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Research Paper

Thumb function and appearance following treatment of Wassel type III duplication thumbs

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ABSTRACT

Objective: The purpose of our study is to evaluate thumb function and appearance after surgical correction of Wassel type III thumbs polydactyly.

Methods: We have reconstructed 28 cases of Wassel type III duplication thumbs, in which the duplicated digits were equal or almost equal in size by ablation of a radial digit. The extra thumb is osteotomized at the bifurcation level and excised except for the distal bone fragment supporting the nail bed and fillet flap. Meanwhile, the nail of the retained thumb should be reserved completely, and if the nail has relatively poor appearance it should be repaired by nail lengthening surgery. Eighteen cases were followed up for more than 3 years and were available for assessment using the Japanese Society for Surgery of the Hand evaluation form. The average age at follow-up was 5 years. The size of the nail and distal phalanx was measured to assess the growth of the thumb.

Results: An average functional point was 12 points (maximum 14 points) and the cosmetic score averaged 3.6 (maximum 4 points) after the assessment. Slightly small nails without a central ridge were deemed acceptable. Second revision surgery is seldom. Long-term results after surgical reconstruction for duplication thumbs were excellent, and all patients and parents were satisfied with the cosmetic and functional results.

Conclusions: This procedure is a helpful and effective way to provide functional and aesthetical thumb for Wassel type III duplication thumbs.

1. Introduction

Thumb polydactyly is a relatively common congenital hand abnormality. In 1969, Wassel provided a simple, effective classification system for the different phenotypic variations in radial polydactyly based on the level of skeleton duplication [1]. Wassel type III duplication thumbs occupies a certain proportion in it and is one of the difficult types for reconstruction surgery, especially in these duplication thumbs that are equal or almost equal in size.

The aim of surgical intervention that addresses duplication thumbs is to obtain a stable, mobile thumb of appropriate shape and adequate size. Dijkman et al. recommended a reliable assessment system—the Japanese Society for Surgery of the Hand (JSSH)—to evaluate functional and aesthetic outcomes after surgery for radial polydactyly by comparing several assessment systems [2]. Based on the Wassel classification and JSSH assessment system, the purpose of our study is to introduce our technique that can maintain stability of the IP joints and appearance with acceptable results.

2. Methods

2.1. Surgical technique

Under general anesthesia, a new clinical evaluation, including the size of the nails of the two thumbs, and the passive mobility of the metacarpophalangeal (MCP) and the interphalangeal (IP) joints, was measured by one of the authors. After a zigzag skin incision and subcutaneous dissection (Fig. 1A), we removed the entire nail of the radial thumb and delimited an ungual soft tissue flap harvested from the radial edge. The nail of the ulnar thumb duplicate was therefore totally preserved. If the nail of one of the thumbs is more than 70% of the contralateral normal, thumb nail width, it is retained in its entirety with excision of the other nail [3]. When the nail width is less than 70% of the contralateral normal, a nail lengthening surgery is needed [4]. Depending on the length of the contralateral fingernail, we designed a small rectangle excision whose size ranges between 2 and 3 mm, and the distance from the distal border of the eponychium is about 5 mm (Fig. 1A). At the level of subcutaneous vascular network,

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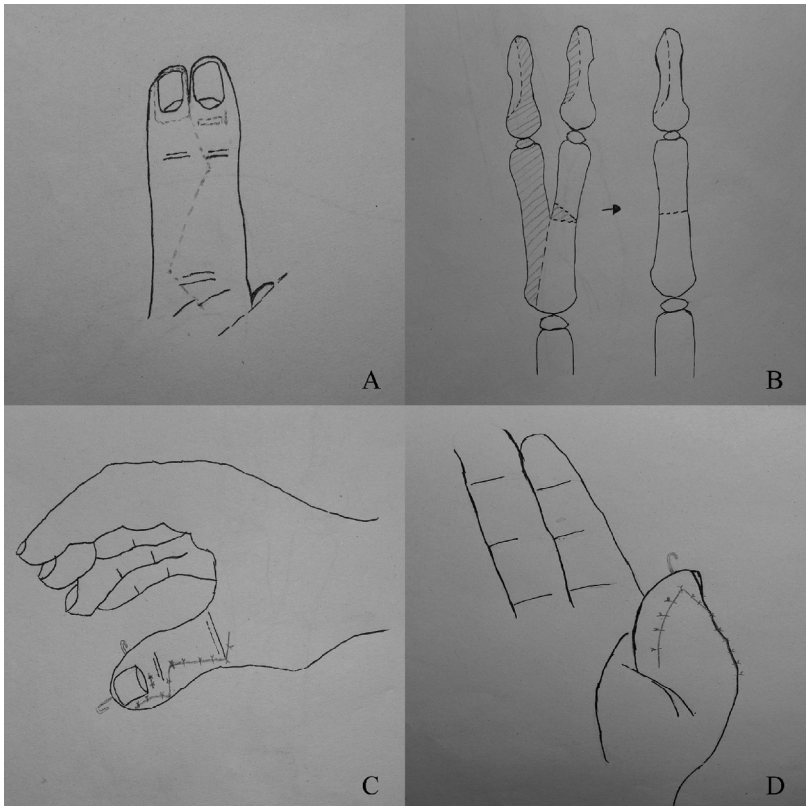

