

Recent Trend of Surgery for Thumb Polydactyly —Plastic Operation Using the Removed Thumb as Fillet Pedicle—^{*)}

Shoichi WATARI, Keiko OKADA, Tadashi UMEDA
and Hiroyuki INOUE

*The Department of Orthopedic Surgery, Hiroshima University School of Medicine, 1-2-3, Kasumi,
Minami-ku, Hiroshima 734, Japan*

(Received March 23, 1984)

Key words: Thumb polydactyly, Surgical procedure, Fillet pedicle, Hand malformation

ABSTRACT

The operation method for thumb polydactyly has developed from simple removal, and it has become the standard procedure at present to collect parts to be used from each of the components and reconstruct one thumb. Traditionally this has been accomplished by the bisecting and joining procedure, known as Bilhaut-Cloquet's method, for the distal phalangeal type, and by the extended bisecting and joining method for the proximal phalangeal type. However, these procedure are technically difficult, and the cosmetic and functional prognosis have not been so good. Undoubtedly, the cause of this is that hard tissue like phalanges and nails are joined together, and recently the tendency is strong to avoid joining such tissues as much as possible. The authors have since 1981 performed plastic operation by a modified method of the traditional bisecting and joining method, in which we remove one of the components and use the removed digit as a fillet. As the result, it has been found that our method not only makes the traditional method wholly unnecessary for the distal phalangeal type but also gives far better results than the past method for the proximal phalangeal type. Nevertheless, there are still cases that have to be treated by the traditional bisecting and joining method, and where to set the point of tangency of the methods will be a problem to be resolved in future.

INTRODUCTION

Thumb polydactyly is the most frequent among the congenital abnormalities of the hand, and because surgical treatment of it is highly effective in improving appearance and function, it is one of the surgical techniques attracting the highest interest in the field of hand surgery.

The history of surgery for this abnormality is not known for certain, but undoubtedly, from the character of the congenital abnormality, simple removal of the visually excessive digit had been conducted immediately after birth. Amid such a trend, what had established surgery for this abnormality as a modern surgical technique is believed to have been the

“bisecting and joining” procedure known as Bilhaut-Cloquet's method¹⁾. Whereas the trend until then had been to conduct what may be called a “subtracting” surgery from the view that “an excessive digit exists in polydactyly and it only needs to be removed,” this may be said to have been an epochal method introducing the “addition” concept of making a new thumb with the tissues from the two polydactylous components. Although new methods have been devised and added from time to time subsequently, this idea for surgery of thumb polydactyly has been succeeded to and is still followed today. In particular, even if the abnormality is the proximal phalangeal type, in case there is no difference in the size and

^{*)} 渡 捷一, 岡田恵子, 梅田 整, 井上博幸: 母指多指症手術に対する最近の動向——切除側を皮弁として形成する方法について——

growth of the two components and it is not possible to keep only one of the components, the so-called "extended bisecting and joining" method, in which the bisecting and joining employed in the distal phalangeal type is extended to the proximal phalangeal level has come into the spotlight recently. However, this also has its demerits. A number of problems have been mentioned, such as bad shape of the finger tip, especially the nail, impaired movement of IP and MP joint, and development of secondary deformities which are very difficult to control, for which no satisfactory methods of solution have as yet been presented. However, since these demerits are due to joining of hard tissues like the nails and phalanges, it should be possible to rectify them to a considerable extent by using the nail and phalanges of just one of the components and making morphological adjustments using the other component as a fillet. Therefore, the authors have, since 1981, made all surgical procedures for thumb polydactyly by removing one component and using it as a fillet pedicle. As the cases treated by us have exceeded 50 at the end of 1983, we wish to present them with a comparison of their types in relation to the surgical techniques employed.

CASES

Wassel's classification²⁾ shown in Table 1, is the most well known morphological classification of thumb polydactyly. It is a major characteristic of this classification that type VII having three phalanges in one or both of the components has been separated and made independent from type I-VI having two phalanges in each component. This type VII polydactyly is very interesting as it suggests the pathogenesis of this abnormality, but generally it still seems to be rare and very difficult to treat. However, study of this type has made progress in recent year, it is already known that there are, by the side on which the three phalanges exist, cases with those only on the radial, cases with those only on the ulnar, and cases with those in both components, and that, by the level of bifurcation, the types vary from metacarpal to distal phalangeal. These are by no means rare frequencywise, and cases with three phalanges in the radial component in particular are routinely seen at a high frequency³⁾. Also this type is easy to treat and operative procedure is not different from that of type IV presenting hypoplasia in the radial component.

Accordingly, in this report which purports to discuss the surgical technique, Wassel's classifi-

Table 1. Classification of thumb polydactyly

By Roentgenographic findings, the method of classification are various, it being made by the bifurcation level, by the type of bifurcation, and by the number of phalanges composing the polydactyly

Wassel's class.	I	II	III	IV	V	VI	VII
Bifurcated level	Distal phalangeal		Proximal phalangeal		Metacarpal		Dist. Proxim. Metac.
Number of phalanges	2-phalangeal						3-phalang.

