



배부 이엽 사각피판과 장부 삼각피판 따라베기에 의한 수지 합지증의 교정

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Dorsal Bilobed Rectangular Flap and Volar Triangular Flap with Back-Cuts in the Correction of Hand Syndactyly

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Purpose: Syndactyly is a one of the most common congenital anomalies of the hand. Each patient requires a thorough assessment of the soft-tissue and bony components within the syndactylized region. The aim of this article is to describe the exact design of the surgical procedure to prevent postoperative web creep using two volar back-cuts in syndactyly correction.

Methods: A retrospective data review of a series of twenty-two consecutive patients who were treated with correction of congenital syndactyly of the hand was conducted. Total patients number was 22. Web separation was performed in 44 webs among a total of 55 webs. This surgical technique was inserting small bilobed rectangular flaps into the volar back-cut defects on both sides, and longer dorsal rectangular flap than the previous surgical technique. Follow-up patients assessed the occurrence of patients that required secondary surgery due to web creep and patients of other sequels.

Results: Total separations of syndactyly of 22 patients who were corrected primarily (40 webs) and secondarily (4 webs) after treatment at other hospitals. There was no postoperative web creep during follow-up. Sequels with different color matches of full-thickness skin graft, angulations (3 patients), and ankylosis (1 patient) were due to the underlying bone and joint structure. Vascular and nerve injuries were absent.

Conclusion: Reconstructing a hand with syndactyly can be complicated and is fraught with potential pitfalls. Careful planning and meticulous surgical techniques with this surgical technique can minimize potential errors and allow satisfactory separation of syndactylized digits.

Key Words: Hand, Syndactyly, Congenital anomaly

INTRODUCTION

Syndactyly is the most common congenital deformity

of the limbs, with the incidence in Europe and the USA being between 1 per 2,000-3,000 live births, more commonly in males and is most often seen in the third web

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space¹. The incidence of hand syndactyly in Korea is 1 per 2,380 live births; however, the incidence of limb syndactyly is 1 per 1,205 live births².

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 with respect to separation of the digits and reconstruction of the web space. It is accepted that the web space must be reconstructed using a flap, which could either be a triangular flap method or a dorsal rectangular flap^{3,4}.

There have been numerous modifications of these two basic methods in order to achieve a normal looking commissure without web creep. Following reconstruction of the web space, the defects at the base of the fingers are conventionally skin grafted with either split or full-thickness skin grafts⁵.

Upton (1984, 1988) described a bilobed dorsal rectangular and palmar triangular flap technique⁶. The palmar triangular flap was marked so that there was always slight over-correction to prevent web creep⁶.

However, author has used a palmar triangular flap with bilateral back-cuts without over-correction, and web line avoided suture lines of inset flaps.

MATERIALS AND METHODS

1. Subject

A retrospective data review of a series of twenty-two consecutive patients who underwent correction of congenital syndactyly of the hand by the author for last 30 years was conducted. The sex distribution was 16 males to 6 females giving a ratio of 2.7 to 1. The age of presentation to the surgeon was within the first six months in only 14% of patients. The incidence of syndactyly was 3rd web (22/55 webs, 40%), 4th web (14/55, 26%), 2nd web (13/55, 24%), and 1st web (6/55, 11%). The syndactyly was bilateral in 59% (13/22 patients) and unilateral in 41% (9/22), the left hand (5/22, 23%) being involved similar to the right (4/22, 18%). The types of

syndactyly were divided by simple (29/55 webs, 53%), complex (23/55, 42%), and complicated (3/55, 5%) types. The number of syndromatic syndactyly was 17 among 22 patients. These patients were associated with brachydactyly (11/17 patients, 65%), constriction band syndrome (3/17, 18%), cleft hand (2/17, 12%), Poland syndrome (1/17, 6%), and others (2/17, 12%). The number of web separations was forty-four among a total of fifty-five webs.

