Cross-sectional Study

A vascular anatomical study of the anterolateral thigh flap in the Vietnamese’s adult cadavers

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ABSTRACT

Background: The aim of this study was to confirm the morphometry of the anterolateral thigh (ALT) pedicle and the location of the perforators in the adult Vietnamese population.

Material and methods: Forty dissections of the thigh were carried out in 20 Vietnamese dedicate cadavers. Including 13 cadavers were fixed by Formalin and 7 cadavers were fixed by fridge. The number, origin, location of the perforators and the diameter of the ALT pedicles were studied and measured.

Results: The length of the thigh was 39.9 ± 2.8 cm. 39/40 cases (97.5%) were a perforator of a 4 cm circle drawn at the midpoint thigh. There were 161 perforators. In 82.7% of perforators were musculocutaneous perforators and 17.3% perforators were septocutaneous perforators. There were 5 types of vascular pedicles. Type 1: the perforators originated from the descending branch were 65%; Type 2: from the oblique branch were 22.5%; Type 3: from the transverse branch were 5%; Type 4: from profundal femoris were 5%; Type 5: from femoral artery were 2.5%. The average length of the flap pedicle was 11.6 ± 2.4 cm, the diameter of the artery was 2.51 ± 0.52 mm, the vein was 2.95 ± 0.56 mm and 2.18 ± 0.46.

Conclusion: The ALT flap is a constant vascular supply, a long pedicle with a suitable diameter for anastomoses. The ALT can be harvest widely and reliable with a perforator of a 4 cm circle drawn at the midpoint thigh.

1. Introduction

The anterolateral thigh flap was the first described in 1984 by Song et al. and the other studies of the other authors [1–3]. All the authors found that the ALT flap was supplied by the perforators arising from the branches of the lateral circumflex femoral artery (LCFA). However, there was a difference between the studies. In the recent years, ALT flap has been widely used for the reconstruction of various defects because the advantage of the ALT flap: A long and large diameter pedicle, low donor site morbility, large skin paddle and can utilise combination of skin, fat, fascia, muscle. This flap still remains disadvantage: it has variable anatomy of vascular pedicle so difficult dissection. The knowledge of the anatomy of the LCFA is suggested for the clinicians planning surgery. Therefore, we carried this study whose purpose was to confirm the morphometry of the ALT pedicle and the location of the perforators in the adult Vietnamese population.

2. Materials and methods

2.1. Materials

The study was dissected in 40 intact thighs of 20 mature Vietnamese cadavers at the Anatomy Department, Ho Chi Minh City Medicine and Ho Chi Minh Pharmacy University in May 2019. Including 12 male cadavers, 8 female cadavers, average age of 70 ± 16 years (range, 33–95 years) in which 13 cadavers were fixed by using the formalin of 10%, 7 fresh cadavers were firstly fixed in the fridge with the temperature at 30 °C, after that maintained at a temperature at −12 °C to −15 °C when using.

2.2. Methods

Cross-sectional observational study.

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2.3. Process of dissection

The all cadavers were lied supine on the operating table.

A reference line was drawn from the anterior superior iliac spine (ASIS) to superior lateral border of the patella. This line was separated into 10 line segments. Draw the circle having a radius of one line segment at the center of this line.

Divide the skin according to anterior thigh, determine perforators of anterolateral thigh and opposite in skin (Fig. 2).

Restrodissected from perforators to the main pedicle: descending branch (DB), oblique branch (OB) and transverse branch (TB) of the LCFA, after revealing the LCFA to the origin and the profunda femoris (Figs. 1 and 3).

For fresh cadavers, inject Methylen blue to pedicle flaps to determine the area of blue skin (Fig. 4)

2.3.1. Qualitative index

- Origin of LCFA
- Branches of LCFA
- Perforators of ALT flap from transverse branch, oblique branch and descending branch (musculocutaneous perforator or septocutaneous vessels) and another branch.
- Distribution of perforators, determination of location of perforators in thigh by each line segment.

2.3.2. Quantitative index (units: mm, cm)

- Length of thigh (from ASIS to superior lateral border of the patella), length of line segment.
- Length of pedicle flaps:
- Diameter of vascular was determined in the origin of pedicle flaps.
- Area of Methylene blue thigh in fresh cadavers.

