



저작자표시-비영리-동일조건변경허락 2.0 대한민국

이용자는 아래의 조건을 따르는 경우에 한하여 자유롭게

- 이 저작물을 복제, 배포, 전송, 전시, 공연 및 방송할 수 있습니다.
- 이차적 저작물을 작성할 수 있습니다.

다음과 같은 조건을 따라야 합니다:



저작자표시. 귀하는 원저작자를 표시하여야 합니다.



비영리. 귀하는 이 저작물을 영리 목적으로 이용할 수 없습니다.



동일조건변경허락. 귀하가 이 저작물을 개작, 변형 또는 가공했을 경우에는, 이 저작물과 동일한 이용허락조건하에서만 배포할 수 있습니다.

- 귀하는, 이 저작물의 재이용이나 배포의 경우, 이 저작물에 적용된 이용허락조건을 명확하게 나타내어야 합니다.
- 저작권자로부터 별도의 허가를 받으면 이러한 조건들은 적용되지 않습니다.

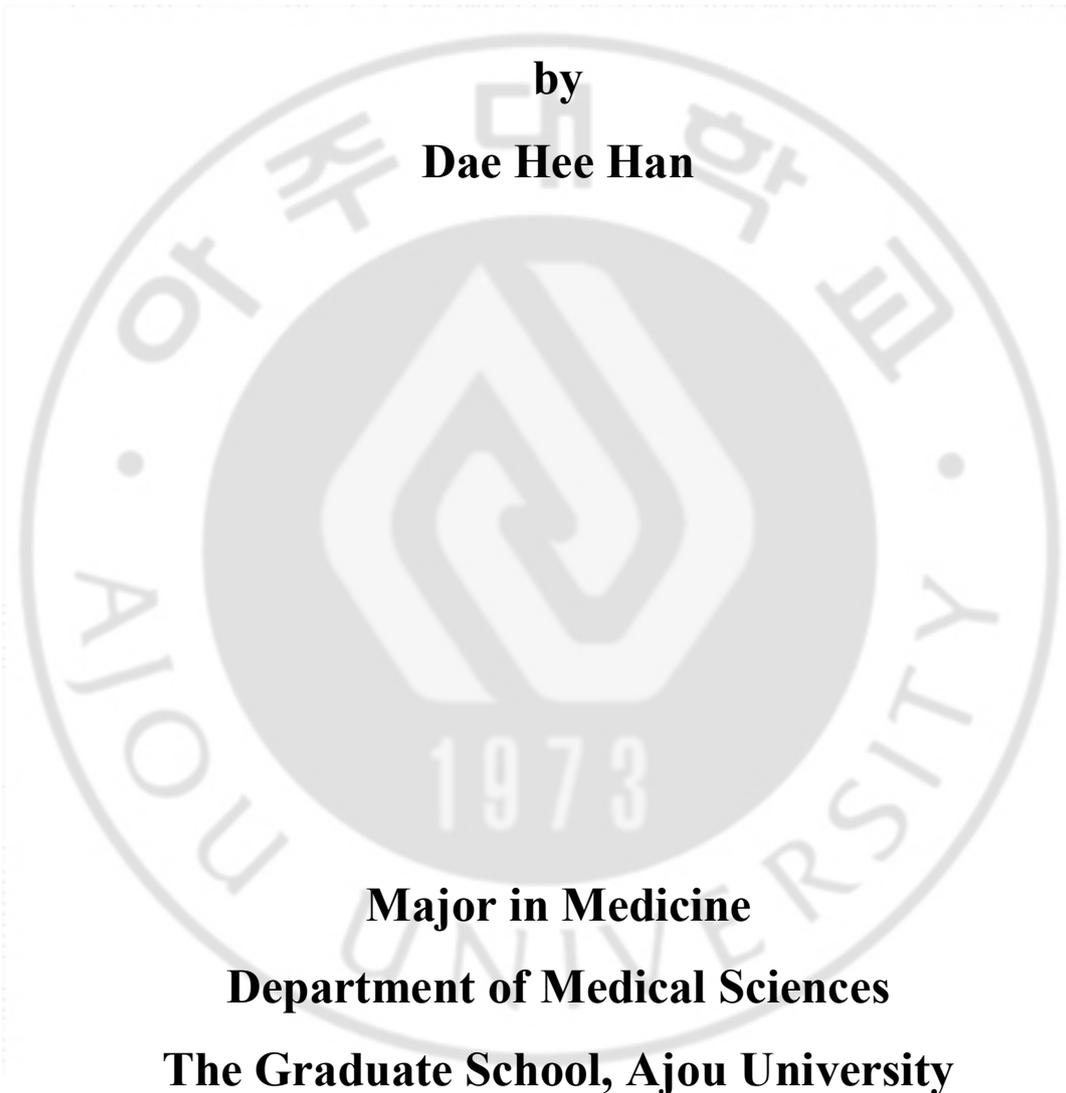
저작권법에 따른 이용자의 권리는 위의 내용에 의하여 영향을 받지 않습니다.

이것은 [이용허락규약\(Legal Code\)](#)을 이해하기 쉽게 요약한 것입니다.

[Disclaimer](#)

Functional Status of the Donor Limb of Anterolateral Thigh Flap

by
Dae Hee Han



Major in Medicine
Department of Medical Sciences
The Graduate School, Ajou University

Functional Status of the Donor Limb of Anterolateral Thigh Flap

by

Dae Hee Han

**A Dissertation Submitted to the Graduate School
of Ajou University in Partial Fulfillment of the
Requirements for the Degree of Master of
Medicine**

Supervised by

Myong Chul Park, M.D., Ph.D.

Major in Medicine

Department of Medical Sciences

The Graduate School, Ajou University

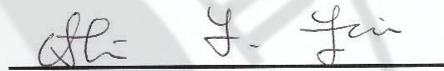
February, 2014

**This certifies that the dissertation
Of Dae Hee Han is approved.**

SUPERVISORY COMMITTEE



Myong Chul Park



Shin Young Yim



Kee Myung Lee

The Graduate School, Ajou University

December, 13th, 2013

- ABSTRACT -

Functional Status of the Donor Limb of Anterolateral Thigh Flap

The anterolateral thigh flap (ALT) is based on the perforator of the descending branch of the lateral circumflex femoral artery. As there are several anatomical variations of the lateral circumflex arterial system, muscle dissection is unavoidable when skin perforator vessels run through the vastus lateralis muscle. In the present study, we prospectively evaluated donor extremity function and investigated the objective functional morbidity of the donor site.