2. Operative technique

The design and markings of dorsal and palmar flaps is described by adequate measurements using adjacent or contra-lateral normal webs and a proximal digital palmar crease as guides. Under tourniquet, at the base of the digits on the palmar aspect, a triangular flap with back-cut is raised. The length of the base of the triangular flap is equal to the width of the adjacent normal web or the web of a contra-lateral normal hand. A long bilobed rectangular flap is raised on the dorsal aspect of the web. The length of the rectangular flap is equal to the distance between the knuckle and the one-third point of the proximal palmar crease of the normal adjacent webs. The distal width of the rectangular flap is equal to double back-cut length. The length of dividing incision making two small bilobed rectangular flaps of distal portion of dorsal rectangular flap is equal to the length of the triangular flap. The length of the back-cuts is approximately one-third of the base-width of the digit. The dorsal and palmar flaps were adequately interdigitated into the depth of the releasing web (Fig. 1).

Dorsal and volar zigzag or dorsal straight incisions are made distally to allow flaps to be raised. All these flaps are elevated, as are the sides of the fingers, leaving intact the veins, arteries, and nerves. This will allow the flaps to be sutured without tension and will also result in more normal-looking digits. After the web has been adequately deepened and hemostasis thoroughly achieved, the flaps are inset. 6/0 Ethicon chromic catgut (Ethicon Inc., Somerville, NJ, USA) is used. The defects at the lateral aspect of the digits are covered with full-thickness skin

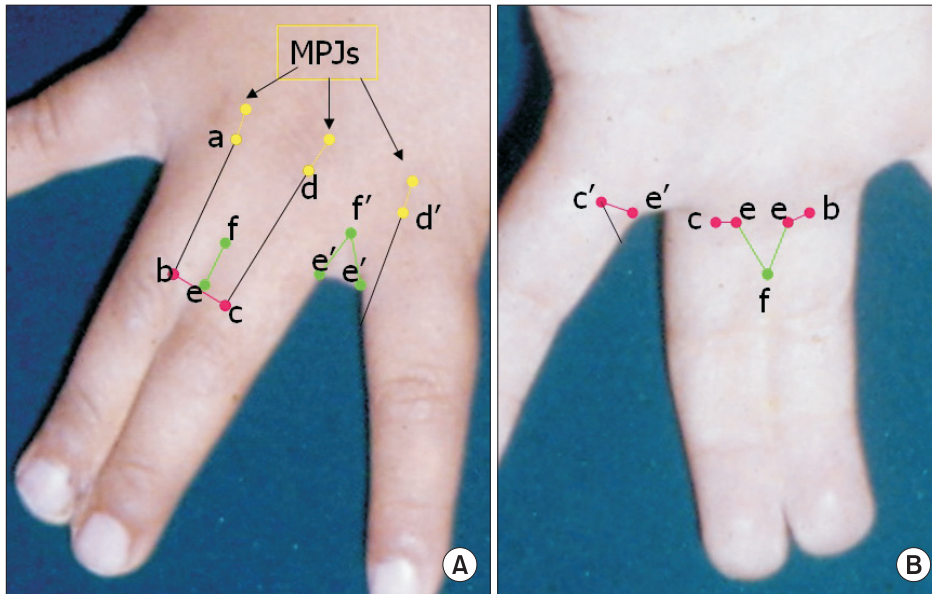


Fig. 1. Design of dorsal rectangular flap and volar triangular flap with back-cut. (A) Rectangular flap (a-b-c-d) and distal halving line (e-f) of the dorsal side, and (B) triangular flap with back-cut (b-e-f-e-c) of the volar side of syndactyly were designed. Length of each of the lines (c'-d', e'-e', e'-f', c'-e') measured from adjacent webs of the normal side of the hand. MPJs: meta-carpophalangeal joints.

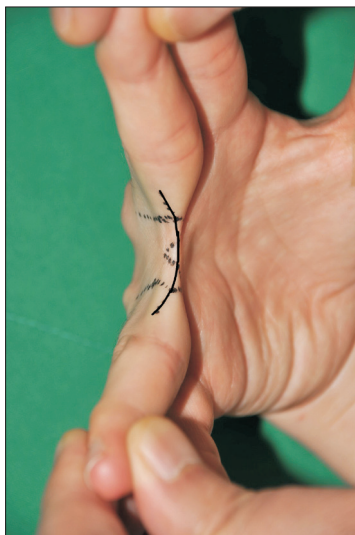


Fig. 2. Black dotted line of the normal web area is the suture line of flaps and black line shows palmar web line across three flaps of dorsal bilobed rectangular flaps and a volar triangular flap.



