Bilobed flap for web reconstruction in adult syndactyly release: A new technique that can avoid the use of skin graft

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KEYWORDS
Syndactyly; Web reconstruction; Bilobed flap; Syndactyly repair without graft

Summary
Aim: The aim of the study was to describe the use of a bilobed flap for web formation of syndactyly release, which decreases the need for graft and also avoids the use of skin grafting in syndactyly cases.
Methods: A retrospective review of this procedure was performed for 15 web space reconstructions. Patients were aged 20–23 years. The mean follow-up period was 7–12 months (mean 7 + 3.2). The operations were performed for the beneficial use of the dorsal hand skin by lowering the need for a skin graft. The flap was on the dorsum of the hand and proximal phalanx and was used for web formation.
Results: Surgery was completed without skin grafting in nine cases of 14 web spaces; two of them were complex/complete syndactylies, and two of them were simple/complete syndactylies. We used a skin graft in one patient because of triangular flap necrosis in a second operation. The use of a bilobed flap allowed the construction of web spaces, providing satisfactory cosmetic outcomes. No partial necrosis or complications was observed in bilobed flaps. No secondary correction was needed during the follow-up period.

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Conclusion: The present surgical technique could be a new surgical option for web formation and reconstruction in primary and secondary cases, especially in an adult population in which the skin on the dorsum of the hand is more pliable.

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The goal of syndactyly release is to create a more normal web space in order to improve the function and appearance of each finger and incur the minimum amount of long-term morbidity. In syndactyly release or any web reconstruction, the use of full-thickness skin grafts is time consuming and often associated with graft contraction, web creep, partial graft loss, hyperpigmentation, hair growth following puberty and hypertrophic scarring.

This study describes the use of a bilobed flap for the formation of web spaces in the treatment of syndactyly release, which decreases the need for graft and also avoids the use of skin grafting in syndactyly release and in web reconstruction cases. The present technique was developed based on a concept of the beneficial use of the dorsal hand skin by lowering or eliminating the need for a skin graft.

Materials and methods

A retrospective chart review of all patients who underwent syndactyly repair performed by the authors between November 2010 and February 2013 was conducted. Written permission was received from all of the patients.

Patients were aged 20–23 years (mean 21.5 ± 0.9). We operated on 10 patients with 15 webs (Table 1). Ten webs were simple/incomplete syndactylies, three webs were complex/complete syndactylies and two webs were simple/complete syndactylies. We did not use a skin graft in incomplete cases, simple/complete cases and two complex/complete webs. In patient 1, who had complete/complex syndactyly, we used a skin graft for middle phalanges because of the distal part of triangular flap necrosis in a second operation. The follow-up period was 7–12 months (mean 7 ± 3.2 months).

The bilobed flap was designed for web formation on the dorsal skin of the proximal phalanx and dorsal skin of the hand. We present 10 patients, of which there were 15 web space syndactyly repairs with a bilobed flap.

Surgical technique

The procedures were performed under axillary block anaesthesia and tourniquet ischaemia. The base of the bilobed flap was designed on the dorsum of the hand between the metacarpal heads of the involved fingers, with the distal tip of the flap on one of the finger’s dorsal skin. The flap is rectangular in shape, with a 2:1 length-to-width ratio. Markings for the finger incisions are composed in a traditional zigzag fashion, creating triangular flaps, with the mirror-image incision marked on the palmar side to create interdigitating flaps (Figures 1–3). The fingers are