Table 2. Cases experienced

The cases have been classified according to the conventional classification

Clinical cases	
A. Common type	42 hands
(Wassel's I-VI type, VII type which has three phalanges in the radial component)	
1. Distal phalangeal type	16
2. Proximal phalangeal type	22
3. Metacarpal type	4
B. Rare type	8 hands
(Wassel's VII type which has three phalanges in the ulnar or both components)	
C. Rudimentary type	2 hands

classification has been further simplified and divided into three types, i. e., common type, including types I-IV and type VII having three phalanges on only the radial side for which typical treatment is performed, divided by level of bifurcation into three types; distal phalangeal type, proximal phalangeal type and metacarpal type; rare type, comprising the two remaining types of type VII; and rudimentary type which is not in Wassel's classification, a type in which hypoplasia has progressed in the radial compo-

nent and there is no longer any relation of bone and joint with the ulnar component. The number of cases of each type is as shown in Table 2. (Table 1, Table 2)

OPERATION METHODS

A. Common type

a. Distal phalangeal type

As evident by the fact that Bilhaut-Cloquet's method is employed for this type, the purpose of operation is plasty of the thumbtip and same technique is indicated for other type of polydactyly when the surgery extends to the thumbtip. This technique therefore is an important one playing the main role in the cosmetic part of operation for the thumb polydactyly. This type includes that which shows fusion of the nails or two independent ones but in both cases the polydactylous components either are of the same size or hypoplastic on the radial component. Therefore, as shown in Fig. 1, it is the radial side that should be removed and a fillet is made with this.

Skin incision is made as shown in Fig. 1, and the distal phalanx is resected as shown in

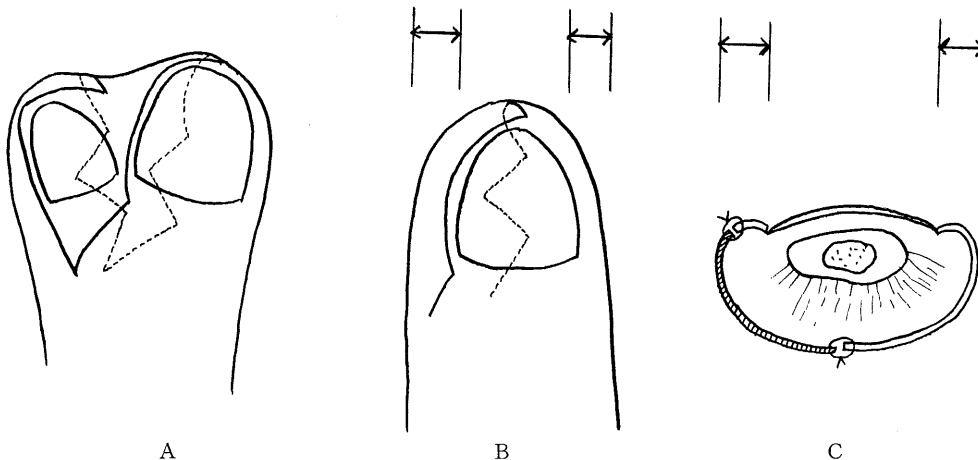


Fig. 1. Operation procedure for distal phalangeal type

A. Skin incision

B. Appearance upon completion of suture

The fillet replaces an extensive area, crossing the middle of the fingertip to the other side. The size and thickness of the soft tissues on both sides of the nail are adjusted so far as to be equal on the radial side (shown with arrow in the figure). The dorsal suture line preferably should be simple but zigzagging is done thoroughly on the volar side.

C. Cross section of thumbtip

The part shown with oblique lines is the fillet. It is necessary to replace nearly half of the thumbtip with the fillet in order to reconstruct the buldge of soft tissues on both sides of the nail and a natural shape of thumbtip is obtained by this.

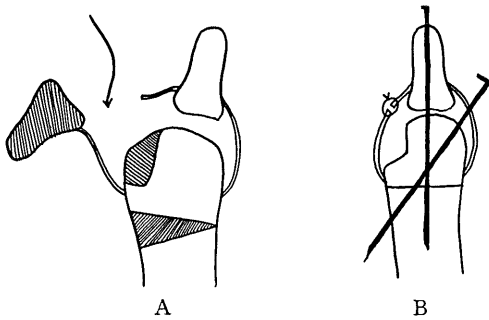


Fig. 2. Operation procedure for distal phalangeal type

A. The radial component is removed. At this time, incision to the joint capsule is made from the part that is in contact with the two distal phalanges and the radial joint capsule is cut from inside of the joint. This is necessary in order to facilitate restoration of the joint capsule. The proximal phalangeal head is removed, leaving only the part opposing the ulnar component. Then, the joint axis is corrected by correction osteotomy of the proximal phalangeal neck. (The excised parts are shown with oblique lines.)
 B. Appearance inside upon completion of operation

Fig. 2-A. Care should be taken at this time to divide so that the radial joint capsule can be enough restored, that is, to leave only the articular surface of the proximal phalangeal

head where it oppose the ulnar distal phalanx. Then, correction osteotomy of the neck of proximal phalanx is performed and the deviation of IP joint is corrected. What is most important in making and suturing the fillet is to make the bulge on the left and the right side of the nail symmetrical, as shown in the cross section of the thumbtip in Fig. 1-C. This

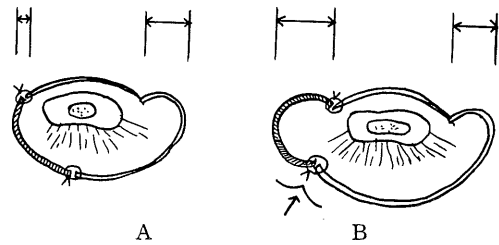


Fig. 3. Unsatisfactory results likely to remain after reconstruction of thumbtip with fillet

A. The width of soft tissues besides the nail is unequal between the left and right side, and viewed from the dorsal side the thumbtip appears distorted. This is liable to occur when the fused nail is bisected or when the fillet is too small. (The fillet is shown with oblique lines.)
 B. Contrary to A, the width is wider on the side the fillet has been sutured. In such a case, the volar suture line becomes constricted and protruded. This is liable to occur when the volar suture line is too simple. A zigzagging suture line always has to be made.