Fig. 3. Black line shows palmar web line across three flaps in early postoperative volar view after correction of the 3rd web of brachysyndactyly hand.

grafts from the inguinal region.

Palmar back-cut areas insert two small rectangular flaps to make a wide web commissure. The palmar web line between the divided syndactyly digits is located across the palmar triangular and two dorsal rectangular flaps (Fig. 2, 3). Unlike previous reports, the author's designs were of a longer rectangular flap, and a volar back-cut defect inserted with two small dorsal bilobed flaps to

prevent volar web line contracture.

RESULTS

The mean age at operation was 5 years, with a range between 2 months to 23 years.

Overall, 44 webs were operated upon, requiring 55 operations. Forty-four webs were operated upon primarily (forty webs) and secondarily (four webs) after treatment

Table 1. Summary of patients

Case No.	Sex	Age (mo)	Syndactyly webs		Types of syndactyly		Associated anomaly	Operation of webs		Results (FU, mo)
			Right	Left	Incomplete	Complete		Right	Left	
1	M	12		1, 2, 3, 4	Complex		BD		2, 4, 1, 3	Excellent (12)
2	F	180	4	4		Simple	Both HP	4	4	Excellent (9)
3	M	12	3, 4	4		Simple	Both HP	4, 3	4	Excellent (12)
4	M	348	3	3	Secondary, Simple			3	3	Excellent (12)
5	M	24	4	4		Simple	Both HP	4	4	Fair (6)
6	M	36	3	3		Secondary, Simple		3	3	Excellent (12)
7	M	72	3	3		Simple		3	3	Excellent (8)
8	M	12	4	4		Simple	Both HP			Fair (6)
9	M	48		2, 4	Complex		CBS		2, 4	Fair (48)
10	F	192	2			Complex	HP, 4th MF	2		Fair (6)
11	M	48	1	1		Complex	Both CH, Rt 4th, Lt 2nd MF	1	1	Good (10)
12	M	24	3	3	Simple			3	3	Excellent (7)
13	M	24	1, 2, 3	1, 2, 3, 4		Complex	Both BD	2	1, 4	Good (12)
14	F	176	3	3		Secondary, Simple	Both BD	3		Excellent (12)
15	F	7	2, 3	2, 3	Simple (Rt 2nd web & Lt 3rd web)	Complicate (Rt 3rd web, Lt 2nd web)	Both BD	3		Excellent (8)
16	F	36		2, 3, 4	Simple		BD		2, 4	Excellent (6)
17	M	4		1, 2	Simple				1, 2	Excellent (9)
18	M	36	2, 3		Simple		BD, PS	2, 3		Excellent (12)
19	M	24	3		Simple	Complicate	CH, symphalangism	3		Fair (264)
20	M	12	2		Complex	Complex	CBS	2		Fair (3)
21	F	3	2, 3, 4	2, 3, 4		Complex	Both CBS	2, 4	2, 3	Fair (12)
22	M	2		3	Simple				3	Excellent (12)

M: male, F: female, FU: follow-up, BD: brachydactyly, HP: hypoplasia, CBS: constriction band syndrome, MF: missing finger, CH: cleft hand, Rt: right, Lt: left, PS: Poland syndrome.

at other hospitals.

Sequels were different color matches of a full-thickness skin grafts, angulations (n-3), and ankylosis (n-1) due to the underlying bone and joint structure. The number of complex syndactyly was small, but as a group, they had a higher incidence of angulations. Web creep was not evident, but also vascular and nerve damage did not develop. The presence of a complete syndactyly or multiple web involvement was not associated with a higher incidence of failure. Flexion contractures on full-thickness skin grafts were minimal. Reconstructing a hand with syndactyly can be complicated and is fraught with potential pitfalls.

