# Anatomical relations between perforators of the descending branch of the lateral femoral circumflex artery and motor nerve branches of the vastus lateralis muscle

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**INTRODUCTION**: The anterolateral thigh flap (ALT flap), which is nourished by perforators from the descending branch of the lateral femoral circumflex artery (LFCA), has been one of the most used flaps for soft tissue reconstruction. Because of its various advantages such as long vascular pedicle, relatively large flap, and possible harvesting in supine position, the ALT flap can be applied to reconstruction of almost all areas. However, the donor site morbidities associated with the ALT flap have elicited increasing attention due to the widespread utilization of this flap. Musculoskeletal dysfunction is one of the most notable disorders causing decreased muscle power of knee extension and fatigue during gait. It is caused by not only direct injury to the vastus lateralis muscle (VL) but also the motor nerve of the vastus lateralis muscle (MNVL) which is arised from the femoral nerve and divided to several branches running along the descending branch of the LFCA to innervate the VL, injury during harvesting the ALT flap. There have been only two anatomical studies but detailed anatomical relationship is still unclear. The purpose of this study is to investigate the overall anatomic locations of perforators from the descending branch of the LFCA and the MNVL using fresh-frozen cadaveric specimens, and to determine which branches of the MNVL are at higher risk of injury.

**METHODS**: This study was conducted on 43 limbs from 23 fresh frozen cadavers without surgical or trauma scars on the femur were used and completed in the Department of Anatomy, Faculty of medicine, Chiang-Mai University, with institutional ethical approval obtained. The 30 mL of a silicone rubber compound was injected into the femoral artery to visualize the vessels. We decided the reference line from the anterior superior iliac spine to the top of the lateral border of the patella and measured the number of skin perforators (P) from the descending branch of the LFCA and their locations through the fascia femoris, and the number of branches from MNVL (N) and the locations where the motor nerve branches invade VL muscle. The locations are expressed as 0-100% from the proximal to the distal side of the reference line. Statistical analysis was performed using IBM SPSS Statistics software. Mann-Whitney's U test was used to compare the obtained data of locations of perforators and motor nerve branches. A value of p 0.05 was considered significant.

**RESULTS SECTION**: There were 1 to 6 (mean 2.7) P from the descending branch of the LFCA. P were designated as P-I to P-VI, respectively, from proximal to distal. The rates of presence were that P-I: 100%, P-II: 93%, P-III: 49%, P-IV: 23%, P-V: 7%, and P-VI: 2%. There were 2 to 7 (mean: 4) N. N were designated as N-I to N-VII, respectively, from proximal to distal. The rates of presence were that N-I: 100%, N-II: 100%, N-III: 95%, N-IV: 40%, N-V: 19%, N-VI: 5%, and N-VII: 2%. The mean locations of the P were that P-I: 51.1%, P-II: 63.8%, P-III: 73.6%, P-IV: 80.4%, P-V: 80.9%, and P-VI: 87.5%. The mean locations of the N were that N-I: 43.0%, N-II: 54.5%, N-III: 63.0%, N-IV: 67.4%, N-V: 68.1%, N-VI: 69.7%, and N-VII: 75.0%. (Figure 1) Comparing the locations between the P and N, N-I was significantly more proximal than P-I (P-I/N-I: $p < 0.01$), and N-II were significantly more proximal than P-II. (P-II/N-II: $p < 0.01$) On the other hand, there were no significant differences in the distributions between P-I and N-II, P-II and N-III, and P-II and N-IV. (P-I/N-II: $p = 0.079$, P-II/N-III: $p = 0.985$, P-II/N-IV: $p = 0.329$, P-II/N-V: $p = 0.438$). When the most reliable two proximal perforators (P-I and P-II) were used for flap harvest using 40 limbs with two or more perforators, 60 nerve branches (N-I:9, N-II:26, N-III:17, N-IV:6, and N-V:2) from the total of 144 (41.7%) between the two perforators could be damaged because transection of the motor nerve branches were required for flap harvest. On average, this was equivalent to damaging 1.5 motor nerve branches per limb. In 13 of 40 limbs (32.5%), only one motor nerve branch was remained after transection of the motor nerve branches during flap harvest. However, there were no cases in which all motor nerve branches were severed.

**DISCUSSION**: The results of this study showed that there was an average of 2.7 perforators from LFCA, and 93% of cadavers had at least two perforators that could be used for ALT flap harvesting. The number and distribution of perforators was similar to that reported in previous studies. On the other hand, the motor nerve branches of the VL muscle ranged from 2 to 7 (mean: 4), and 95% of cadavers had at least three motor nerve branches. Statistically, N-I was located more proximal than P-I, which might indicate that N-I was unlikely injured during the flap harvest. However, the N-II was statistically located between the P-I and P-II, which might indicate that the N-II was the most likely injured during the flap harvest when both the P-I and P-II were included in the flap. When the most reliable two perforators (P-I and P-II) were used for flap harvest, 41.7% of motor nerve branches located between P-I and P-II could be damaged. However, there were no cases in which all motor nerve branches were severed. These results may support the previous report that the ALT flap containing two perforators does not cause severe muscle weakness at the donor site, because the risk of sacrificing all motor nerves is very low. The VL muscle is innervated by several motor nerves branches, and it is still unclear how many sacrificing branches will cause clinically significant dysfunction. The results of our study indicate that limbs with small number of motor nerve branches are likely to leave only one nerve branch after the flap harvest if two perforators are included in the flap (Figure 2). In such cases, muscle weakness may occur more easily. However, it is difficult to identify all nerve branches intraoperatively despite the possibility of such case. In order to prevent muscle weakness, it may be preferred to repair the severed nerve as much as possible after the flap harvest or to abandon using two perforators when a single perforator is enough to nourish a flap. There were some limitations in our study. The results using cadavers may differ from those of living bodies, the clinical detriment of sacrificing a few of several motor nerve branches has not been determined, and the need for repair of the damaged nerve is unknown.

**SIGNIFICANCE/CLINICAL RELEVANCE**

This study is to investigate the overall anatomic locations of perforators from the descending branch of the LFCA and the MNVL using fresh-frozen cadaveric specimens, and to determine which branches of the MNVL are at higher risk of injury during harvesting the ALT flap.

Figure 1

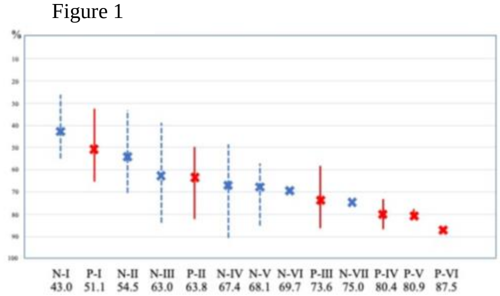


Figure 2

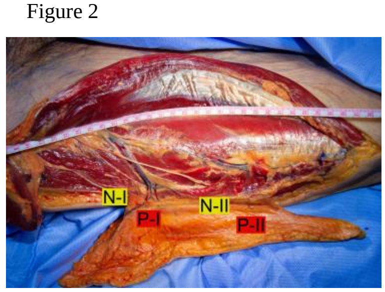


**Figure1.**
Location of Perforators and Motor nerve branches

**Figure 2.**
When the two proximal perforators (P-I and P-II) were used for flap harvest, 1 nerve (N-II) could be damaged, and only N-I remained.