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Reconstruction of the Lower Extremity with the Microsurgical Technique

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〈국문요약〉

미세수술을 이용한 하지 재건술

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본 연세대학교 의과대학 정형외과학교실에서는 1982년에서 1989년 사이에 모두 160건의 미세수술기법을 이용한 하지 재건술을 시행하였다.

이들중 남자가 96건, 여자가 64건이었으며 이들의 평균연령은 23.8세이고, 약 21.4개월의 치유관찰기간을 두었다.

원인으로는 교통사고가 118건, 종양이 18건, 작업장손상이 12건, 화상 5건, 폭발사고가 2건이며 기타 9건이었다.

이중 견갑피판이식이 55건, 서혜부피판이식이 35건, 유리 혈관부착 골피판이식이 23건, 견갑피판이식이 18건, 견갑부 및 광배근 복합피판이 9건, 분절절제술 및 회전재접합술이 8건이었다.

모두 134건에서 성공적인 치유를 경험하였으며, 기능 및 외관에서 모두 좋은 성적을 거두었다.

유리 혈관부착 골피판을 이용한 미세수술적 하지재건술을 광범위한 골결손과 손상 신경재건 및 여러차례의 재건술이 필요한 경우에 좋은 적응증이 되며 이러한 미세수술적 하지재건술은 광범위한 골결손과 손상신경재건 및 여러차례의 재건술이 필요한 경우에 좋은 적응증이 되며 이러한 점에서 상기기법으로 한번의 재건술이라는 장점을 지닌다.

Key Words : Reconstruction, Extremity, Microsurgical Technique

MATERIALS AND MATHODS

From January, 1982 to December, 1989, one hundred and sixty patients with defects in the lower extremity and degloving injuries were treated in the department of orhtopaedic surgery, Yonsei University College of Medicine.

Mean follow-up period was 21.4months (from 10 montsh to 52 months). Ninty six patients were men and sixty four were women, and the average age of the patients were 23.8years (Table 1). The

most common cause was traffic accidents and other causes in decreasing order of frequency were tumor, machinery accident and burns (Table 2). The most common lesion sites were the ankle and foot (Table 3). For one hundred and thirty three patients with massive extensive injuries in the lower extremity, the most common condition of recipient site was skin and soft tissue defect with bone or tendon exposure (Table 4), and the most common associated injuries were fracture and dislocation (Table 5).

Indications of microsurgical reconstructive surgery were skin and soft tissue defect with exposure of bone and tendon, large bone loss because of non-union with bone graft, scar contracture and limitation of motion with congenital anomaly, wound infection, and tumors around the knee joint. In these cases, we applied the free vascularized skin flap, the osteocutaneous flap, and resection and rotationplasty (Table 6).

In microsurgical reconstructive surgery, there was an exact knowledge of anatomy of donor site, condition of patient because of the long time need for the operation, and estimation of size of recipient and donor site. Expecially in resection and

Table 1. Age and sex distribution

Age	Sex	
	M	F
0–10	33	34
11–20	9	9
21–30	23	5
31–40	15	6
41–50	11	5
51–60	5	4
61–		1
Total	96	64

Mean age : 23.8Yrs.

Table 2. Causes of injury

Cause	No
Traffic accident	114
Tumor	18
Machinery injury	12
Burn	5
Explosive injury	2
Others	9
Total	160

Table 3. Sites of lesion

Sites	Number
Foot	46
Ankle	39
Leg	37
Knee	26
Thigh	12
Total	160

Table 4. Conditions of recipient site

Condition	Number
Skin & soft tissue defect with bone or tendon exposure	57
Skin & soft tissue defect with infection of bone	43
Unstable skin condition Joint contracture due to scar	18
Total	133

Table 5. Associated injuries

Dignosis	Number
Fracture & dislocation	57
Tendon & muscle injury	50
Loss of bone	17
Neurovascular injury	5
Amputation	4
Total	133

