

**Abstract**

**Functioning Gracilis Musculocutaneous Free Flap Transplantation  
for the Reconstruction of Hand Function**

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**Purpose** : We performed this study in order to analyze the clinical results of functioning gracilis musculocutaneous free flap transplantation for reconstruction of hand function in cases of Volkmann's ischemic contracture and massive soft tissue injury of forearm.

**Materials and methods** : 18 cases were reviewed with 5 years of mean follow up period. We evaluated total active motion of the finger joints and wrist, pinch and grip strength.

**Results** : The flap were survived in 17 cases and 1 case was failed due to infection. The sum of active motion of finger joints(TAM) was improved from 0 to 173.8. The average grip and pinch strength was improved from 0 kg to  $2.7 \pm 2.1$ kg and from 0 kg to  $2.4 \pm 1.6$ kg.

**Conclusion** : The results in most cases were acceptable in relatively long term follow-up. It may be an option for reconstruction of hand function in cases of Volkmann's ischemic contracture and traumatic upper extremity injury.

**Key Words** : Gracilis musculocutaneous free flap transfer, Volkmann's ischemic contracture, Reconstruction of hand function

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가 (muscle 가 18  
 sliding operation), 가  
 (tendon transfer)  
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 가  
 1970 Tamai <sup>8)</sup>  
 가  
 Manketelow Mckee<sup>6)</sup> Gordon 1.  
 Buncke<sup>2)</sup> 1981 11 1999 6  
 가  
 18  
 16 2 ,  
 (Gracilis Flap), 9 54  
 (Pectoralis Major Flap) 29.2 . 18 9 가  
 (Latissimus Dorsi Flap),  
 (gastrocnemius) (Volkman n 's  
 Ischemic Contracture) , 2 가  
 가 (denervation), 2 가  
 , 5 가  
 36.0  
 1981 11 1999 8 1 1 11 7 5  
 2 (Table 1).

**Table 1.** Patient Analysis

Case	Age/Sex	Diagnosis	Periods from injury to op	Initial condition of forearm flexor
1	45/M	Deep laceration, VIC	11yr4m	VIC Dennervated
2	13/F	Supracondylar fx. VIC	3yr.4m.	VIC Dennervated
3	54/M	Deep laceration, VIC	10m.	VIC Dennervated
4	22/M	Crushing, VIC	11m.	VIC Dennervated
5	29/M	Deep laceration, VIC	8m.	VIC Dennervated
6	28/M	Crushing	1yr.6m.	Muscle crushing
7	9/M	Radius fracture, VIC	2yr.8m.	VIC Dennervated
8	23/M	Deep laceration Glass injury	5m.	Dennervated
9	30/M	Deep laceration Glass injury	9yr.	Dennervated
10	24/M	BE amputation(Replantation)	1yr.	Dennervated
11	37/M	BE Amputation(Replantation)	6m.	Dennervated
12	20/M	Crushing injury	1yr.11m.	VIC Dennervated
13	42/M	Crushing injury	3yr.5m.	VIC Dennervated
14	45/M	Crushing injury	2m.	Muscle crushing Dennervated
15	32/M	Brachial plexus injury (C7, T1), Crushing	10m.	Dennervated
16	19/M	Crushing injury.	3m.	Muscle loss Dennervated
17	29/F	Supracondylar fx. VIC	26yr.	VIC Dennervated
18	26/M	Crushing injury	3m.	Muscle crushing Dennervated

2. 8 ~ 12cm (dominant pedicle) 가  
(adductor longus muscle)

8 ~ 10cm (obturator nerve) 가 가  
(functional position) 가

resting length 5cm

5 ~ 6cm 가 (tendinous part) 가  
2 ~ 3cm 4  
가 10cm, 30 (functional position)  
20cm resting length 1 ~ 4