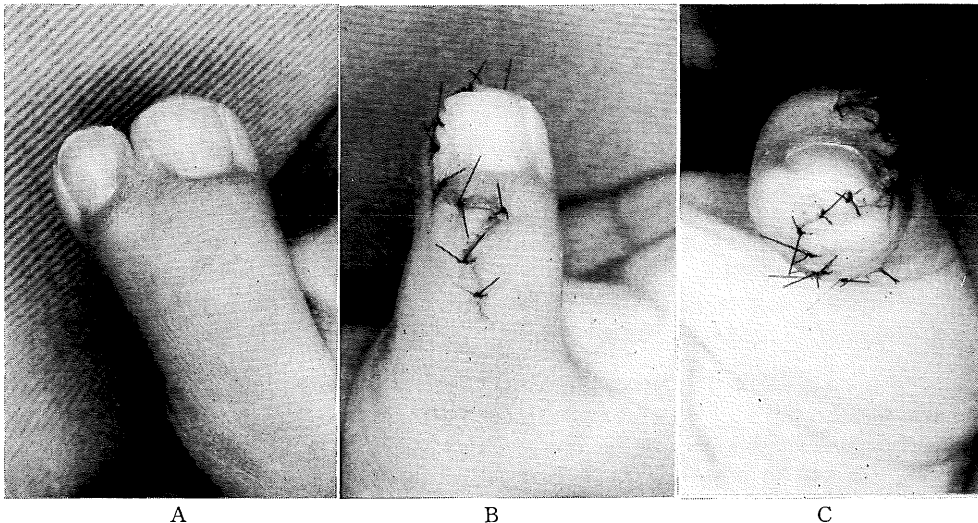


Fig. 4. A case operated on for distal phalangeal type

A. Preoperative appearance
 B. Appearance upon completion of operation
 C. Axial view of the thumbtip.
 A large fillet has been sutured. The bulge on the radial side of the thumb has been reproduced well.

reconstruction of the bulge on both sides of the nail is, in case of removal of one side, the greatest cosmetic point of this method, equal to the reconstruction of nail in the bisecting and joining procedure. Unsatisfactory results as shown in Fig. 3 are caused by this procedure. That is, the soft tissues on the separated side of the nail becomes flat when the sutured fillet is too small or the fused nail is bisected. There are cases to the contrary in which the side of the nail protrude and volar suture line becomes constricted. The fillet being too small is a cause of this but the volar suture line being too simple is also a major cause, and the suture line here requires much zigzagging as shown in Fig. 1-B. The fillet should be so large that it occupies half of the radial side on the volar aspect, and it crosses the center and extends into the ulnar side at the thumbtip. Also, the design has to be accurate to preclude the volar skin of the fillet from intruding into the dorsal

skin of the recipient site and contrarily the dorsal skin of the fillet from intruding into the volar skin of the recipient site.

Fig. 4 shows the appearance in a case immediately after plastic operation by this method.

b. Proximal phalangeal type

This type of polydactyly which is the most frequently observed routinely is that with hypoplasia of the radial component. Roentgenographically, the type is Wassel IV and in some cases it is type VII with three phalanges in the radial component, but no clear distinction can be made between the two on X-ray. This is because, even though an interposed phalanx is present in the radial component and it is three phalangeal, no ossification is yet present and roentgenographically it has to be classified as two phalangeal. If the polydactyly of this type were to be left neglected until completion of growth, the percentage accounted for by type VII would probably be extremely high.

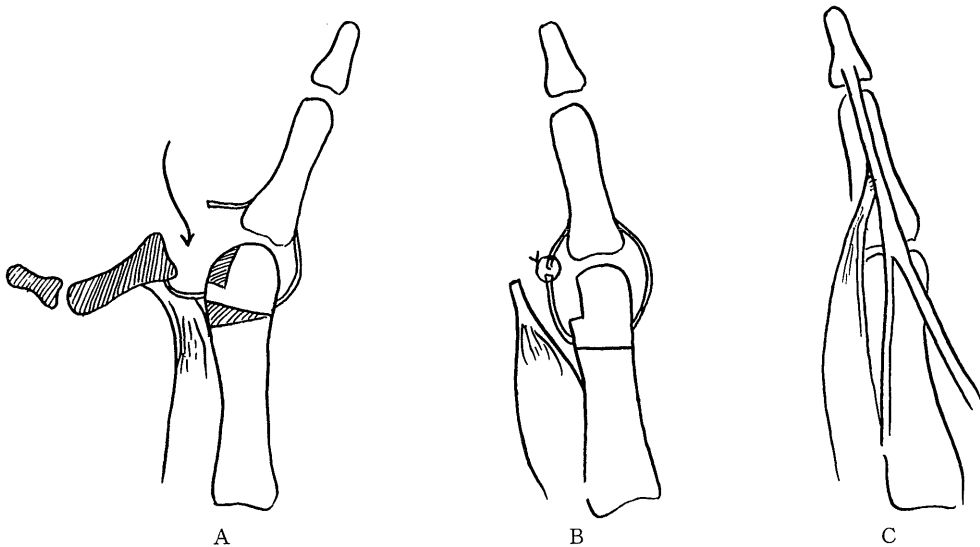


Fig. 5. Operative procedure for proximal phalangeal type presenting hypoplasia of radial component