Table 6. Types of operation

Type	Performed Op.	Survival No.
Scapular flap	55	45
Groin flap	35	22
Free vascularized osteocutaneous flap	23	17
Parascapular flap	18	17
Combined scapular & latissimus dorsi flap	9	8
Segmental resection & rotationplasty	8	8
Deltoid flap	6	5
Latissimus dorsi flap	6	6
Lateral thigh flap	5	3
Tensor fascia lata flap	2	1
Dorsalis pedis flap	2	2
Total	169	134

rotational plasty, metastais and local tissue expansion of tumor were studied. Angiography was done in all patients to discover anatomical variation. During the operation, arteries and veins were separated and according to the condition of the recipient site, diameters of vessels were estimated. In the osteocutanous flap and resection and rotationplasty[2], open reduction and internal fixation of bone was done, and in the latter, myoplasty was important for functional recovery. If possible, one arterial anastomosis and two vein anastomosis were done. In arteries, end to end or end to side anstomosis were done. After the operation, there was no tension in the operation site. As antithrombotic agents, Persantin in 100mg and Aspirin 1200mg divided in two doses for one week were given and Dextran 40 was given for 3 days. Smoking was not permitted in patients, especially adults, and air conditioners were not also permitted. The room temperature was maintained over 22℃

RESULTS

Success was achieved in 134 cases which resulted in good functional recovery. Nine cases needed reoperation. The over all success rate of the free vascularized graft was 78.9% (Table 6). The osteocutaneous flap was done in large bone defects, nonunion after fracture and pseudoarthrosis. The fibula and iliac crest were used as sources of the osteocutaneous flap. The advatages of osteocutaneous flap were that there were less bone resorption than inconventional bone resorption, short reparative periods and more resistance to wound infections. The disadvantage was a longer operation time period than in other microsurgical reconstructive surgery. Complications after operation were necrosis of free vascularized flaps, especially in groin flaps, focal necrosis of flaps, hematoma formation, psedoarthrosis, nonunion, wound dehiscence and hypoesthesia of flaps.

CASE REPORTS

Case 1. A four year old girl was admitted to this hospital after a traffic accident. The diagnosis was degloving injury of the right ankle and foot including the open fracture of the medial malleolus and exposure of the tendon (Fig 1). After debridement (Fig 2), free vascularized groin flap was done (Fig 3). There was no exposure of the tendon and bone. Also there was no wound infedtion. There was good functional recovery. After 1 year and 5 months follow-up, there were good function and good appearance (Fig 5).

Case 2. A twenty-ony year old man was admitted to this hospital due to scar contracture and limitation of motion of the left knee after burn. In the past history, he had had poliomyleitis at 2 years of age. At thirteen year of age, there was scar contracture and limitation of motion of the

Fig. 1. *Preoperative appearance*: There was degloving injury on the left ankle and foot, and exposure of medial malleouls.

Fig. 2. During operation, debridement was done.

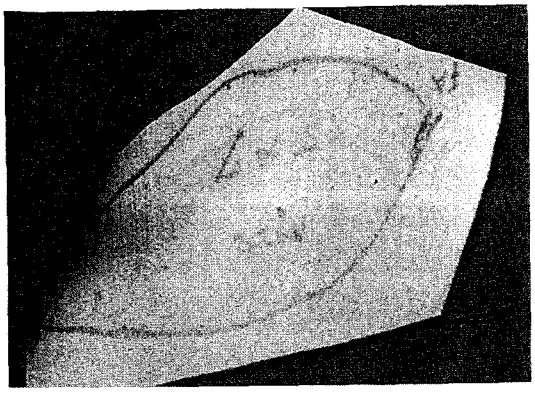

Fig. 3. Groin flap was designed from the right inguinal area.

left knee joint because of burn injury. One year before, he received iliopsoas tenotomy and hamstring muscle release twice. At admission, there was limitation of motion of the knee joint from 70 degrees to 120 degrees, and scar contracture on the popliteal area (Fig 6).

Before the operation, skin traction was done on the left lower extremity. Angiography was done (Fig 7). Latissimus dorsi flap was designed (21cm

Fig. 4. Postoperative state : There was a good appearance.

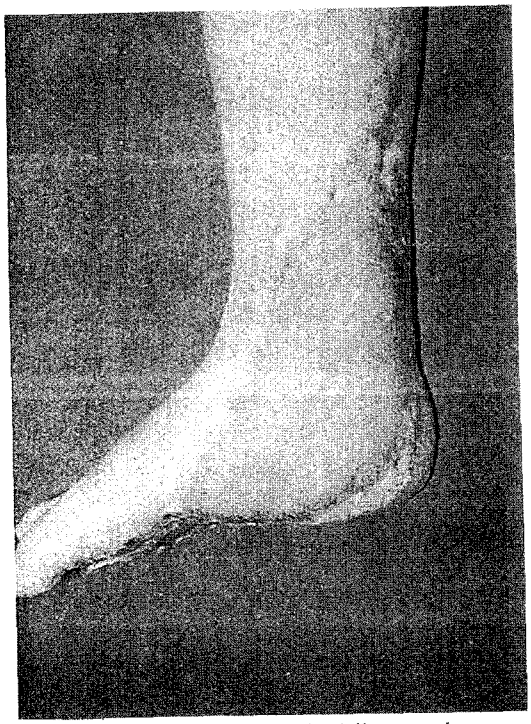

Fig. 5. After 1 year and 5 months follow-up, there were good function and good appearance.