**Table 2.** Evaluation of Operation

Case	Gracilis m. status	Length of m. flap(cm)	Size of skin flap(cm)	Connected tendons	Ischemic time	Operation time	Complication
1	Normal	27	27 × 6	FDP, FPL	2hr. 27m.	6hr. 45m.	No
2	Normal	24	15 × 5	FDP, FPL	1hr. 48m.	4hr. 40m.	Marginal necrosis
3	Normal	28	No	FDP, FPL	1hr. 34m.	4hr. 50m.	No
4	Normal	23	No	FDP, FPL	1hr. 30m.	4hr. 20m.	No
5	Normal	23	15 × 5	FDP, FPL	2hr. 13m.	5hr. 10m.	No
6	Rt:Normal Lt:Cong. Abscence	26	21 × 4	FDP, FPL	2hr. 5m.	5hr. 30m.	Venous congestion
7	Normal	19	No	FDP, FPL	1hr. 42m.	4hr. 3m.	Marginal necrosis
8	Normal	24	16 × 6	FDP, FPL	1hr. 50m.	5hr.	Echymosis
9	Normal	27	No	FDP, FPL	1hr. 50m.	4hr. 40m.	No
10	Normal	29	No	FDP	1hr. 30m.	4hr. 30m.	No
11	Normal	25	12 × 3	FDP, FPL	1hr. 55m.	4hr. 8m.	No
12	Normal	30	13 × 4	FDP, FPL	1hr. 50m.	7hr. 40m.	No
13	Normal	27	12 × 4.5	FDP, FPL	2hr. 25m.	4hr. 30m.	MRSA infection
14	Normal		12 × 26	FDP, FPL	1hr. 45m.	4hr.	No
15	Normal	23	4 × 12	FDP, FPL	1hr. 59m.	4hr. 9m.	No
16	Normal	27	5 × 18	FDP, FPL	1hr. 40m.	7hr. 10m.	No
17	Normal		20 × 5	FDP, FPL	1hr. 30m.	4hr.	No
18	Normal	22	13 × 7	FDP, FPL	2hr. 12m.	5hr. 10m.	No

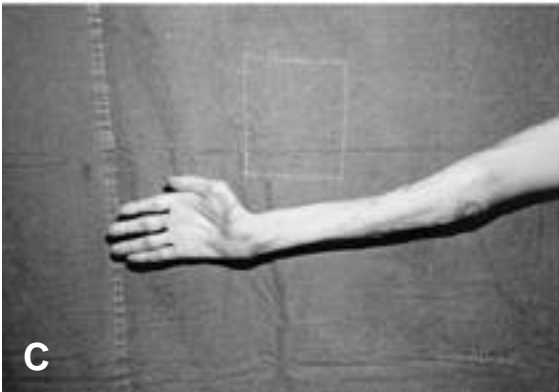
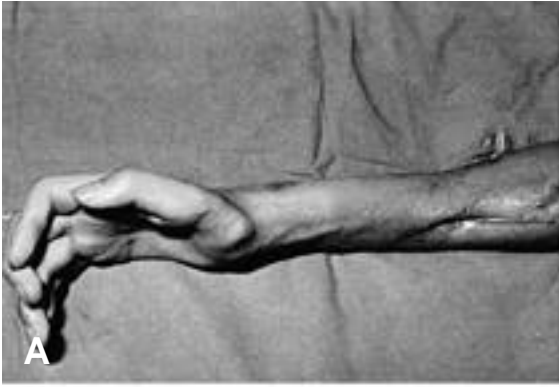
(medial femoral (degree) , (sum of circumflex artery) , flexion degree of MP, PIP, DIP) , (anterior interosseous 가 (extension lag) N.) (TAM: total active range of motion) 가 . Preston hand-held dynamometer Preston pinch gauge (grip strength) (pinch strength) , (proximal palmar crease) 18 5 13 , 5 19cm 30cm 22.0cm 18 1 17 12×3cm<sup>2</sup> 27×6cm<sup>2</sup> 가 (Table 2). (p<0.05), 0° 34.5±7.3° , (TAM) 0° 90° , 173.8±45.6° . 0kg 2.7±2.1kg 2.4±1.6kg 500cc 10% dextran 0kg 7.8±2.4cm 3 , 1.2gm aspirin 75gm 2.8±4.1cm (Table 3). persantin 14 . 6 가 (MRSA) 1 (Electrical stimulation 3 , 1 1 therapy) 가 4cm 4. 가 goniometer .

**Table 3.** Comparison between Preoperative and Postoperative Functional Measurements

	aROM of Elbow Flexion	aROM of Wrist Flexion	TAM of Fingers Flexion	Grip Strength	Pinch Strength	Width between fingertip to palmar crease
Preoperative	118.1 ± 19.1 °	0 °	0 °	0kg	0kg	7.8 ± 2.4cm
Postoperative	122.9 ± 14.8 °	34.5 ± 7.3 °	173.8 ± 45.6 °	2.7 ± 2.1kg	2.4 ± 1.6kg	2.8 ± 4.1cm

aROM: active range of motion

TAM: total active range of motion



**Fig. 1.** 22 years old male patients was operated due to crushing injury sequele.

- A.** Preoperative photograph showing severe contracture of the hand.
- B.** Elevated gracilis muscle flap showing neurovascular pedicle.
- C.** Postoperative 9 years photographs showing ROM exercise and holding a cup.