1) Treatment of internal structure

A. The phalanges of the radial component are removed. At this time, incision of the joint capsule is made from the part that is in contact with the proximal phalanx and the radial joint capsule is cut from inside of the joint. At that time, the thenar muscles, comprising mainly the abductor pollicis brevis muscle, which is attached to the base of the proximal phalanx of the radial component, is detached subperiosteally. The metacarpal head is excised leaving the part opposing the ulnar component and the joint axis is corrected by osteotomy of the metacarpal neck.

B. The appearance upon completion of repair of MP joint capsule and correction osteotomy is shown.

C. The thenar muscle which has been detached earlier is divided proximally and advanced distally. Then, it is transferred to the extensor pollicis longus tendon, going beyond expansion hood. This means is indispensable for preventing ulnar deviation of the MP joint and for stabilizing the thumb.

Generally, the radial component presenting hypoplasia has been removed, and there have been no particular problems. That is, as shown in Fig. 5, after removal of the radial component, the MP joint is reconstructed and joint axis is corrected by osteotomy of the metacarpus; then transferring the abductor pollicis brevis muscle, the wound is closed by zigzag suture. This is the common procedure and we also have employed it regularly for many years. However, the tendency for the part distal to the MP joint to abruptly become thin cannot be avoided by this method, which appears to be lacking somewhat in the way of cosmetic effect. Plastic operation using the radial component as fillet pedicle is indeed the optimum procedure for the improvement of such a point and the method routinely used by the authors is shown in Fig. 6. However, it is troublesome and requires proficiency to make a design of such a incision, the authors have developed a simple method as shown in Fig. 7, which makes the operation easy for even beginners.

Further, the shape of the tip of the remaining

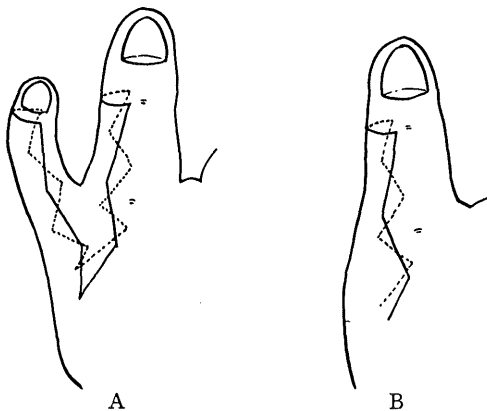


Fig. 6. Operative procedure for proximal phalangeal type presenting hypoplasia of radial component

2) Plastic method using fillet

A) Skin incision is shown. Because a zigzag suture on the dorsal side is conspicuous, it is advisable to make the suture as simple as possible on this side. However, a zigzag suture has to be made on the volar side. It does not make a conspicuous scar on this side.

B) The shape of the thumbtip is good in most cases of this type, so that the fillet had better not be filled higher than the IP joint. Such fillet transfer from the radial side is also very effective in preventing ulnar deviation of the MP joint.

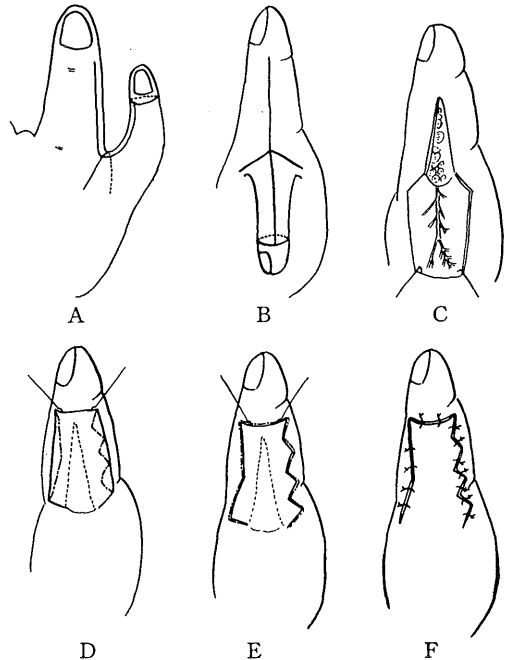


Fig. 7. Operative procedure for proximal phalangeal type presenting hypoplasia of radial component

3) Convenient method of skin incision

In typical operations which are usually the most frequently performed, the convenient incision method does not fail and can be adequately performed by beginners also.

A) Treatment of the internal structure is performed with the skin incision shown in the drawing.

B) Skin incision is shown with the radial component brought down radially.

C) Internal treatment is performed and the radial component is made into a fillet as shown. Care is taken not to damage the neurovascular bundle. D) The fillet is applied to the radial side of the ulnar component, the midlateral lines of the two are arranged properly, and the fillet is first trimmed simply on the dorsal side and then zigzagged on the volar side.