We performed a prospective study on 14 cases of head and neck defect reconstruction using free ALT flap at Ajou university hospital between September 2011 and November 2012. Patients were followed-up postoperatively at 6 months by questionnaire. The Biodex System (Biodex medical systems, providing reliable and reproducible data, was used for the dynamic functional evaluation of the knee joint of patients both preoperatively and postoperatively. We compared the variables pre-operation and post-operation and in terms of the donor limb and non-donor limb, septocutaneous perforator and musculocutaneous perforator, donor site primary closure and skin graft, and size of flap $<64\text{cm}^2$ vs. $\geq 64\text{cm}^2$.

All flaps survived and the recovery of the donor limb was uneventful. On postoperative follow up, some patients complained their decreased sensation around the donor limb and decreased mobility. However, there was no limitation in their daily life. In the objective test, overall, there were no significant differences between the groups, except for total work at 180° extension (0.0459). Changes in the ratio of peak torque/weight and total work of the knee

extension or flexion were statistically negligible ($p < 0.05$).

The results of our questionnaire mirrored the literature. Pain and hypoesthesia were observed, but, they did not interfere with their daily life. There was a decrease in total work of knee extension compared to the preoperative data. The postoperative long period of rest may cause delayed functional recovery. Therefore, we have to encourage the patient to do the rehabilitation exercise. The present study indicates that functional damage to the donor limb of the anterolateral thigh flap is minimal even if the muscle is injured during harvesting. Moreover, we found that complaints concerning a decreased mobility were not objective from the results of our questionnaire.

Key words: Free tissue flap, Lower extremity, Tissue donors, Morbidity

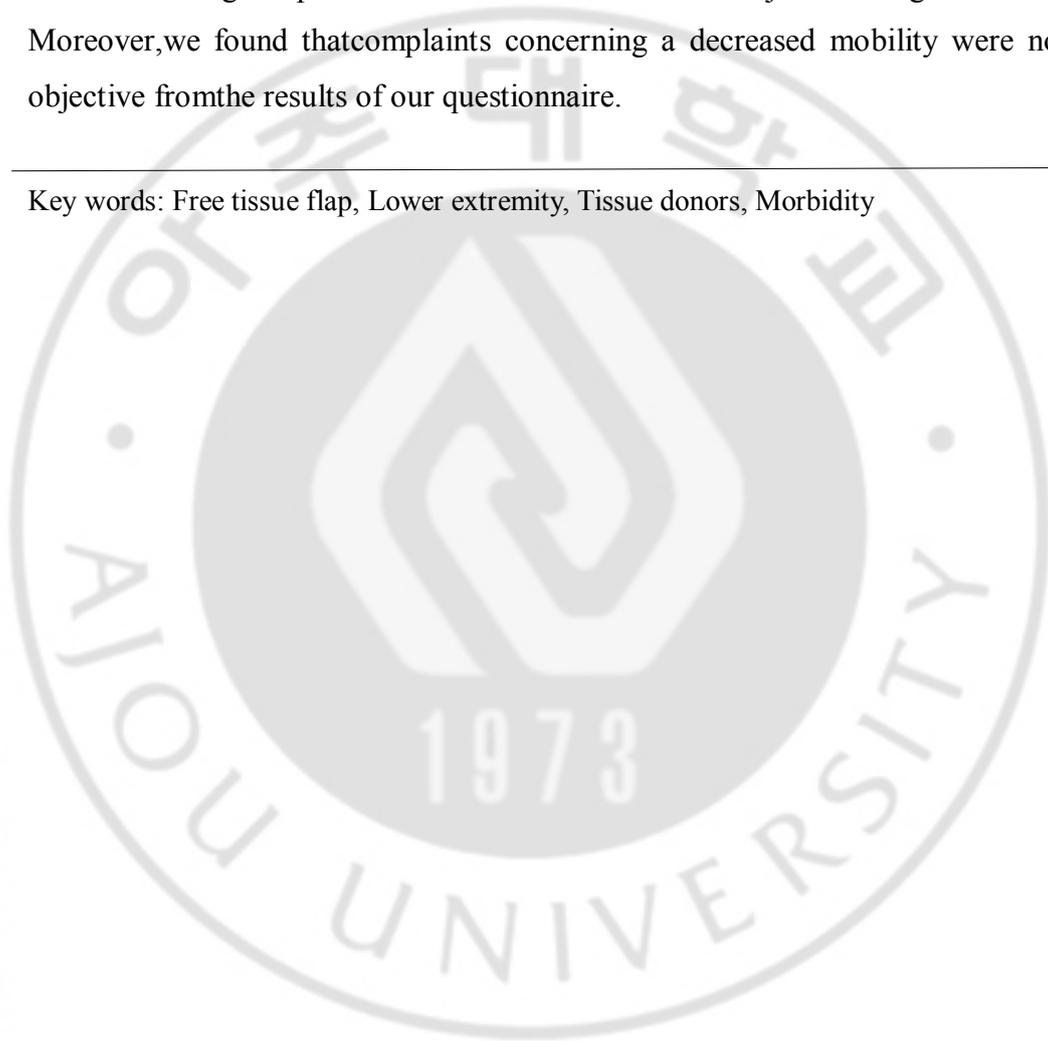
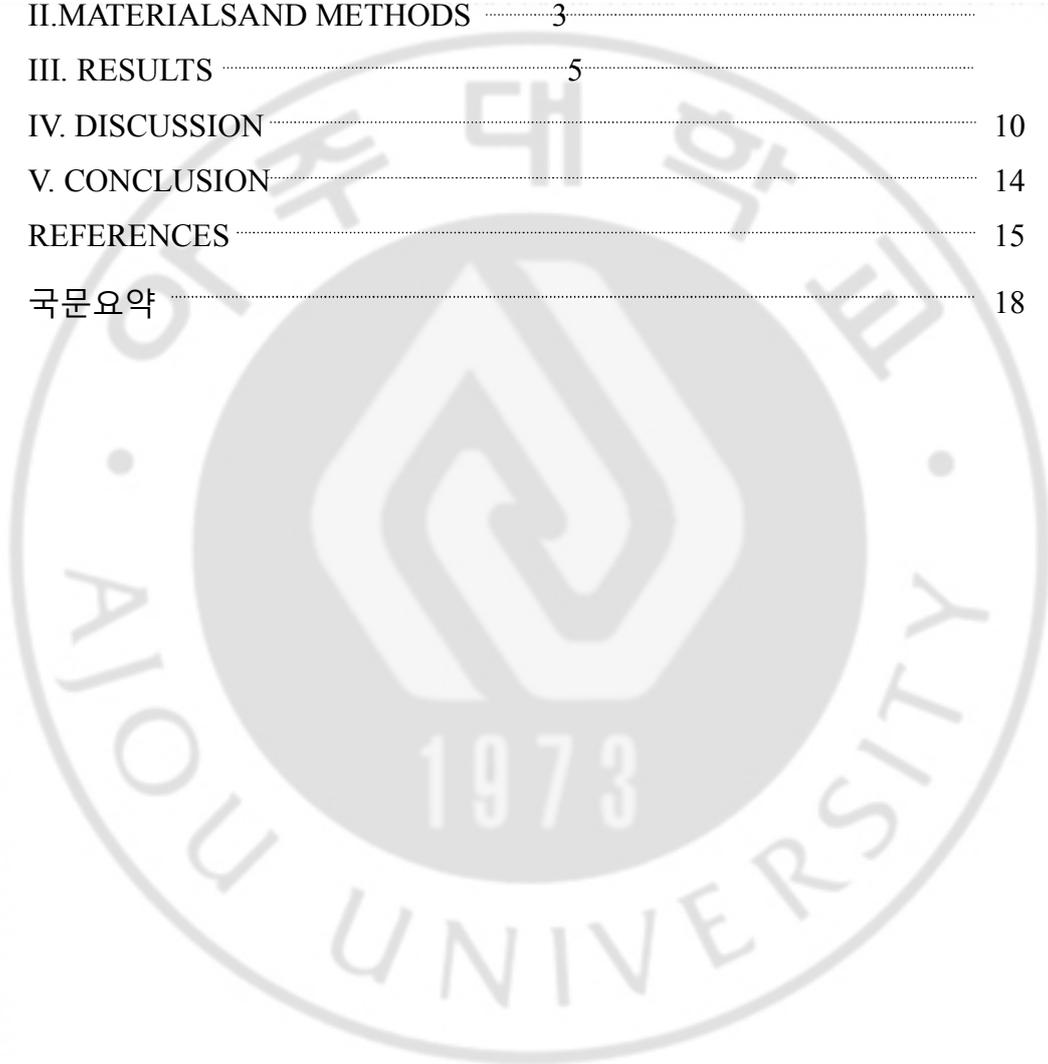