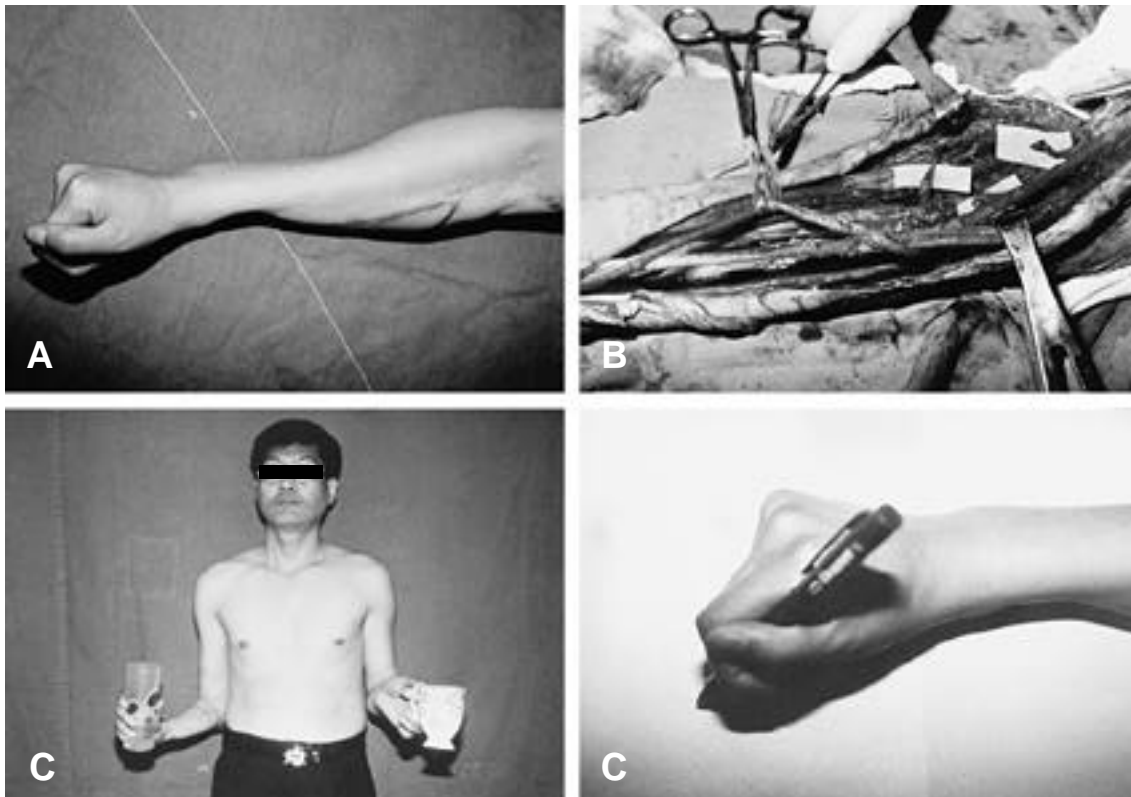
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(functioning muscle free transfer)

1970 Tamai <sup>8)</sup>

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**Fig. 2.** 28 years old male patients was operated due to crushing injury sequele.  
**A.** Preoperative photograph showing contracture of the hand.  
**B.** Intraoperative finding showing dissected recipient neurovascular structure.  
**C.** Postoperative photographs showing holding a cup and pencil 12 years after operation.

Manktelow Mcke <sup>8)</sup>	Gordon Buncke	Egerszepe <sup>1)</sup>	
<sup>2)</sup>			
(Pectoralis major), (Rectus femoris), 가 (strength),	(Latismus dorsi), (Serratus anterior) , (muscle excursion)	strength pinch strength tip to crease Innocenti <sup>4)</sup>	22 ~ 43%  grip 1.6&m  50%
1972 Orthicoche <sup>7)</sup> 가	(Obtrator		
N.)	, 가		
Zukowski <sup>9)</sup> Holle <sup>3)</sup>	가 <sup>5)</sup>		

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(reinnervation)  
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Grip Pinch strenght,  
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