Fig. 6. Preoperative state : Burn scar was over the posterior aspect of the left lower extremity and there was limition of motion of the left knee due to scar contracture.

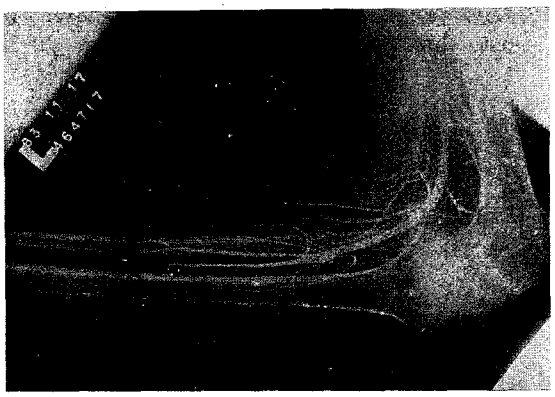

Fig. 7. Angiographic findings : There was no anatomic variation and blood vessels were intact.

×11cm) on the left axillar area. Free vascularized latissimus dorsi flap was done. After the operation, range of motion of the knee joint was from 0 degree to 120 degrees and there was good appearance (Fing 8). After achieving as much approximation as possible, the remaining defect was covered with a split thickness skin graft. Subsequently there was no limitation of motion of the scapulohumeral joint (Fig 10).

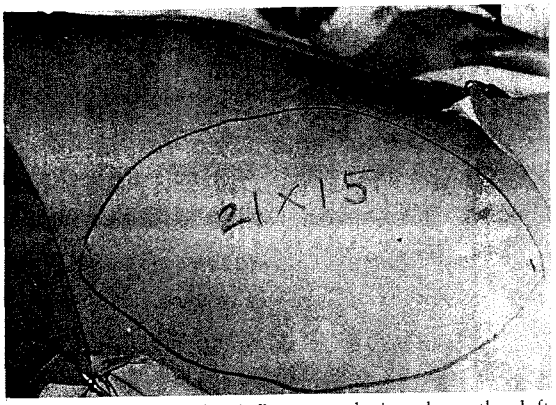

Fig. 8. Latissimus dorsi flap was designed on the left shoulder.

Fig. 9. Postoperative state : There was no limitation of motion and cosmetic appearance was good.

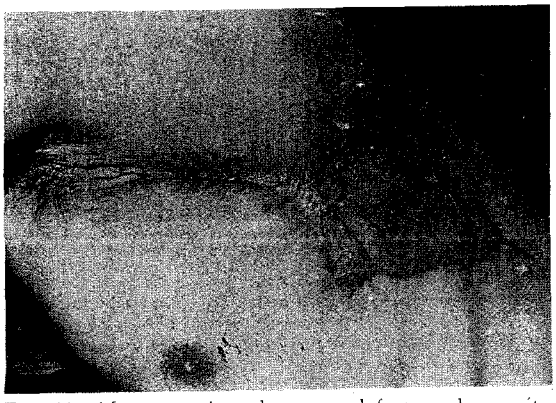

Fig. 10. After operation, there was defect on donor site and then, split thickness skin graft was done.

DISCUSSION

Jacobson and Suarez[3] introduced the microsurgical reconstructive surgery in orthopedic surgery and the possibility of the reconstructive surgery promised a little limitation. Except replantation of the amputated digit, it took over ten years for this technique could be applied clinical-

ly. In 1973, Taylor and Daniel[4] had success in free vascularized flaps and after that, various types of free vascularized grafts have been developed. Development of microsurgical vascular anastomotic technique had a important place in the free vascularized graft, free vascularized osteocutanous graft for large bone defect, and nerve graft for recovery of nerves in the extremity[5]. To attempt free vascularized grafts with microsurgery it is essential to have an exact anatomical knowledge of the donor sites with long operation time, under the care of an experienced surgical team. Free vascularized graft and osteocutaneous flap was used to fill extensive skin and soft tissue defects, and large bone defects which were not correctable by the classical treatment. It was used as a one-stage reconstructive surgical technique[6].