<table>
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<th>Table 1 List of the operated patients.</th>
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<tr>
<td>List of the patients</td>
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<tr>
<td>Patient 1: 3rd web left hand Complex, complete Graft on middle phalanx Necrosis in two triangular flap distal parts at middle phalanx (grafted)</td>
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<tr>
<td>Patient 2: 3rd web right hand Simple, incomplete Graftless No complication</td>
</tr>
<tr>
<td>Patient 3: 3rd web right hand Simple, incomplete Graftless No complication</td>
</tr>
<tr>
<td>Patient 4: 3rd web left hand Simple, incomplete Graftless No complication</td>
</tr>
<tr>
<td>Patient 5: 3rd web right hand Simple, incomplete Graftless No complication</td>
</tr>
<tr>
<td>Patient 6: 3rd web left hand Simple, incomplete Graftless No complication</td>
</tr>
<tr>
<td>Patient 7: 3rd web right hand Simple, incomplete Graftless No complication</td>
</tr>
<tr>
<td>Patient 8: 3rd web right hand Simple, incomplete Graftless No complication</td>
</tr>
<tr>
<td>Patient 9: 3rd web right hand Simple, complete Graftless No complication Delayed wound healing due to tension at two triangular flap distal parts on 3rd finger</td>
</tr>
<tr>
<td>Patient 10: 3rd web left hand Simple, incomplete Graftless No complication</td>
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separated along the zigzag incisions. The full-thickness bilobed flap is raised and the subcutaneous tissues are dissected free to rotate the flap. The deep, soft tissues are maintained as a vascular pedicle between the metacarpal heads. The fat between the two proximal phalanges is excised when required, while avoiding injury to the digital neurovascular bundles. The dorsal bilobed flap was rotated through the web space (Figure 1b). The midpoint of the tip of the flap was incised approximately 5 mm parallel to the long axis of the flap, and a palmar triangular flap was sutured here to create the volar aspect of the web (Figure 1(b) — window). In this way, the straight incision

Figure 1  Tips for drawing. (a). *: incision line to split the distal end of the flap; **: previous marking line; green line: indicates not to incise the line from here to point A. (b). Dorsal view of the bilobed flap lined on the web. *: The blue double arrow shows the tension line before modification of the drawing. Window: View of the split dorsal flap and volar triangular flap suturing each other, which breaks the straight incision line.

Figure 2  The photographs of patient 10. (a): preoperative view (b): drawing (c): post-operative 7-month view.
The triangular flaps are then wrapped around the newly separated fingers and sutured in place to completely close the skin along the sides of the two fingers. The hand is then placed in a long arm cast for a week when needed. After removal of the cast, a light dressing is placed and the patient can begin to move the fingers.

**Technical points to optimise flap design**

First, we tick the metacarpophalangeal (MCP) and proximal interphalangeal (PIP) joints, which are shown in Figure 1(a) as points A and B. Then, we divide the distance between the two joints into three equal parts. The area between the MCP joints creates the base of the flap (points A and E in Figure 1(a)). Later, we draw the first flap from these points approximately 45° to the long axis of fingers. The length of the flap must be equal to 2/3 of the proximal phalanx. One important thing is not to plan the flap narrowly. The diameter of CD (the width of the flap) must be almost equal to the diameter of AE, which is shown in Figure 1(a). Thereafter, we draw the second flap with the same thickness and length of the first flap and at an angle of about 45° to the first flap. The midpoint of the tip of the flap is marked approximately 5 mm parallel to the long axis of the flap (which is shown Figure 1(a) with *) for the palmar triangular flap to be sutured here, which creates the volar aspect of the web (Figure 1(b) — window). During surgery, we noticed much tension at a point (which is shown with a double arrow in Figure 1(b)) and made a modification to the drawing shown in Figure 1(a) with **. The blue dotted line is the line previously drawn; we do not use that drawing anymore. Because of the tension at the mentioned site, the new drawing is the purple line (Figure 1(a)). The tension problem is therefore solved with this modification. We made a new modification in the drawing. After completing the mentioned drawing, we sign the midpoint of the AC line, which comes across the point E (which is shown with a yellow line in Figure 1(a)), and we do not incise from this point to point A. Markings for the finger incisions are composed in a traditional zigzag fashion.

**Results**

There were no intraoperative complications and no cases of neurovascular compromise. There were also no incidences of bilobed flap loss or ischaemic injury. In all patients, the donor site of the dorsal flap healed with an acceptable scar formation.