TABLE OF CONTENTS

ABSTRACT	i
TABLE OF CONTENTS	iii
LIST OF FIGURES	iv
LIST OF TABLES	v
I. INTRODUCTION	1
II. MATERIALS AND METHODS	3
III. RESULTS	5
IV. DISCUSSION	10
V. CONCLUSION	14
REFERENCES	15
국문요약	18



LIST OF FIGURES

Figure 1. Objective evaluations of donor limb function regarding factors contributing to the morbidity	9
--------------------------------------------------------------------------------------------------------------	---



LIST OF TABLES

Table 1.Characteristics of the subjects	6
Table 2. Subjective symptoms of donor limb of the anterolateral thigh flap at follow up	7
Table 3. Comparison of functional morbidity	8



I. INTRODUCTION

The anterolateral thigh (ALT) flap was first described in 1984 that was based on the perforators of the descending branch of the lateral circumflex femoral artery (Song et al., 1984). The ALT flap has many advantages, including the large skin territory, thin and pliable skin, long pedicle, and minimal donor limb morbidity. With the development of microsurgery, the ALT has been shown to be an extremely versatile flap for the reconstruction of head and neck, upper and lower extremity, and trunk (Ali et al., 2009). Especially, for the reconstruction of head and neck defects after cancer ablation, the ALT has become the first choice option (Koshima et al., 1993).

However, there were several anatomical variations of perforating artery derived from the descending branch of lateral circumflex femoral artery system. Moreover, musculocutaneous perforators, which ran through the vastus lateralis muscle, were much more common than septocutaneous perforators (Koshima et al., 1989). To dissect the musculocutaneous perforators, the vastus lateralis muscle in the course must be damaged. Although some studies have cited minimal donor site morbidity as an advantage of this flap (Huang et al., 2004; Pribaz et al., 1995), we raised the concern for the morbidity of donor limb.

Until now, most studies evaluating the donor limb of the ALT have employed questionnaire-based assessments or indirect clinical parameters such as range of motion and thigh circumference (Hanasono et al., 2010; Lipa et al., 2005; Mureau et al., 2005; Kimata et al., 2000). Moreover, concerning the objective functional evaluation of donor limb, to our knowledge, there were only a few reports (Kuo et al., 2001, Tsuji et al., 2008, Kuo et al., 2009, Townley et al., 2011). Although those reports tried to evaluate the function of donor limb objectively, limitations of those studies were evaluation of only donor limb and

lack of data about factors that may influence the morbidity. Comparing with contralateral normal limb may give a baseline value for donor limb and the pattern of pedicle, size of flap, and donor site closure can be contributing factors to donor limb morbidity.

In the present study, we prospectively evaluated the functional morbidity of donor limb of ALT flap, subjectively and objectively. We collected the data from the patient using questionnaire, subjectively and evaluated donor limb function using Biodex System, objectively. We tried to prove the morbidity of donor limb of ALT comprehensively and determine factors contributing to the donor limb morbidity.



II. MATERIALS AND METHODS

From September 2011 and November 2012, we conducted a prospective study on 14 patients who underwent free ALT flaps for head and neck defect reconstruction. All participants read and signed an informed consent form before the operation. The purpose of the study was to compare the donor limb of ALT with a normal limb, we excluded all the patients who received any kind of surgery on the contralateral limb and had any lower extremity trauma. We also excluded patients with preoperative donor limb morbidity from cerebral or cardiac dysfunction or osteoarthritis of the lower extremities or trauma.