Patient outcome assessment was divided into excellent, good (proper segmentation with distal interphalangeal joint deviation), fair (proper segmentation with proximal and distal interphalangeal joint deviation or ankylosis, with improper length of digits), and poor (improper seg-

mentation of syndactyly). The overall success rates for the procedure as assessed by the surgeons were as follows: excellent (13 patients, 59%), good (2 patients, 9%) (Fig. 4E and 4F), fair (7 patient, 32%) (Fig. 5D), and poor (0 patient, 0%) (Table 1).

DISCUSSION

Syndactyly can also be classified as either complete or incomplete, depending on the extent of fusion of adjacent digits. Simple syndactyly defines a subtype in which only the skin is involved, while complex syndactyly presents skeletal union, usually at the distal phalangeal level. Complicated syndactyly forms bone union, duplications, and abnormal phalangeal segments (Fig. 4, 5)⁶.

Syndactyly may present as the sole abnormality or may be associated with other syndromes such as Poland and Apert syndrome or Cleft hand (Fig. 4, 5)¹.

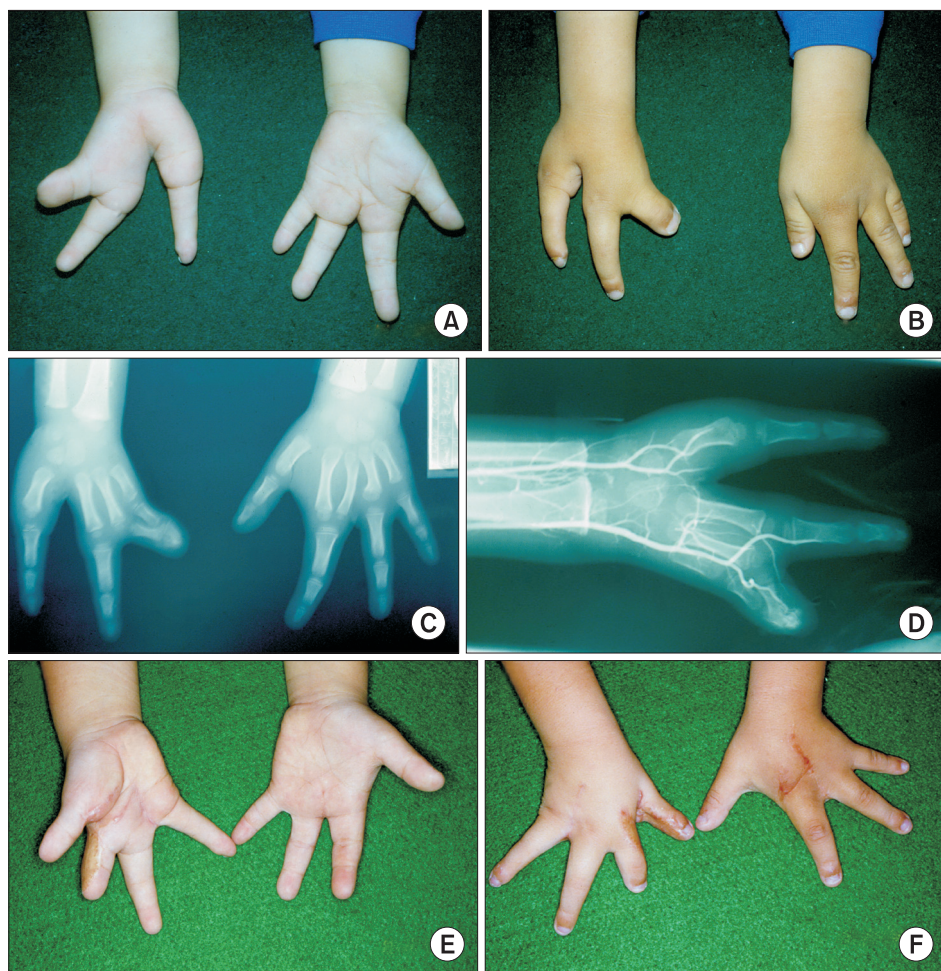


Fig. 4. A syndactyly of the right 1st web in bilateral cleft hands of a case 11. (A) Preoperative volar view. (B) Preoperative dorsal view. (C) Preoperative X-ray finding. (D) Preoperative angiogram of the right hand with disturbed palmar arch of the artery. (E) Postoperative volar view after two staged corrections of the syndactyly and cleft hand. (F) Postoperative dorsal view.