E) Next, the skin of the ulnar component is removed so as to conform to the design of fillet.

F) The appearance upon completion of suture is shown.

ulnar component is good, so that an adverse effect is produced if the fillet is applied up to the thumbtip. Therefore, it suffices if the fillet reaches as high as the IP joint. The dorsal suture line has to be made carefully, because marked zigzagging will produce a conspicuous scar. Fig. 8 shows a case operated on by this

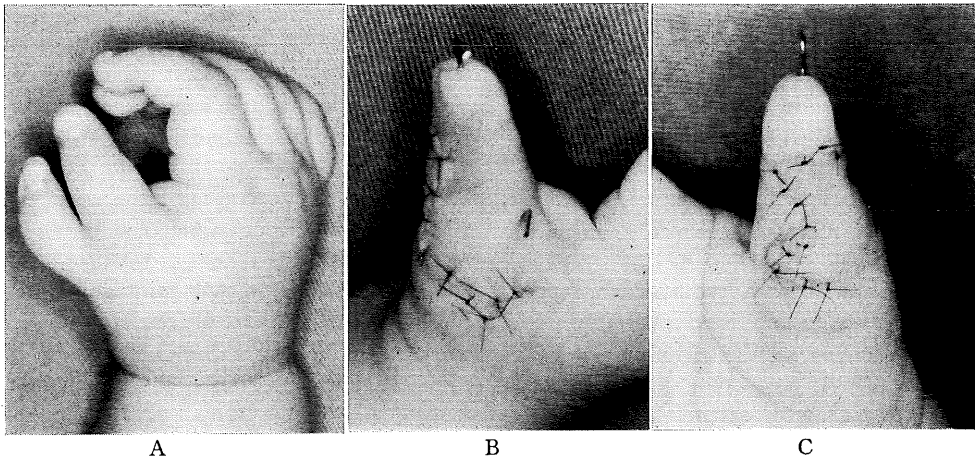


Fig. 8. Case operated on for proximal phalangeal type presenting hypoplasia of radial component
 A. Preoperative appearance
 B. Dorsal view upon completion of operation
 A simple dorsal suture line is preferable as it is inconspicuous.
 C. Volar view upon completion of operation
 The volar suture line must be a zigzagged one.

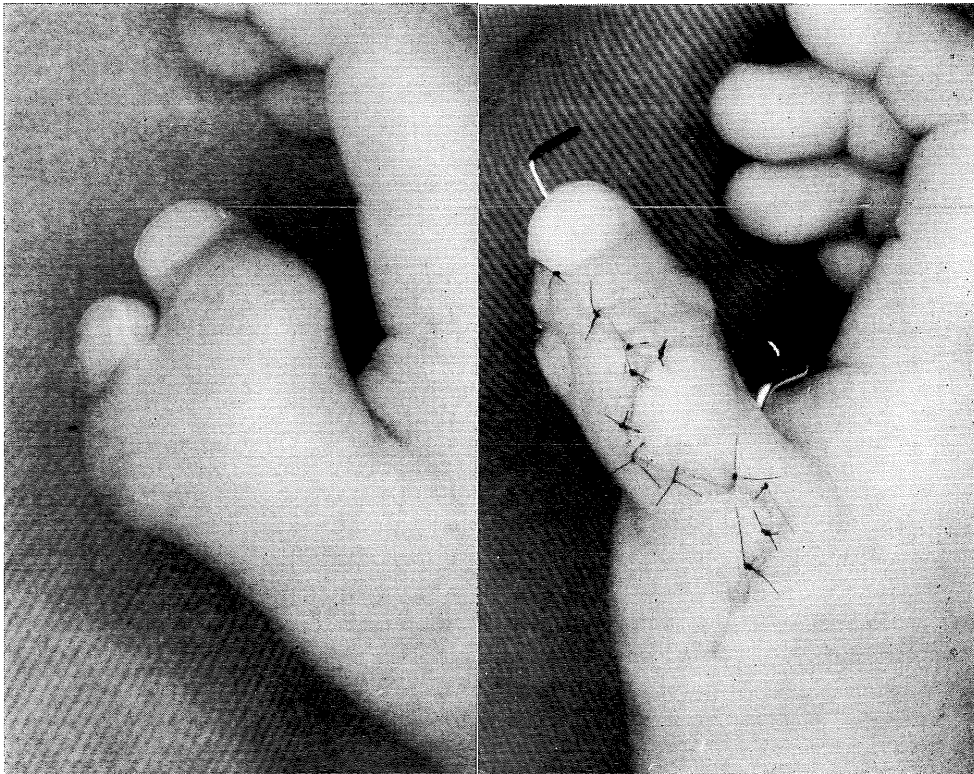


Fig. 9. Case operated on for proximal phalangeal type in which the two components are about the same size and present crab-pincers deformity
 A. Preoperative appearance
 B. Appearance upon completion of operation

method.