The flap was elevated as a fasciocutaneous flap to fill the defects, that is, skin with its attached fat and fascia were harvested at the same time. The size of flap was measured as the longest length of the longitudinal axis and perpendicular to that axis.

The septocutaneous perforators mean vessels course between major muscle groups in an intermuscular septum and musculocutaneous perforators address vessels enter the deep fascia and contribute to both the deep fascia and cutaneous circulation (Mathes et al. 1982). During flap elevation, if a large septocutaneous perforator arising from the descending branch or transverse branch of the lateral circumflex femoral artery was present, then the flap can be harvested as a septocutaneous flap. However, the septocutaneous perforator was absent, intramuscular dissection of the musculocutaneous perforator was performed. We tried to cover the donor site with a local flap primarily, but, if there was too much tension around the thigh, a split thickness skin graft was performed.

Evaluation and records

Subjective evaluation

A questionnaire was given to patients during postoperative evaluation. Questions were formulated so that patients would compare presence of pain, itching sensation, hypoesthesia, intolerance to cold, fatigue while walking, climbing, and descending stairs, and subjective complaints of lower extremity weakness while performing activities of daily life before and after surgery.

Objective evaluation

The functional evaluation of the donor limb was conducted by the Biodex System, which can assess the muscle strength and endurance profiles of both donor and opposite normal thigh (Ohkoshi et al., 1998; Kannus et al., 1992). The isokinetic concentric peak torque/weight represents the muscle strength and the total work stands for muscle endurance. Bilateral leg testing was done to allow comparison between the donor limb and the non-donor limb for each subject. The knee extension and flexion at an angular velocity of 60° and 180° per second were measured and recorded (Tsuji et al., 2008). Each evaluation was performed separately for the donor limb and the non-donor limb.

At first, a preoperative dynamic functional evaluation was performed on both the donor and non-donor sides (Carl et al., 1988; Reichard et al., 2005), and all patients were evaluated again at a 6 month postoperative follow up.

Second, we divided the patient groups according to the pattern of perforator (septocutaneous vs. musculocutaneous), method of donor site closure (primary closure vs. skin graft), and size of flap (<64cm² vs. ≥64cm²).

Finally, statistical analysis was performed using a statistical software package SPSS 13.0 (SPSS, Chicago, Illinois, USA). Values were analyzed for statistical significance by the paired *t*-test to compare differences in quadriceps contraction between donor and normal thighs. A *p*-value of <0.05 was considered statistically significant. The data are described in terms of mean and standard error of the means.

III. RESULT

All flaps were successfully survived without early complications. Thirty patients were 11 men and 3 women with mean age of 53.8 years (range: 33 – 76). The average flap width was 6.92 cm (range, 3 to 11.0 cm) and the average flap length was 11.96 cm (range, 6.5 to 25.0 cm). The mean flap size was 86.75 cm². Musculocutaneous perforators were found in 9 cases, while 5 were septocutaneous. In all cases, an amount of fascia equivalent to the area of the skin paddle was included with the flap. The donor site was closed directly in 7 cases and covered with a split thickness skin graft in 7 cases (Table 1).

The ALT donor site was assessed postoperatively at a minimum follow-up of 6 months. The results of the questionnaire are shown in Table 2. The most common complaint at follow up was hypoesthesia in the lateral thigh area (8/14 flaps, 57.1%). 8 patients described a decreased mobility throughout while climbing and descending stairs at follow-up. However, all patients can walk alone, and none of them presented signs of circulatory disturbance in the donor leg, either at rest or on exertion.

The results of the functional assessment are shown in Table 3. We present the comparison between the pre- and post-operation groups and donor limb and non-donor limb. Overall, there were no significant differences between the groups, except for total work at 180° extension. The values of isokinetic peak torque/weight and total work of the knee extension or flexion at an angular velocity of 60 or 180° per second was not significant statistically ($p < 0.05$). We assessed whether the donor limb morbidity was affected by pattern of perforator, method of donor site closure, and flap size. We concluded that these factors did not cause the morbidity of donor limb (Fig. 1).

Table 1.Characteristics of the subjects (n=14)

Variable	Number
Mean age (years)	53.8 (33 ~ 76)
Gender	
Men	11
Women	3
Pattern of perforator	
Septocutaneous	5
Musculocutaneous	9
Method of donor site closure	
Primary closure	7
Skin graft	7
Size of flap (cm ²)	
Mean (SD)	86.75 (57.19)
<64	6
≥64	8

Table2. Subjective symptoms of donor limb of the anterolateral thigh flap at follow up

Symptoms	Number of patients (%)
Pain sensation	5(35.7)
Difficulty walking	2 (14.3)
Itching sensation	5(35.7)
Hypoesthesia	8(57.1)
Cold intolerance	1(7.1)
Fatigue while walking	4(28.6)
Fatigue while climbing and descending stairs	8(57.1)
Muscle weakness	4(28.6)