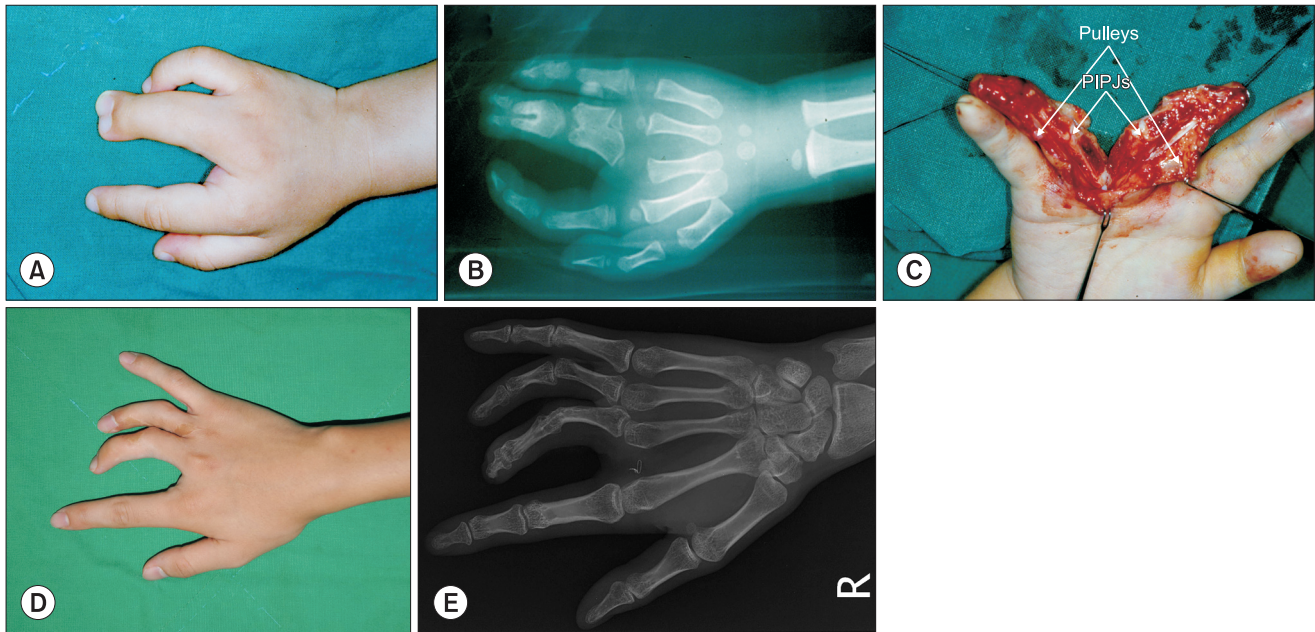


Fig. 5. A complicated syndactyly of the right 3rd web of a case 19. (A) Preoperative dorsal view. (B) Preoperative X-ray finding. (C) Intraoperative view after division of fused proximal, middle phalangeal bones, and soft-tissue. Exposed proximal phalangeal joints covered with flaps, and pulleys restored with divided pulley of middle and ring fingers. (D) Postoperative dorsal view 22 years after surgery. (E) Postoperative X-ray finding of undergrowth and malrotation of middle and ring fingers. PIPJs: proximal interphalangeal joints.

Malik⁷ presented a current classification scheme of the cardinal phenotypes, inheritance patterns, and clinical and genetic heterogeneities based on an overview of well-characterized, isolated syndactyly.