The proximal phalangeal type that is next most frequent and also offers many problems is the type shown in Fig. 9-A. The two polydactylous component are about the same size and the appearance of a crab's pincers is presented because they are opposed to each other showing a marked Z-deformity. Since removal of one side results in having a small nail and a thin thumb with frequent recurrence of the deformity, the top level operation for such cases, which is mainly performed in our country at present, is so-called extended bisecting and joining method, extending traditional Bilhaut-Cloquet's method for the distal phalangeal type to the proximal phalangeal type. However, this method has been very difficult technically. Moreover, the demerits of the Bilhaut-Cloquet's method has appeared far more markedly than in the distal phalangeal type, and the method has not necessarily been satisfactory from the cosmetic or functional point of view. Accordingly, the authors tried the

method of removing the radial component and using this as fillet to give thickness to the remaining ulnar component. The procedure is shown in Fig. 10 and Fig. 11. What is most important in this method is primary correction of the digital axis as shown in Fig. 10. To accomplish this, osteotomy is necessary at least two levels, in the proximal phalanx and in the metacarpus. The other procedures, such as reconstruction of the MP joint and transfer of the abductor pollicis brevis muscle, are the same as previously described. Next is the preparation of the fillet. The design of this is determined by the shape of the thumbtip of the ulnar component that is to be left. As a typical case of this type is shown in Fig. 12, the width of the soft tissues on both sides of the nail in the thumbtip of the ulnar component is asymmetrical. That is, the aspect opposing the radial component is small, so that the fillet will have to be such that it will adequately make up for the deficiency of this part.

Fig. 9-B shows a case on which plastic

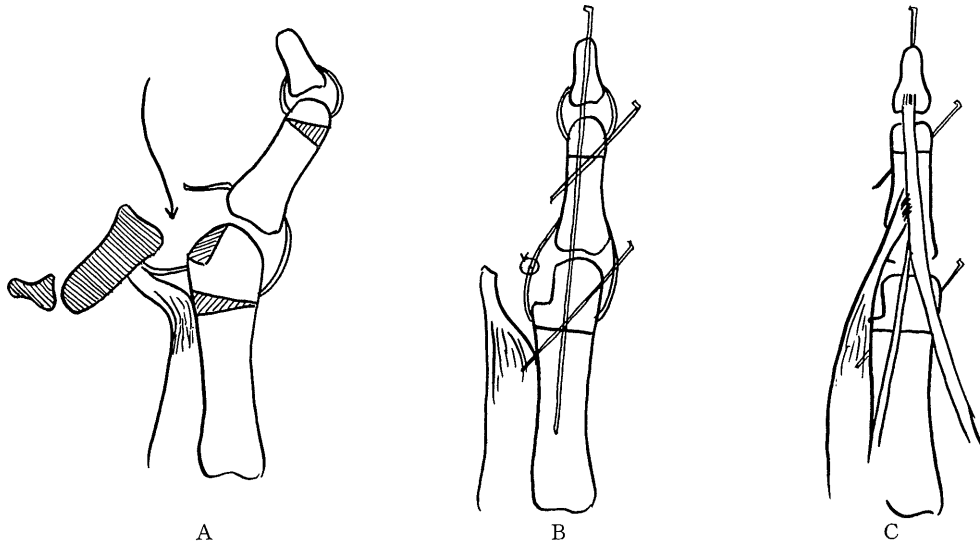


Fig. 10. Operation for proximal phalangeal type in which the two components are about the same size and present crab-pincers deformity

1) Treatment of internal structure

A) The radial component is removed. The removal method and arthroplasty of the MP joint are the same as previously described, except that correction osteotomy is performed at two levels, in the metacarpus and the proximal phalanx. At this time, osteotomy of the metacarpus preferably should be hypercorrective, but osteotomy of the proximal phalanx must be appropriate; otherwise, a counter deformity develops.

B) Appearance upon completion of osteotomy and arthroplasty.

C) Transfer of the abductor pollicis brevis muscle is performed as is conventionally done.

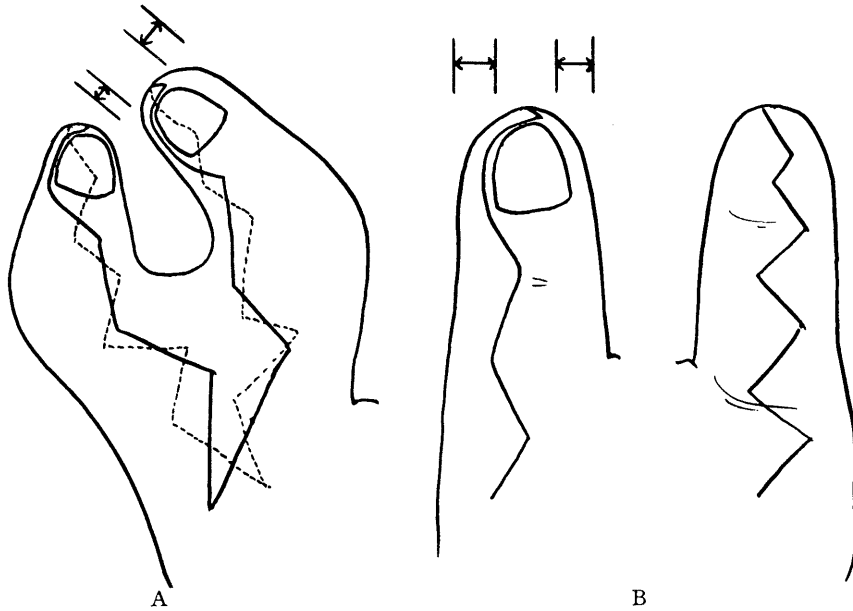


Fig. 11. Operation for proximal phalangeal type in which the two components are about the same size and present crab-pincers deformity

2) Preparing and suturing of fillet

A) Often in this type, the thumbtip of the ulnar component to be left is thin on the side opposing the radial component and is asymmetrical. Therefore, this part has to be reconstructed so that the left and right side are symmetrical. This requires that the fillet be so large as to extend beyond the thumbtip.