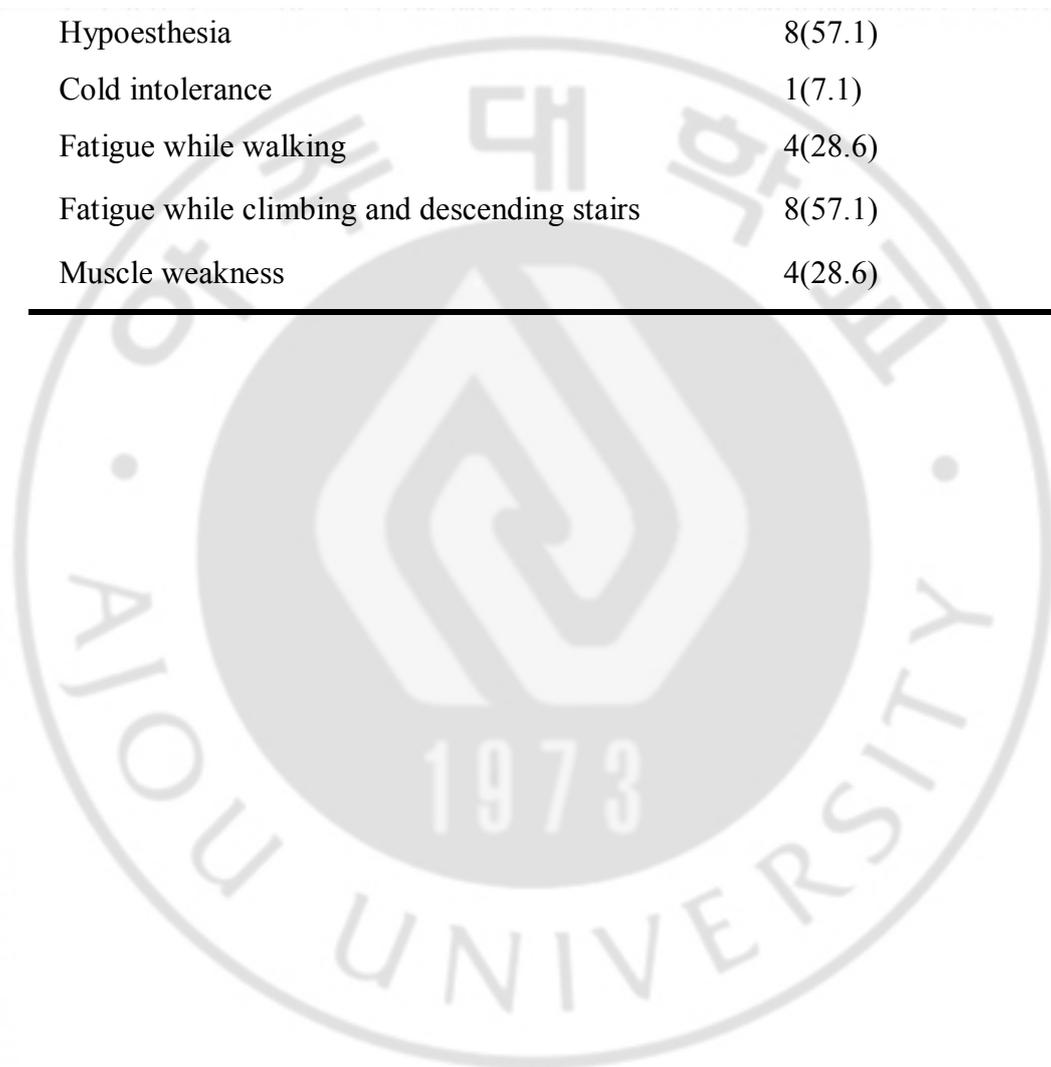
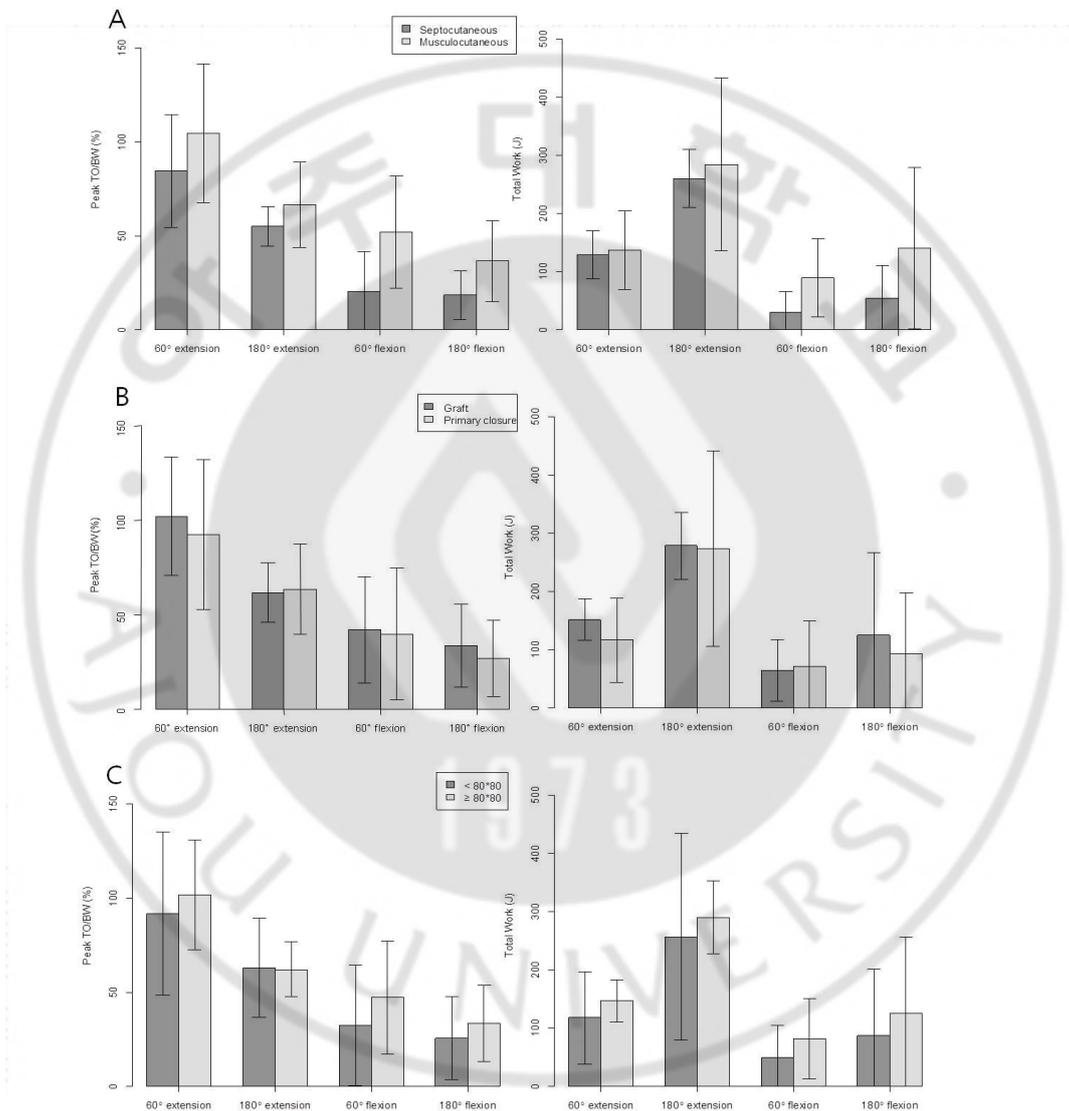