The used free vascularized grafts were the groin flap, latissimus flap[5], tensor fascia later flap[7], scapular flap[8,9], parascapular flap[10], a combined scapular and latissimus dorsi flap[11] and medial and lateral thigh flap[12]. In this study, the scapular flap was most widely used and in decreasing order of frequency, the groin flap, parascapular flap and a combined flap were used.

The scapular flap was introduced by Majou[9] and Hamilton[8] in 1982. The advantages of the scapular flap were that the scapular flap was thin, there was a long vessel, and there was little variable anatomical sturctures. The disadvantages of the scapular flap were that it was a small sized flap, not useful to fill a large defect, and it left a defect on the donor site. When we used this flap, we had no experience of defect on the donor site, but there was a little scar formation after natural healing.

Nassif and Vidal[10] were introduced the parascapular flap to decrease the disadvantages of the scapular flap and to obtaine a larger flap. In this study, we had the highest success rate in parascapular flaps. We had success in 45 cases out 55 cased in scapular flaps and 17 out of 18 cases in parascapular flaps. The largerst size of the scaular flap was 20cm×10cm and the largest size of the parascapular flap was 20cm×15cm. We used these two flaps in pediatric patients and had the following experience. Before surgery preparation was made easier due to the free flap technique and, whether free vascularized flap was suitable to the function of the recipient or not, there was good results.[13]

The groin flap introduced by the Daniel and Taylor[4] has had good results as stated by many[14,15]. In this stduy, the result of the groin flap had a poorer result than the other flaps. The reason was that there was a anatomical variation. We thought that the reasons was that the necrosis of groin flap was a different diameter between recipient and donor vessel, and also because of the bad condition of the vessels. In addition to the above flaps, we applied the deltoid flap, lateral thigh flap, and combined scapular and latissimus flaps. The lateral thigh flap was introduced by Baek[12]. This flap had a long vessel, was a large sized flap and had a unique cutaneous distribution. The disadvantage was stated to be a difficulty of primary repair, but in our cases, we had no difficulty of primary repair.

A combined scapular and latissimus dorsi flap introduced by park[11] and Hahn included the use of the scapular flap with the circumflex scapular artery and the latissimus doris flap with the thoracodorsal artery. The advantages of this flap were that there was a large flap and that there was a long vessel. The disadvantage was that there was difficulty of primary repair and it was necessary to take a skin graft. In this study, we preformed a skin graft and there was no limitation of shoulder joint.

In 1974, Bunke had his first success of free vascularized rib graft for the patient with a defect of the tibia. In 1975, Taylor in Australia, introduced free vascularized fibular graft. After that, osteocutaneous rib graft, osteocutaneous iliac graft

with deep circumflex iliac artery and second metatsal ostocutaneous flap with the first dorsal metatarsal artery were intruduced[17]. In traumatic or fibrous dysplasia, giant cell tumor, simple bone cyst, and curettage and resection of bone, the osteocutaneous flap was used. The sources of osteocutaneous flaps were the rib, fibula, iliac crest and second metatarsal bone[16]. We used mainly fibular bone. The advantages of the osteocutaneous flap were that there was less bone resorption than classical bone graft, and a short reparative period. The other advantages were that there was less hypertrophy of graft bone, and resistance of infection. Disadvantage of this flap was that there was longer operation time[18,19].

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— Abstract —

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One hundred and sixty patients had reconstructive surgery of the lower extremity with the microsurgical technique at the department of orthopaedic surgery, Yonsei University College of Medicine from 1982 to 1989. There were ninty-six cases of men and sixty-four cases of women, in which the mean age was 23.8 years. These patients were followed for 21.4 months. The causes were 114 cases from traffic accidents, 18 cases from tumors, 12 cases from machinery injuries, 5 cases from burns, 2 cases from explosive injuries, and 9 cases from other reasons. There were 55 cases of scapular flap, 35 cases of groin flap, 23 cases of free vascularized osteocutaneous flap, 18 cases of parascapular flap, 9 cases of combined scapular and latissimus dorsi flaps, and 8 cases of segmental resection and rotationplasty. Success in reconstructive surgery with the microsurgical technique was achieved in one hundred and thirty four cases, and function and cosmetic results were excellent.

Free vascularized flap with development of the microsurgical technique has taken an important role in reconstruction of large extremity defects where skin graft and distant flap were not applicable. Reconstruction of the lower extremity with the microsurgical technique is indicated with free vascularized osteocutaneous flap when there is a large defect of bone, a need for injured nerve replacement, and in the case of needed multiple staged operations[1]. In these instences, this technique is regarded as simple one-staged reconstructive surgery.

Key Words : Reconstruction, Extremity, Microsurgical Technique