B) The appearance of the dorsal and volar aspects upon completion of suture is shown. The thumbtip becomes large by making the left and right side of the nail symmetrical, but a small and markedly curved nail remains.

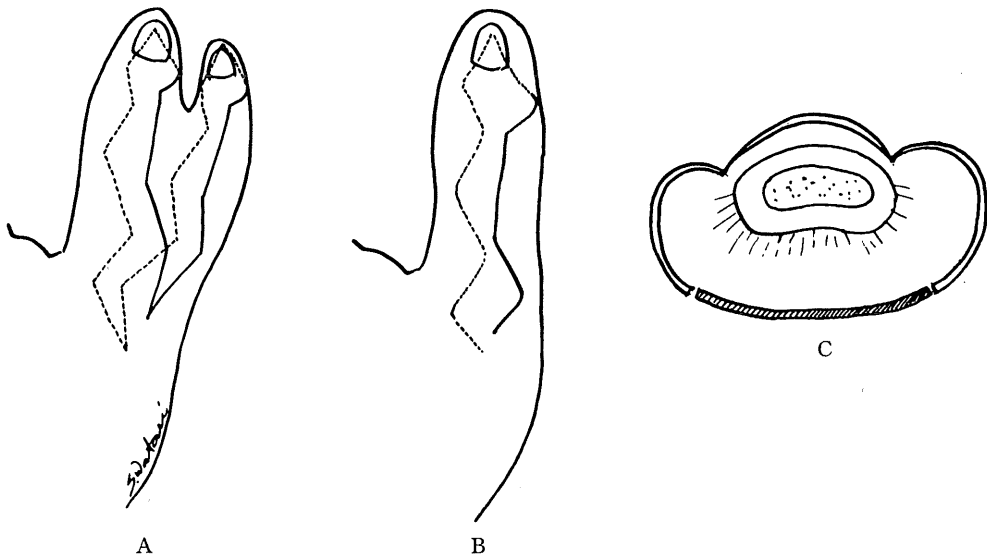


Fig. 12. Operation for proximal phalangeal type presenting hypoplasia of both components
 In such a type, not just the thumbtip but the entire thumb has to be reconstructed largely. Therefore, the volar side of the ulnar component is opened and filled with a large fillet.
 A. Skin incision is shown. Needless to say, skin resection of the ulnar component is made small and the fillet is made large.
 B. The appearance upon completion of suture is shown. Not just the thumbtip but the entire thumb is large.
 C. A cross section of the thumbtip is shown. It is seen that the fillet fills on the volar side and the thumb is distended on both sides.

operation was performed by this method. It is not denied that the nail is too small for the size of the thumbtip. However, this nail appears small because of its great curvature, and we had thought that it was possible to enlarge the nail by flattening the nail bed in the secondary operation, but the nail seems to flatten of itself with time, so we wish to observe the course for a while. Fig. 9-B shows the postoperative appearance by this method.

In such a crab-pincer type as described above, the growth of the two components is comparatively good, but when their growth becomes poor, the crab-pincer form changes and two components gradually become parallel. When this condition develops, the traditional bisecting and joining method and plastic method using fillet by removal of one component become competitive and there may be many opportunities to employ the traditional method. However, the operation is by no means impossible by the authors' method. In such a case, it is necessary to enlarge the whole ulnar component, it suf-

fices to open the middle of the volar side of the ulnar component, spread it fully apart left and right, and fill the deficiency with the fillet. The only demerit of this is that the nail is a little small; otherwise, results for excelling the bisecting and joining method can be obtained.

c. Metacarpal type

If it is a polydactyly of this type that bifurcates near the MP joint, operation is performed for cosmetic improvement according to the method employed for proximal phalangeal type using the removed radial component as fillet. Others will not be discussed here as no special problems are presented.

B. Rare type

a. Type VII polydactyly with three phalanges in the ulnar component

As shown in Fig. 13-A, it is a characteristic of this type of polydactyly that the ulnar component whose growth and function are good, is separated from the radial component and attached to the center of the first interdigital space or to the radial side of the index finger.