Table3. Comparison of functional morbidity: Pre-operation vs. Post-operation group and Donor limb vs. Non-donor limb

	Knee extension		Knee flexion	
	60°/sec	180°/sec	60°/sec	180°/sec
Peak torque/weight (%)				
Pre-operation	110.2 ± 46.55	69.1 ± 24.09	36.1 ± 29.17	33.4 ± 18.15
Post-operation	97.2 ± 49.15	62.3 ± 24.91	40.7 ± 28.08	30.0 ± 19.19
<i>p-value</i>	0.1909	0.2584	0.5505	0.3713
Donor limb	97.2 ± 49.15	62.3 ± 24.91	40.7 ± 28.08	30.0 ± 19.19
Non-donor limb	95.3 ± 29.92	54.5 ± 19.83	42.2 ± 22.59	29.6 ± 19.16
<i>p-value</i>	0.7846	0.0795	0.6601	0.8554
Total work (J)				
Pre-operation	151.4 ± 72.14	340.8 ± 177.73	52.8 ± 49.51	134.3 ± 109.89
Post-operation	134.1 ± 57.71	275.8 ± 120.45	67.7 ± 63.67	109.1 ± 120.98
<i>p-value</i>	0.2113	0.0459*	0.2993	0.1499
Donor limb	134.1 ± 57.71	275.8 ± 120.45	67.7 ± 63.67	109.1 ± 120.98
Non-donor limb	136.3 ± 43.13	261.3 ± 116.85	62.8 ± 43.23	105.6 ± 109.35
<i>p-value</i>	0.8643	0.4998	0.5964	0.6511

p-value < 0.05

Figure 1. Objective evaluations of donor limb function regarding factors contributing to the morbidity (p -value < 0.05). A. Pattern of pedicle, comparison between septocutaneous perforator and musculocutaneous perforator. B. Method of donor site closure, comparison between skin graft and primary closure. C. Size of flap, comparison according to flap size.



IV. DISCUSSION

The present study represents the prospective and comprehensive assessment of donor limb morbidity following ALT free flap. The results of this study show that there was no remarkable functional morbidity of donor limb after ALT flap operation, whatever, pattern of pedicle, method of closure, and size of flap.

Head and neck soft tissue defects following resection of tumor present a difficult reconstructive challenge (Koshima et al., 1993). The ideal surgical reconstruction will have the lowest morbidity and mortality, no fistulae or stricture rate, and allow early functional rehabilitation in relation to swallowing and tracheoesophageal speech (Murray et al., 2007). The preferential reconstructive technique is based on the surgeon's experience as well as the reported complications and donor site morbidity. Since reconstructive techniques and flap choices have evolved, reduction of donor site morbidity and uncomplicated primary wound healing have become important considerations in addition to flap survival (Townley et al., 2011).

The ALT free flap is being used with increasing frequency as a reconstructive option for full-thickness defects requiring relatively thin, pliable coverage. This free flap also has a long pedicle enabling a 2-team approach (Koshima et al., 1993).

The ALT flap was first reported by Song et al., 1984 as a septocutaneous perforator-based flap. If septocutaneous perforators are absent and only musculocutaneous perforators are found, intramuscular dissection of the perforators is required. Moreover, there are much more musculocutaneous perforators than septocutaneous perforators (Koshima et al., 1989). Therefore, during the dissection of the flap, it is not possible to avoid injury to the vastus lateralis muscle to some degree (Tsuji et al., 2008). As noted

by Casey et al., 2007 it is sometimes not possible to preserve the motor nerve to the vastus lateralis when it is intimately intertwined with the components of the vascular pedicle or interpolated between two consecutive perforators included in the flap design.

However, most authors describe the functional loss of the donor limb as minimal; the minimal impact of ALT free flap harvest on lower extremity strength, even when the vastus lateralis muscle is interrupted or the motor nerve transected, is most likely attributable to the synergistic effect of the remaining three muscle bellies of the quadriceps. In addition, there are frequently multiple branches supplying the vastus lateralis muscle and often, at least some of these branches can be spared even when the major branch or branches cannot (Hanasono et al., 2010).

In this study, we were able to assess the morbidity of the ALT flap donor limb subjectively and objectively.

At first, we found that the majority of patients (57.1%) lost sensation in the distribution of the lateral femoral cutaneous nerve. It is similar to the findings of Kimata et al., 2000 who noted a loss of sensitivity in 87.5 % of 32 patients evaluated after ALT free or pedicled flap harvest. The skin territory of the ALT flap is innervated by branches of the lateral femoral cutaneous nerve of the thigh, which are frequently encountered when raising the flap (Townley et al., 2011). The thigh skin envelope requires protective but not fine perceptive sensation. The sensory disturbance was rarely troublesome. Although patients initially reported a loss of anterior thigh sensation, the nerve was not completely transected and were therefore recovered along with sensation, or other local nerves (superior perforating nerve and median perforating nerve) were able to compensate over time (Ribuffo et al., 2005). Suprafascial flap dissection may be potentially helpful in preserving the lateral femoral cutaneous nerve, therefore, reducing sensory loss and also possibly decreasing pain (Lipa et al.,

2005).

In the objective study, first, we performed the functional assessment by comparing donor and normal thighs, preoperatively and postoperatively. Tumor resection and reconstruction in head and neck surgery is significantly invasive, and our patients therefore required a certain period of bed rest. Because the muscle strength of the lower limb may weaken during that period, we performed preoperative functional evaluation of both extremities and compared the results with those obtained during evaluation of muscle function at 6 months postoperatively.

Using the Biodex System, we could assess the isokinetic and isometric function, and the concentric and eccentric function of the tested muscle (Tsuji et al., 2008). In the isokinetic test, isokinetic loading has accommodating resistance throughout the range of motion. Thus, it can assess muscle function objectively and the data are both reliable and reproducible (Reichard et al., 2005; Ohkoshi et al., 1998). Power and endurance of the thigh muscles are reflected by the data of peak torque/weight and total work. Most of our patients did not show significant differences in isokinetic power tests at 60° and 180° of flexion or extension of the thigh muscles between donor and normal thighs ($p < 0.05$). There was a statistically significant difference between pre- and post-operation groups concerning total work at 180° of extension. The long period of rest may be the contributing factor. The total work of knee extension reflects the endurance of the anterior thigh. As the strength of the anterior thigh was preserved, we can expect the recovery of the knee endurance through rehabilitation.