Fig. 1. Schematic depiction of surgical techniques. (A) A zigzag incision on the thumb and a small rectangle excision in nail lengthening surgery if the nail width is less than 70% of the contralateral normal. (B) A wedge osteotomy is performed to correct the angular deformity and the distal bone fragment from supernumerary thumb is supporting the nail bed and making the distal phalange bigger and wider. (C) Skin closure was performed and the Kirschner wire fixed in osteotomy site. (D) Skin closure on the volar.

the rectangle site was de-epithelialized. After a small retractor separated the eponychium from the nail matrix, we could slide the eponychial flap proximally and suture two ends by PDS® 6.0.

The radial ligament and periosteum from supernumerary thumb should be spread apart gently but ended in the distal bone fragment supporting the nail bed and fillet flap to augment the retained ulnar duplicate. The extra thumb is separated and osteotomized at the bifurcation level and the distal bone fragment attached ligament and periosteum is fixed to retained thumb bone whose distal radial bone piece was excised and then a suitable Kirschner wire should be used to fix them. When the angular deformity of the interphalangeal joint is >30° [5,6], a corrective closing wedge osteotomy is performed at the proximal phalanx of the retained thumb, and the osteotomy site is held by advancing the transarticular Kirschner wire (Fig. 1B). If the angle of the IP joint was greater than 20° but less than 30°, the radial collateral ligament restoration was done, as a small amount of angulation at the IP joint can be corrected by transferring the soft tissues from the radial digit.

We then proceeded to suture the periosteum to the bone using PDS® 5.0 sutures. We concluded with reinsertion of the extensor apparatus and the flexor pollicis longus tendon with stitches at the metaphysis. Skin closure of the radial flap was performed with separate stitches using PDS® 6.0 (Fig. 1C and 1D). The thumb was immobilized and protected within a light plaster support for 4 weeks after surgery. All procedures were performed by the same surgeon and two assistants.

2.2. Demographics

Between 2010 and 2012, twenty eight patients presenting type III thumb duplication were operated in our department (Fig. 2A). There was one case who had a family history of thumb polydactyly in first-degree relatives. Five cases with extra thumb obviously smaller than the other were treated by an ablation of the smaller digit. And four cases did not follow up over 3 years. The above 10 cases were excluded from this study. The remaining 18 cases included 12 duplication of the right thumb and 6 duplications of the left. The median age at surgery was 12 months (range: 6 months–35 years) including two adults surgeries. Ten were male. In all the cases, patients should have 2 digits with equal or almost equal size and anteroposterior x-rays of the thumb were done.

The 18 patients operated with this technique were followed up for a mean of 47 months (range: 36–60 months). The clinical results were assessed functionally and aesthetically using an evaluation form for duplication thumbs provided by the Japanese Society for Surgery of the Hand (Table 1). Functional assessment outcomes, including abnormal alignment, instability, active flexion, and extension lag at the level of the IP and MCP joints, as well as palmar abduction at the level of MCP and CMC joints, were measured and scored. Although aesthetic assessment is subjective, it is also an important measure of the success of the procedure. Cosmetic evaluation was done in terms of surgical scar and nail deformity. The maximum width and the length of the fingernail were measured and compared to the other side. The result was considered excellent if the score was 20, good if the score was greater than 16 points, fair if the score was between 14 and 16 points, and poor if the score was less than 13 points. The study was approved by our hospital and oral patient consent was obtained.