All surgeries obtained the expected results. There were no intraoperative complications and no cases of neurovascular compromise. A skin graft was used later in one patient because of triangular flap necrosis. There was an epidermal necrosis in a flap and a full-thickness necrosis requiring grafting in another flap because of venous congestion and infection on the mid-phalanxes in this patient who had a complete/complex syndactyly. However, there were no observed signs of ischaemia, congestion or necrosis on the bilobed flaps in any patients. In the follow-up period, the webs were found to be thin, soft, sensitive and close to their natural appearance. Late complications, such as contractures in incision lines or web creep, were not observed. In all patients, the donor site of the dorsal flap healed with a minimal scar formation (Figures 2–4).

**Discussion**

The aim of treatment in syndactyly is to separate the fused digits, provide cutaneous cover and create a normal web space. In the past, there have been numerous techniques described for syndactyly correction. The methods have differed in respect of separation of the digits and reconstruction of the web space. It is accepted that long-term stability of the newly created web space is best achieved when the web space is reconstructed using a flap. Traditional surgical approaches to syndactyly repair have used
flaps from the dorsum of the involved fingers and dorsal and palmar interdigitating flaps. However, these flaps are dependent upon skin from syndactyl fingers already insufficient in the surface area. As a result, full-thickness or split-thickness skin grafts have often been used to cover remaining surgical defects. Most of the full-thickness skin grafts became hyperpigmented and featured hair bearing, leading to dissatisfaction in a large number of patients. On the other hand, some split-thickness skin grafts exhibited shrinkage or instability, which was also a reason for complaints by some of the patients. Besides, donor-site scarring can be an important problem for the patients. In the study by Lumenta et al., the reported incidence of web creep after syndactyl release ranges from 2% to 24%. In 17 of 24 surgical web spaces in which full-thickness skin grafts were used, patients reported hair growth in the grafted region. In the predominantly Caucasian study population (17 of 19), hyperpigmentation was noted in two cases.

To avoid complications related to skin grafts, many different methods were tried. Greuse reported closing the raw areas by applying defatting to the flaps. This can be used when needed, but it is mostly not enough to close the defects. Various flaps based on the dorsal metacarpal arterial system have been used for web formation and reconstruction, such as a proximally based flap, an island flap based on a direct cutaneous branch of the dorsomeatal artery and a reverse-flow dorsal metacarpal flap. Sheriff MM defined a V-Y dorsal metacarpal artery flap for web reconstruction, reported the experience in 12 patients and also reported that he did not use a skin graft for any of them. Aydin et al. used this flap for the correction of syndactyly as a transposition flap. Wafa AM used an hourglass design of the dorsal metacarpal artery island flap to reconstruct web syndactyly. This flap can achieve a comfortable web without a skin graft, but the procedure is time consuming, more traumatic and technically complicated. Besides, a 12% rate of scar contractures resulting from partial flap necrosis and sloughing at the palmar end of the web space was reported in this study during the follow-up period. Kumar et al. described a flap based upon subcutaneous tissue in the web, which is moved in a V−Y fashion to resurface the neo-web and which closed the donor site primarily. However, in this method, the web shape was triangular and not suitable anatomically. Furthermore, this technique leaves a linear scar along the fingers, which is not suitable according to plastic surgery principles. Gao et al. used a dorsal metacarpal artery flap designed in a pentagonal shape to reconstruct 17 web spaces in 10 patients. Moreover, he reported that he did not use a skin graft in any of the cases. Savaci et al. reconstructed the web space using two reverse V−Y island triangular flaps; this technique does not require the use of a skin graft. In this method, because of narrowing of the flaps, top and bottom webs were not similar to the normal anatomic hourglass shape. Furthermore, V−Y advancement leads to narrowing of the web apex dorsally, and scar tissue present in this area will be subjected to subsequent contracture that will lead to the limitation of web abduction. In another report, V−M plasty was used for web reconstruction. Yildirim et al. described a different technique using a combination of a dorsal separated V−Y advancement flap and a volar triangular flap. They used the dorsal skin for web formation, so they used a skin graft.