Second, we attempted to investigate the effect of muscular injury during the operation. We divided the patients into the septocutaneous perforator flap and musculocutaneous perforator flap groups for comparison. There were no significant differences between the groups. During the ALT flap harvest, only the vastus lateralis is dissected and still three bellies of the quadriceps could provide

good functional synergy (Hanasono et al., 2010).

Third, the effect of donor limb coverage methods was evaluated. The coverage technique (primary closure vs. skin graft) did not seem to affect weakness. Kimata et al., 2000 reported that 3 of 5 patients developed restricted range of motion after skin graft donor-site closure, which they attributed to graft contracture. However, in our study, there were no significant changes in knee range of motion in any of the patients, regardless of the type of donor-site closure performed. There was also no remarkable complication among the patients in the skin graft group. Therefore, whenever the wound cannot be closed without significant tension to avoid wound dehiscence or even a compartment syndrome-type complication with muscle necrosis, consider the skin graft closure.

Finally, donor site morbidity regarding the flap size was assessed. Lipa et al., 2005 reported that the sacrifice of a large segment of deep fascia has a significant impact on persistent weakness and pain, resulting in lower-extremity dysfunction. Previous studies (Zhou et al., 1991) indicated that the deep fascia of the thigh is an important component of the ALT flap and must be included in the flap elevation to ensure adequate flap perfusion. Thus, we elevated the flap with deep fascia to achieve better survival of the flap. Based on our finding regarding the effect of fascia defect on the donor site morbidity, there was very little functional compromise to the patient. Additionally, we were able to achieve a good flap success rate without donor site morbidity.

This study proves objectively that damage to or functional disturbance of the donor limb of the ALT flap is minimal even if the muscle is injured during harvesting. Moreover, we found that complaints concerning a decreased mobility were not objective from the results of our questionnaire.

V. CONCLUSION

Donor-site morbidity is a factor affecting the choice of flap used in defect reconstruction (Kimata et al., 2000). This study provides a comprehensive assessment (subjective and objective) of the ALT donor site morbidity. We can conclude that in terms of muscle strength and indurations, the ALT flap shows the minimal donor limb morbidity and does not affect the patient's daily life. Nevertheless, we have identified that the postoperative long period of rest may cause delayed functional recovery. Therefore, we have to encourage the patient to do the rehabilitation exercise.

Knowledge of the reliability, versatility, and low donor-site morbidity of the ALT free flap will drive better decision-making for both surgeons and their patients when presented with flap alternatives for defect coverage. The ALT free flap can be the first-line option for defects reconstruction encompassing a wide range of surface areas and thicknesses.

REFERENCES

1. Ali RS, Bluebond-Langner R, Rodriguez ED, Cheng MH, “The versatility of the anterolateral thigh flap”, *Plast Reconstr Surg*, 124, pp. 395–407, 2009.
2. Carl LH, Allen WJ, Niel BM, “Concentric and eccentric torque comparisons for knee extension and flexion in young adult males and females using the kinetic communicator”, *Am J Sports Med*, 16, pp. 234–237, 1988.
3. Casey WJ, Rebecca AM, Smith AA, Craft RO, Hayden RE, Buchel EW, “Vastus lateralis motor nerve can adversely affect anterolateral thigh flap harvest”, *Plast Reconstr Surg*, 120, pp. 196–201, 2007.
4. Hanasono MM, Skoracki RJ, Yu P, “A prospective study of donor site morbidity after anterolateral thigh fasciocutaneous and myocutaneous free flap harvest in 220 patients”, *Plast Reconstr Surg*, 125(1), pp. 209–214, 2010.
5. Huang CH, Chen HC, Huang YL, Mardini S, Feng GM, “Comparison of the radial forearm flap and the thinned anterolateral thigh cutaneous flap for reconstruction of tongue defects: An evaluation of donor-site morbidity”, *Plast Reconstr Surg*, 114, pp. 1704–1710, 2004.
6. Kannus P, Järvinen M, Johnson R, Renström P, Pope M, Beynon B, Nichols C, Kaplan M, “Function of the quadriceps and hamstrings muscles in knees with chronic partial deficiency of the anterior cruciate ligament: Isometric and isokinetic evaluation”, *Am J Sports Med*, 20, pp. 162–168, 1992.
7. Kimata Y, Uchiyama K, Ebihara S, Sakuraba M, Iida H, Nakatsuka T, Harii K, “Anterolateral thigh flap donor-site complications and morbidity”, *Plast Reconstr Surg*, 106(3), pp. 584–589, 2000.
8. Koshima L, Fukuda H, Yamamoto H, Moriguchi T, Soeda S, Ohta S, “Free

- anterolateral thigh flaps for reconstruction of head and neck defects”, *Plast Reconstr Surg*, 92, pp. 421-428, 1993.
9. Koshima I, Fukuda H, Utsunomiya R, Soeda S, “The anterolateral thigh flap; variations in its vascular pedicle”, *Br J Plast Surg*, 42, pp. 260–262, 1989.
 10. Kuo YR, Jeng SF, Kuo MH, Huang MN, Liu YT, Chiang YC, Yeh M, Wei FC, “Free anterolateral thigh flap for extremity reconstruction: clinical experience and functional assessment of donor site”, *Plast Reconstr Surg*, 107, pp. 1766-1771, 2001.
 11. Kuo YR, Yeh MC, Shih HS, Chen CC, Lin PY, Chiang YC, Jeng SF, “Versatility of the anterolateral thigh flap with vascularized fascia lata for reconstruction of complex soft-tissue defects: clinical experience and functional assessment of the donor site”, *Plast Reconstr Surg*, 124, pp. 171-180, 2009.
 12. Lipa JE, Novak CB, Binhammer PA, “Patient-reported donor-site morbidity following anterolateral thigh free flaps”, *J Reconstr Microsurg*, 21(6), pp. 365-370, 2005.
 13. Mathes SJ, Nahai F, Clinical applications for muscle and musculocutaneous flaps, CV Mosby, St. Louis, 1982.
 14. Mureau MA, Posch NA, Meeuwis CA, Hofer SO, “Anterolateral thigh flap reconstruction of large external facial skin defects: a follow-up study on functional and aesthetic recipient- and donor-site outcome”, *Plast Reconstr Surg*, 115(4), pp. 1077-1086, 2005.
 15. Murray DJ, Gilbert RW, Vesely MJ, Novak CB, Zaitlin-Gencher S, Clark JR, Gullane PJ, Neligan PC, “Functional outcomes and donor site morbidity following circumferential pharyngoesophageal reconstruction using an anterolateral thigh flap and salivary bypass tube”, *Head Neck*, 29, pp. 147-154, 2007.
 16. Ohkoshi Y, Inoue C, Yamane S, Hashimoto T, Ishida R, “Changes in muscle