Several articles described techniques to avoid skin grafts in cutaneous syndactyly. One describes an “open” technique using multiple flaps and limited closure⁸. Another describes the use of aggressive defatting of the fingers⁹. The third describes the use of a dorsal metacarpal flap¹⁰⁻¹². The last technique uses the advanced dorsal skin to recreate the commissural flap and avoid skin grafting; however, opponents of the technique note that it leaves a more prominent dorsal scar¹³.

Creep is defined as distal migration of the web following surgery to correct syndactyly. However, there is no clear definition as to the normal position of the web. Some authors use needles to mark the new web using adjacent spaces as guides¹⁴; others measure from the distal palmar crease¹⁵ or from the “normal palmar crease”¹⁶. Preliminary findings from an ongoing study of hand X-rays in normal children of varying ages show that the normal web is approximately half-way between the

metacarpal head and the head of the proximal phalanx, confirming the opinion of Dobyns¹⁴. The primary aim in syndactyly surgery is to approach normality, both cosmetically and functionally⁵.

With an atraumatic technique, using magnification and bipolar coagulation, one should obtain primary healing with a tension-free closure of well-designed and raised flaps. The formation of a wide commissure to be free of contracture is one of the most important features in a syndactyly repair. Palmar back-cut areas insert two small rectangular flaps to make a wide web commissure. The palmar web line between divided syndactyly digits is located across the palmar triangular and two dorsal rectangular flaps (Fig. 2). This line avoids suture lines of inset flaps in my technique. Therefore, it makes a long web line and minimizes web contracture after surgery.

Many previous techniques held more potential to develop web creeps with suture scar contracture of inset flaps on the palmar web line. Wound margins of the skin graft area must not be located on the palmar web line. Therefore, the palmar incision line between the fused digits uses a zigzag pattern. Dorsal incision lines can be

either a zigzag or straight pattern. This line is less related to web creep. Straight incision lines of dorsal syndactyly achieved less exposure to grafted areas of skin. The zigzag incision yields a superior aesthetic appearance.

According to the syndactyly type, simple or complex typed patients could be satisfied with short-term follow-up. In the complicated type, the deformity was not resolved by several long-term procedures.

CONCLUSION

Reconstructing a hand with syndactyly can be complicated and is fraught with potential pitfalls. Careful planning and meticulous surgical techniques with this surgical technique can minimize potential errors and allow satisfactory separation of syndactylized digits.

CONFLICTS OF INTEREST

The author has nothing to disclose.

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배부 이엽 사각피판과 장부 삼각피판 따라베기에 의한 수지 합지증의 교정

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목적: 합지증은 수부의 가장 흔한 선천성 기형의 하나다. 본 논문에서는 합지 분리술에서 2개의 장부 따라베기를 사용하여 수술 후 지간 크리프(creep)를 예방하기 위한 수술 과정의 정확한 디자인을 제시하고자 한다.

방법: 저자가 손의 선천성 합지증의 교정술을 시행한 22명 환자에 대한 일련의 후향적 데이터 검토를 수행하였다. 합지 분리술은 전체 55지간들 중에서 44지간들을 시행하였다. 본 수술 방법은 양측의 따라베기 결손부에 배부의 작은 양측의 직사각형 피판 끝 부위를 삽입하고, 이전 수술 기법보다 긴 배부 사각 피판을 삽입하는 것이었다. 추적 관찰 환자들은 지간 크리프와 다른 후유증으로 인해 이차 수술을 필요로 하는 환자들의 발생을 평가했다.

결과: 22명 환자에서 40지간은 일차로, 4지간은 타 병원 수술 후 이차로 분리술을 하였다. 추적 관찰 중에 수술 후 웹 크리프는 발생하지 않았다. 전층 식피술의 배색 이상 이외에 내재된 골격과 관절구조가 초래한 3명의 경사와 1명의 강직이 있었으며 혈관과 신경 손상은 없었다.

결론: 합지증 재건은 복잡할 수 있고, 숨겨진 어려움들이 내재되어 있다. 이 수술은 주의 깊은 계획과 숙련된 술기만이 내재된 잘못들을 최소화하고 합지의 만족스러운 분리를 얻을 수가 있다.

색인단어: 수부, 합지증, 선천성 기형

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