Besides these dorsal rectangular and volar triangular flaps, a dorsal seagull flap and palmar flaps were used for web reconstruction. However, all of these methods require skin grafts and carry the risk of graft-related complications. Furthermore, there are several methods described that can only be used in cases of incomplete syndactyly. Some of these flaps are triangular flaps, a web flap on a subcutaneous tissue pedicle and modification of this flap, bell-bottom flap, three-flap web plasty and ‘dancing girl’ flap. All of these techniques have advantages and disadvantages of their own.
In patients with syndactyly distal to the PIP joint of fingers, there is usually enough skin to cover the defects. However, in the complete syndactyly cases proximal phalanx side faces and web section, the skin is insufficient to cover all of the defects. Therefore, taking advantage of dorsal loose skin in adults to close the raw surfaces is a wise choice. In this way, the original quality of the skin is moved to the commissure and to the finger’s side faces without using skin grafts.

By design, the dorsal bilobed flap reduces or avoids the need for skin grafting in syndactyly repair by using skin from the dorsum of the hand, rather than the proximal phalanges, to line the web. Because this is a local flap, it offers an excellent colour, thickness and texture match to the adjacent fingers. Furthermore, there is minimal scarring after primary closure of the donor site on the dorsum of the hand (Figures 2-4).

A proximally based dorsal rectangular skin flap is the most common procedure for reconstructing web spaces. However, with this method, the linear scar along the palmar border of the web space may lead to secondary contracture and web creep, and modifications have been recommended for this procedure. We have used the split dorsal rectangular skin flap as the first flap of bilobed flap to minimise the risk of web creep and scar contracture (Figure 1).

Traditional surgical approaches to syndactyly repair have used flaps from the dorsum of the involved fingers and dorsal and palmar interdigitating flaps. However, these flaps are dependent upon skin from syndactylic fingers already insufficient in the surface area. This study reported favourable outcomes obtained using a bilobed flap for the surgical correction of syndactyly. In the repair of syndactyly, long-term stability of the newly created web space is best achieved when lined with well-vascularised native skin. This technique can provide syndactyly repair without a skin graft. Operation time is shorter than the classical technique, which needs to use a skin graft. Moreover, it is possible to reconstruct multiple webs in the same patient with this flap. We released four web spaces (two of them were complete syndactylies) with bilobed flaps in patient 8 and did not use any skin grafts (Figure 4).

Figure 5 shows the flap designs when two or more neighbouring web spaces are to be released using this technique. The result is very satisfactory both functionally and aesthetically. Syndactyly repair using the bilobed flap is a simple and reliable operation. The design of the flap and the subsequent procedure are technically straightforward. The vascular supply of the flap is good. In this series, there were no incidences of bilobed flap loss or ischaemic injury. We recommend its use for all types of syndactyly and for web reconstructions or formations. With no intraoperative complications and few late complications, this technically simple and reliable procedure improves upon previous approaches to the surgical reconstruction of syndactylies.

In this series, the bilobed flap offered adequate soft-tissue coverage without a skin graft in all syndactyly cases except for patient 1 (a skin graft was used because of triangular flap necrosis, not bilobed flap, in a second operation) (Table 1). In this series, the average operative time was shorter compared with an average operative time of syndactyly repair with a skin graft. The disadvantage of this flap is the presence of scarring on the dorsum of the hand. This technique is better in adult syndactyly cases because of the pliable dorsal hand skin. The scar found in the present study was acceptable. However, scars on the dorsum of the hand are known to settle down well and they were barely noticeable 6 months after the operation. Rather than messing about with complications of the graft, the scar on the dorsum of the hand seems to be more convenient. The limitation of our study included the fact that the average follow-up period was only 7 months. This is because all of our patients were soldiers. Therefore, after they finished their military duty, they did not come to controls. There was no case of web creep during this period, and only one patient required a secondary operation (patient 1, Table 1).

Figure 5  The design of the flap when two or more neighbouring web spaces are to be released using this technique. The orange lines show the scar line. This flap can be planned in the same direction as in the top row or opposite directions as in the bottom row (green arrows show the flap directions).
Conclusion

We conclude that the bilobed flap can effectively be used in the treatment of primary and secondary syndactyly cases for web formation and reconstruction, especially in an adult population in which the skin on the dorsum of the hand is more pliable; thus, you may be able to avoid problems related to the skin graft.

Disclosure

None of the authors has a financial interest in any of the products, devices or drugs mentioned in this manuscript.

References