- strength properties caused by harvesting of autogenous semitendinosus tendon for reconstruction of contralateral anterior cruciate ligament” *Arthroscopy*, 14, pp. 580–584, 1998.
17. Pribaz JJ, Orgill DP, Epstein MD, Sampson CE, Hergrueter CA, “Anterolateral thigh free flap”, *Ann Plast Surg*, 34, pp. 585–592, 1995.
 18. Reichard LB, Croisier JL, Malnati M, Katz-Leurer M, Dvir Z, “Testing knee extension and flexion strength at different ranges of motion: The an isokinetic and electromyographic study”, *Eur J Appl Physiol*, 95, pp. 371–376, 2005.
 19. Ribuffo D, Cigna E, Gargano F, Spalvieri C, Scuderi N, “The innervated anterolateral thigh flap: Anatomical study and clinical implications”, *Plast Reconstr Surg*. 115, pp. 464–470, 2005.
 20. Song YG, Chen GZ, Song YL, “The free thigh flap: a new free flap concept based on the septocutaneous artery”, *Br J Plast Surg*, 37, pp. 149–159, 1984.
 21. Townley WA, Royston EC, Karmiris N, Crick A, Dunn RL, “Critical assessment of the anterolateral thigh flap donor site”, *J Plast Reconstr Aesthet Surg*, 64, pp. 1621-1626, 2011.
 22. Tsuji N, Suga H, Uda K, Sugawara Y, “Functional evaluation of anterolateral thigh flap donor sites: Isokinetic torque comparisons for knee function”, *Microsurgery*, 28, 233–237, 2008.
 23. Zhou G, Qiao Q, Chen GY, Ling YC, Swift R, “Clinical experience and surgical anatomy of 32 free anterolateral thigh flap transplantations”, *Br J Plast Surg*, 44, pp. 91–96, 1991.

- 국문요약 -

앞가쪽 넓다리 유리 피판공여부위 기능의객관적인 평가

아주대학교 대학원 의학과

한대희

(지도교수: 박명철)

앞가쪽넓다리유리피판은가쪽넓다리휘돌이동맥의내림가지의천공지를 바탕으로하고있다. 넓다리휘돌이동맥에다양한해부학적변이가있기때문에천공지를찾기위해외측광근에대한근육박리를피할수없다. 기존의연구 논문에서는공여부의이환률에대하여객관적인평가보다는환자에게설문조사를 통한주관적인평가가대부분이었다. 본연구에서는전향적으로하지공여부의기능에대해서평가하고공여부기능상의객관적인이환률에대하여조사하고자한다.

2011년9월부터2012년11월까지아주대학교병원에서시행한앞가쪽넓다리유리피판을이용한두경부결손의재건환자14명을대상으로전향적연구를시행하였다.주관적인평가로수술후 6개월째설문조사를 통한평가를시행하

였다. 그리고 객관적인 평가로 수술 전과 수술 후에 무릎 관절에 대한 운동 능력을 평가하였다. 이때 Biodex System으로 운동 능력을 평가하였고 이것은 근육의 기능을 객관적으로 평가할 수 있으며 그 결과 자료는 믿을 수 있고 재생 가능한 것으로 알려져 있다. 공여부의 수술 전과 수술 후 변화를 비교하였고 공여부와 정상 부위의 변화를 비교하였다. 그리고 추가적으로 환자 군을 나누어서 사이막 천공지피판군과 근피부천공지피판군, 공여부 재건을 봉합으로 한 군과 피부 이식으로 한 군, 그리고 공여부 결손의 크기가 64cm^2 이상인 군과 미만인 군으로 나누어서 비교하였다.

연구 결과 먼저 본 연구에서 시행하였던 14례의 두경부 재건 수술은 성공적으로 끝났다. 설문지 조사를 통한 주관적인 평가에서는 일부 환자들이 공여부 주변으로 감각 저하를 호소하였고 일부 운동 능력에도 감소되었다고 표현하였다. 하지만 대부분의 환자들은 일상 생활에 큰 제한은 없었다. 그리고 객관적인 평가에서는 허벅지에서 발휘되는 근력과 근지구력으로 공여부의 기능을 평가하였다. 수술 부위 180도 신전했을 때 수술 전과 비교했을 때 근지구력에서 통계적으로 의미가 있는 감소를 보였다 (0.0459). 그밖에 정상 부위와 수술 부위, 사이막 천공지피판군과 근피부천공지피판군, 공여부 재건을 봉합으로 한 군과 피부 이식으로 한 군, 그리고 공여부 결손의 크기가 64cm^2 이상인 군과 미만인 군에서 통계적으로 의미 있는 차이가 보이지 않았다 ($p < 0.05$).

환자가 호소하는 공여부의 감각의 변화는 기존의 발표되었던 논문의 결과와 같다고 볼 수 있겠으며 감각신경이 모두 절제된 것이 아니고 주변신경에서 자라나 오는 것을 기대해 볼 수 있기 때문에 회복을 기대해 볼 수 있겠다. 그리고 전반적으로 수술부위의 객관적인 기능은 보존되어 있었다. 수술 후 근지구력 일부 감소된 것은 수술 후 장기간 침상 안정으로 재활이 충분하지 못했던 것으로 보이며 수술 후 재활에 대하여 환자 교육이 필요하겠다.

본 연구에서는 앞가쪽 넓다리 유리피판을 거상하는 동안에 근육에 손상이 있어도 공여부의 기능적인 손상이 적다는 것을 객관적으로 증명하였다. 덧붙여 환자가 호소하는 다소간의 운동능력 감소 소견은 객관적이지 못하다는 것을 확인할 수 있었다.