3. Results

There were no early postsurgical complications in all cases (Fig. 2B). A detailed outcome is shown in Table 2. There was no secondary surgery in 18 patients until now. In six cases, the oblique wedge osteotomy of the proximal phalanx had been done. Fifteen cases had relocated surgery of flexor pollicis longus (FPL) tendon

Fig. 2. (A) Preoperative radiographic evaluation of Wassel type III polydactyly, the duplicated digits were equal or almost equal in size. (B) A radiographic evaluation and the outcome of appearance postoperatively after a 4-year follow-up.

and 12 cases had experienced extensor pollicis longus (EPL) augmentation surgery. The total point score averaged 18.1 (maximum 20 points). Sixteen cases were rated good and 2 cases fair.

The functional point score averaged 12.3 (maximum 14 points). Stability and alignment of the MCP joint and abduction of the thumb were good in all cases. Less than 17° of malalignment at the IP joint was observed in cases 4, 8 and 13. Less than 12° of instability of the IP joint was observed in cases 5 and 10. Flexion motion was restricted to 60% of the other side in 3 cases (cases 12, 15 and 18). In another four cases (cases 7, 11, 13, and 16), less than 30° of extension lag was observed.

The cosmetic point score averaged 3.8 (maximum 4 points). No severe nail deformity was observed, and the surgical scar was acceptable, but a small thumb was present in 3 cases (cases 8, 11, and 16). The average nail size in comparison to the other side was 88% in width and 91% in length.

In total, the patients and parents were contented with the aesthetic and functional outcome of the surgery.

Table 1
Scoring system for thumb duplication provided by the Japanese Society for Surgery of the Hand.

Functional	Points		
	2	1	0
Abnormal alignment			
IP	<5°	6~20°	>20°
MCP	<5°	6~20°	>20°
Instability			
IP	<10°	11~19°	>20°
MCP	<40°	41~59°	>60°
Active flexion			
IP + MCP	<90°	60~90°	<60°
Extension lag			
IP + MCP	0°	<30°	>30°
Palmar abduction			
MCP + CMC	<60°	31~59°	<30°
Cosmetic	Points		
	1		0
Size	Acceptable		Unacceptable
Finger pulp/nail	Acceptable		Unacceptable
Surgical scar	Acceptable		Unacceptable
Bulging	None		Prominent
Subjective	Points		
	1		0
Pain	None		Pain
Satisfaction	Yes		No
Total	Points		
Excellent	20		
Good	17~19		
Fair	14~16		
Poor	0~13		

IP: interphalangeal joint; MCP: metacarpophalangeal joint; CMC: carpometacarpal joint.

4. Discussion

Thumb polydactyly is a common congenital hand deformity and it represents a physical and emotional problem as the psychological burden behind owning an extra finger is always linked to psychosis in adulthood [7]. With the help of surgical procedure, most of the patients and parents were satisfied with cosmetically and functionally acceptable retained thumb and their prime psychological concern could be removed. However, reconstruction of duplicated thumb still remains a challenge for hand surgeons to achieve his/her greatest potential and to minimize or eradicate any functional and cosmetic disadvantages. And from the view of hand function in tip pinch and tripod pinch strengths, patients with type III duplicated thumbs had significant differences when compared to patients with nonsurgical and surgical thumbs [8]. Thus the careful reconstructive surgery is almost always indicated.

Simple amputation of the smaller supernumerary thumb was used long time ago. However, many subsequent reports emphasized the shortcomings of this technique, including hypoplasia and instability of the joints [9,10]. Therefore, simple excision is not recommended in treating Wassel type III duplication thumbs especially those with equal or almost equal size in terms of thumb length, mobility, strength and stability.

The reconstruction techniques including simple ablating the bony elements of extra thumb and using a ligamentous periosteal flap from the ablated thumb to augment the remained thumb had been reported [11]. Although this method removed the bony elements and strengthened centralization of the retained phalanx, the remaining thumb would have malalignment without osteotomy correction.

Bilhaut-Cloquet procedure, which is a bilateral thumb reconstruction, combines equal longitudinal components of each thumb to achieve greater size and stability, albeit at the cost of loss of some mobility, nail deformity, and growth disturbance that appeared to bridge the growth plate of the larger distal phalanx [12].

