourniquet, a skin incision was planned around the radial side of the IP joint of the rudimentary thumb including the skin around the joint. With the preservation of radial side digital artery, skin flap was elevated starting from the distal side. As the distal phalanx was reached 0.5–1 cm distal to the IP joint an osteotomy was performed to the distal phalanx. The same osteotomy was performed to the proximal phalanx proximal to the IP joint. Then the IP joint was elevated as a vascularized joint flap with the radial side digital artery and the radial side skin over it. The radial rudimentary thumb then was ablated through the proximal phalanx. The same skin incision was made around the radial side of TPT and the skin was excised. The PIP joint surfaces of the proximal and delta phalanx were osteotomized with an equal margin, as the vascularized joint-skin flap was then adapted to this space of the triphalangeal thumb (Fig. 3). The flexor tendon sheath and pulley system of the triphalangeal thumb was preserved and left untouched to improve the range of motion of the thumb. We also corrected the ulnar deviation of TPT and we put the finger in a slight radial deviation to create a more functional thumb. A Kirchner wire (K-W) was placed and the radial collateral ligament was repaired and tightened to stabilize the joint (Fig. 4). After the operation K-W was retained for 4 weeks to maintain postoperative stabilization.

Fig. 3 The diagrammatic representation of the transfer of the IP joint of the rudimentary thumb to PIP joint of the TPT

Fig. 4 Post operative early radiography of the reconstructed thumb

Methods of Assessment

Postoperative physical examinations included range of motion (ROM) measurement, alignment at the MP, PIP and DIP joints of affected thumb and test of stability. The subjective opinion regarding the appearance and function of the reconstructed thumb of family was added as the other evaluating parameter [6].

Results

Parents' Satisfaction

At the final assessment, the parents were pleased with the cosmetic improvement and better hand function that had been achieved. The child also had no problem with the appearance and function of his thumb and he did not hide it.

Fig. 5 General appearance of the thumb 2 years after the operation. The child and his parents are happy with the appearance and there was not any sensory or vascular deficit

Fig. 6 Finally the child was able to efficiently pick up small objects between the pulps of the index finger and the reconstructed thumb

General Appearance of the Thumb

When compared with the preoperative photographs at the follow up it is observed that the hypoplastic thumb nearly reached the size of the normal thumb. The child and his parents are happy with the appearance and there was not any sensory or vascular deficit at the reconstructed thumb (Fig. 5).

Functional Assessment

The child who was having problems with using his polydactylic thumb functionally before the operation, started to use his thumb more actively for pinching and grasping after the transfer. Lateral pinch also improved, producing better ability to firmly hold large keys. Finally the child was able to efficiently pick up small objects between the pulps of the index finger and the reconstructed thumb (Fig. 6). No interphalangeal joint instability was noticed at the end of the follow-up.

Fig. 7 Radiologically the fractures healed well but there was a minimal ulnar deviation at IP joint

At the final assessment, the total active arc of motion of the thumb was 30° while that of the metacarpophalangeal joint was 50°. The thumb could be actively opposed to touch the tips of all fingers.

Radiological Assessment

Radiologically the fractures at the proximal phalanx healed well. But at the distal side there was a Z deformity with an ulnar deviation at the PIP joint and a radial deviation at the DIP joint.

No surgical intraoperative complication was observed. The K-W was not loosened and pin tract infection was not observed.

Discussion

The case presented here had a well developed TPT with a delta phalanx. But the IP joint of this TPT was malformed and nonfunctioning. The rudimentary radial side polydactyly was underdeveloped but it had a well developed and functioning IP joint.

So we did not consider neither ablating the TPT, as described by Wassel [7], because the rudimentary thumb had underdeveloped, nor transferring the TPT to the radial side, as described by Wood [8], because it was not functioning. So as an alternative surgical method we transferred the well functioning IP joint of the rudimentary thumb to the ulnar side. We transferred the IP joint of the rudimentary thumb to the TPT and then we ablated the rudimentary thumb.

The shape and position of the thumb appeared nearly normal, but there was 40° of ulnar deviation at the new PIP joint. We thought that it may result from the delayed union or malunion at the distal part of the transferred distal phalanx or may result from a remnant of the delta phalanx, but this deviation did not alter the functional outcome.

Concerning the postoperative x-rays it is seen that a Z deformity was developed with the ulnar deviation of the PIP joint and radial deviation of the DIP joint. Because the radial side of the PIP joint was quite stable on physical examination we thought that this deformity may result from the asymmetrical development of the delta phalanx.

Because we could not predict the development of the delta phalanx we planned a second operation when the bone maturation is completed but the family was satisfied with the result and they did not accept another operation (Fig. 7).

There was also some degree of radial rotation at the PIP of joint of the operated thumb. Preoperatively the TPT

thumb was rotated to the ulnar side and this rotation was contributing to the limited the function of this thumb. Post-operatively the radial rotation of the thumb resulted in a more functional thumb as we planned preoperatively.

Dautel [9] found an average IP joint movement of 40.2° in a series of 19 patients operated with vascularized joint transfer to the thumb. This is similar to the literature as it is found around 37+/- 9° in systemic review [10]. In our case we found a total active arc of motion of 30° at the newly created thumb. This movement was attributed to the newly created PIP joint because there was no active range of motion at the DIP joint of the TPT preoperatively. Although this was considerably less than the IP joint movement of the thumb of the other hand (90°), this range of motion was quite satisfactory for the patient and the parents.

We also noticed that the underdeveloped delta phalanx gained its normal length at a 2 year period compared to the right thumb. Finally we achieved a near normal looking thumb with a satisfactory function.

The limitation of this study is relatively short follow-up period and the ulnar deviation at the IP joint of the thumb. But together with the stable and good functioning joint we achieved an acceptable result.

So we recommend keeping this method of joint transfer in mind for these unusual cases of TPT with polydactyly.

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