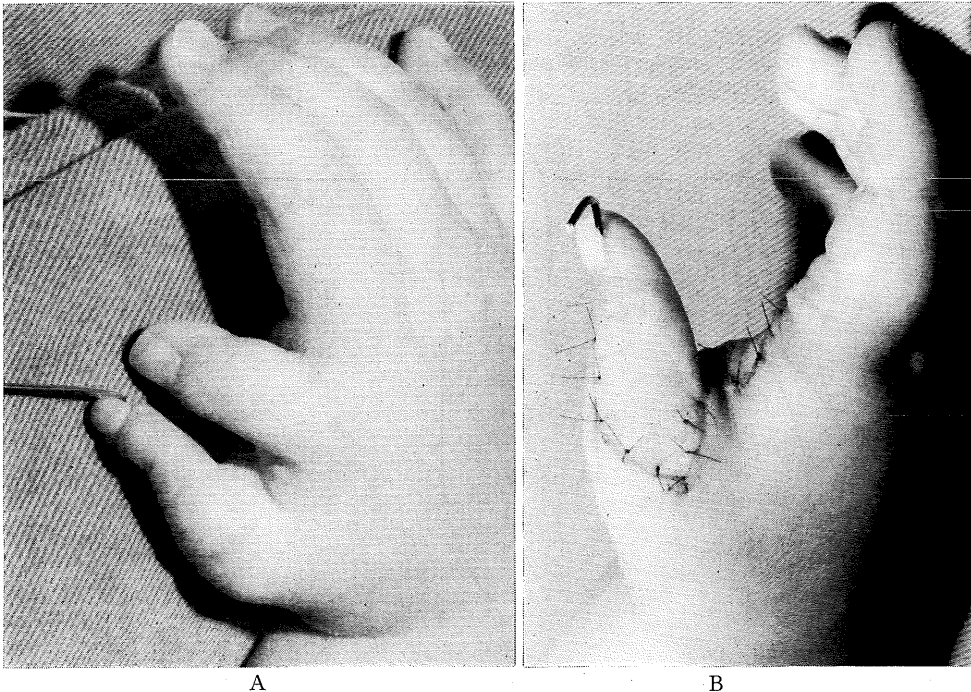


Fig. 13. Case operated on for type VII having three phalanges in the ulnar component

A. Preoperative appearance

The ulnar component is better functionally and morphologically. Moreover, it is attached closer to the index finger.

B. Appearance upon completion of operation

Digital transfer and plasty using fillet have been performed,

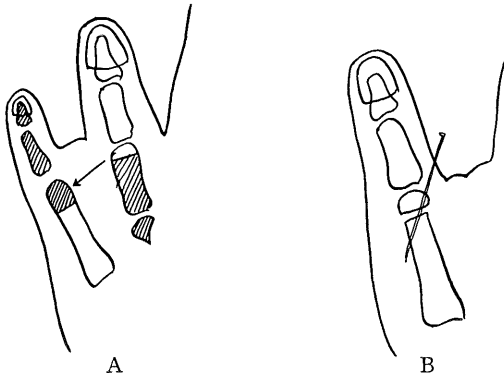


Fig. 14. Operation for thumb polydactyly by digital transfer

1) Treatment of phalanges

A. The external appearance frequently seen in case of type VII with three phalanges in the ulnar component is as shown here. The ulnar component, showing a growth that is satisfactory both functionally and morphologically, is attached to the middle of the first interdigital space or the radial side of the index finger. The parts of the phalanges shown with oblique lines in the drawing are removed and the PIP joint of the ulnar component is transferred to become the MP joint of the thumb.

B. The appearance upon completion of transfer is shown.

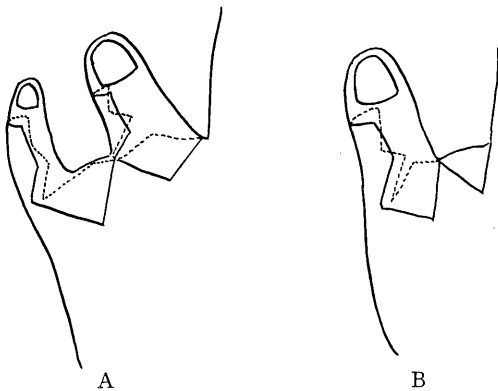


Fig. 15. Operation for thumb polydactyly by digital transfer

2) Skin incision is shown.

A. Digital transfer was made with skin incision as shown in the drawing. The flexor and extensor tendons and the neurovascular bundle become the pedicle.

B. Plasty of the radial side of the thumb using the radial component as fillet at this time is effective both cosmetically and in preventing recurrence of the secondary deformity.

In this case, digital transfer is made of the ulnar component to the radial side. The details are shown in Fig. 14 and Fig. 15. The cosmetic effect will be enhanced by using the radial component as fillet and thickening the thumb. The postoperative appearance by this method is shown in Fig. 13-B.

b. Type VII polydactyly with three phalanges in both components

In this type, hypoplasia is marked in both components and in some cases there is no alternative but to employ the extended bisecting and joining method, but secondary deformity occurs almost with certainty postoperatively by this method. Moreover, this secondary deformity is difficult to control and the postoperative prognosis has been very poor. This is because phalanges with as yet undetermined further growth or deformity tendencies have been joined together. For such cases, the authors are recently employing the above described method. That is, the phalanges of the radial component are excised and primary adjustment is made of the number of phalanges in also the ulnar component that is to be left. All necessary operative procedure, such as reconstruction of MP joint and correction of digital axis, are completed primarily, and then the fillet is sutured by the technique shown in Fig. 12 and morphological adjustment is made. Comparatively good results have been obtained by this method.

ACKNOWLEDGEMENT

The authors are greatly indebted to Professor Kenya Tsuge, M. D. chairman of the Department of Orthopedic Surgery, for his kind advices.

REFERENCES

1. **Barsky, A. J.** 1958. Congenital anomalies of the hand and their surgical treatment, 63, Charles C. Thomas, New York.
2. **Wassel, H. D.** 1969. The results of surgery for polydactyly of the thumb. *Clin. Orth. Relat. Res.* 44 : 175-193.
3. **Wood, V. E.** 1978. Polydactyly and triphalangeal thumb. *J. Hand Surg.* 3 : 436-444.