Several modifications have been reported to overcome reconstructed disadvantages. Take the modified Bilhaut-Cloquet procedure for example; this modification could preserve IP joint motion but also present a bifid appearance in the fingernail [13]. Meanwhile, it is also difficult to solve the problems about inherently unstable IP joint.

In order to preserve the nail appearance, many methods have been used to repair the nail. Iwasawa et al. reported excellent meticulous results to suture the nail bed and fill the nail using a small piece of cortex from the excised phalanx to extend the nail width

Table 2
Summary of patient data.

Case	Gender	Affected site	Age at surgery	OWO	EPL	FPL	NLS	Follow-up age (y)	Functional points (14 points)	Cosmetic points (4 points)	Pain and satisfaction (2 points)	Total (20 points)	Nail length (%)	Nail width (%)
1	M	R	6 m	–	+	+	+	4	13	4	2	19	91	90
2	F	R	8 m	–	+	+	–	5	12	4	2	18	90	88
3	M	L	13 m	+	+	–	+	3.5	13	4	2	19	95	92
4	M	R	9 m	–	+	+	–	4.5	11	4	2	17	88	85
5	M	R	16 m	+	+	–	–	3.8	13	3	2	18	89	85
6	F	R	12 m	+	+	+	+	5	12	4	2	18	93	89
7	F	R	7 m	–	–	+	–	4	12	4	2	18	90	85
8	M	L	10 m	–	–	+	–	5	11	3	2	16	90	88
9	M	L	24 m	+	+	–	+	4.2	12	4	2	18	94	91
10	F	R	9 m	–	–	+	–	3	13	4	2	19	88	86
11	M	R	6 m	–	+	+	–	5	13	4	2	19	89	84
12	M	R	12 m	–	–	+	+	3.8	12	4	2	18	95	92
13	F	L	11 m	–	+	+	–	3	11	3	2	16	90	85
14	F	R	28 m	+	+	+	+	4.5	13	4	2	19	92	90
15	F	L	5 y	–	–	+	–	5	12	4	2	18	88	85
16	M	L	10 y	–	+	+	+	3	13	4	2	19	94	90
17	M	R	35 y	+	+	+	+	3.5	13	4	2	19	95	92
18	F	R	27 y	–	–	+	–	5	13	3	2	18	93	90

OWO: the oblique wedge osteotomy of the proximal phalanx; EPL: extensor pollicis longus augmentation surgery; FPL: flexor pollicis longus reinsertion surgery; NLS: nail lengthening surgery.

[14]. However, this surgical correction would pay the price for damaging the nail bed. Horii et al. reported the surgical outcomes by excising the radial thumb with augmentation [15]. One complete nail was preserved and the width of distal phalanx was added. The features of their technique without nail deformity, however, restricted IP motion and existed double proximal phalanx. Many patients and parents would worry about the residual proximal phalanx from the perspective of psychological trepidation.

Our technique could preserve not only in IP joint and in the appearance to treat type III duplicated digit in the large extent. We used the nail lengthening operation to improve the aesthetics of the nail when the length is lower than 70% of the other thumb. To increase the motion of IP joint and avoid damage, we performed an oblique wedge osteotomy and selected the distal bone fragment affiliated periosteum and ligament from the extra thumb to strengthen the preserved thumb. The size of distal phalange could become bigger and wider. Patients and parents were satisfied with the function and appearance after long term follow-up.

Three cases complained about the reconstructed thumbs after surgery as the relatively smaller thumb was visible when compared to bilateral thumbs strictly. The drawbacks of our methods were a few extra extended operation time and the meticulous dissection of the thumb.

5. Conclusion

Reconstruction of radial polydactyly is a rewarding intervention and our method is a useful and reliable method for reconstructing type III duplicated thumb with satisfactory cosmetic and functional outcomes.

Conflicts of interest

The authors report no conflicts of interest.

Ethical approval

No ethical approval was necessary.

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Author contribution

Dong Han: Operation surgeon; Haifeng Zhang: writer and data collectors; Zijing Du: the assistant in Operation; Hao Jiang: revisor; Qingfeng Li: advisor

Guarantor

Dong Han

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