3. Result

- The length from ASIS to the superior lateral aspect of the patella was 39.9 \(\pm\) 2.8 cm (from 35 cm to 44.5 cm), mean length of one line segment is 3.99 cm (\(\approx\) 4 cm). Therefore, the radius of the circle whose center was the midpoint of the line from the ASIS to the superior lateral aspect of the patella was 4 cm.

3.1. Perforators

- In 40 thighs have 161 perforators. In inclusion, the right side has 83 perforators and the left side has 78 perforators. The numbers of perforators in the thigh are mean of 4.1 perforators (from 1 to 6 perforators), the rate of musculocutaneous perforators is 82.7%, septocutaneous vessel is 17.3% in total of perforators.

In Diagram 1, the perforators mostly concentrated in segments: 5, 6, 7 and 8. In 40 dissected flaps, 39/40 (97.5%) flaps have perforators that located in the central circle. In Diagram 2, the majority of septocutaneous perforators were found in segments: 3, 4, 5 and the majority of musculocutaneous perforators were found in segments: 6, 7, 8.

3.2. Origin of vascular pedicle of flap

- Originating from the LCFA with 37/40 specimens, account to 92.5%.
- Directly originating from the profunda femoris with 2/40 specimens, account to 5%.
- Originating from the femoral artery with 1/40 specimens, account to 2.5%.

Type of vascular pedicle of flap: We have seen 5 types of vascular pedicle of flap:
- Type 1: vascular of flap is perforator having origin from the descending branch of LCFA (26/40 specimens, account to 65%).
- Type 2: vascular of flap is perforator having origin from the oblique branch of LCFA (9/40 specimens, account to 22.5%).
- Type 3: vascular of flap is perforator having origin from the transverse branch of LCFA (2/40 specimens, account to 5%).
- Type 4: vascular of flap is perforator having origin from the profunda femoris (2/40 specimens, account to 5%).
- Type 5: vascular of flap is perforator having origin from the femoral artery (1/40 specimens, account to 2.5%).

3.3. Composition, length, diameter of vascular pedicle of ALT flap

Composition of vascular pedicle of ALT flap: Vascular pedicle of ALT flap having one artery and one vein accounts to 10/40 specimens (25%). There is no abnormal case in composition of vascular pedicle of flap.

Length of vascular pedicle of ALT flap: Vascular pedicle of flap has a length of $11.6 \pm 2.4$ cm (with sample $n = 40$), in which the longest is 16.5 cm and the shortest is 5.7 cm.

Diameter of vascular pedicle of ALT flap: The diameter of artery is $2.51 \pm 0.52$ mm (from 1.8 - 3.7 mm), big vein is $2.95 \pm 0.56$ mm (from 2.2 - 4.6 mm), small vein is $2.18 \pm 0.46$ mm (from 1.2 - 3.2 mm).

The area of Methylene blue in the thigh has the length of $22.86 \pm 3.65$ cm (from 16 to 29 cm), the width of $12.43 \pm 1.91$ cm (from 10 to
cases. The average diameter of the smaller veins was 2.18 mm (1.2–0.46 mm). The average diameter of the bigger veins was 2.95 mm (2.2–4.6 mm). So, the ALT flap had a long pedicle length with big vessel diameter that was suitable for anastomosis.

The size of the flap: Koshima reported that the ALT flap was harvested with the 35 cm maximum length and the 25 cm maximum width [13]. In medical literature searching, the maximum length of the ALT flap was 38 cm. In our study, through Methylene blue injection into the pedicle to identify the blood supply, the length area of Methylene blue in the thigh ranged from 20 to 27 cm and the width ranged from 12 to 15 cm, the maximum size of area of Methylene blue in the thigh was 27 × 15 cm.

5. Conclusion
The average length of the thigh was 39.9 ± 2.8 cm. In 97.5% of the dissections, the perforators concentrated within a 4 cm radius circle drawn at the midpoint of a line connecting the ASIS and the superior lateral aspect of patella. 82.7% of perforators were musculocutaneous perforators and 17.3% of perforators were septocutaneous perforators. The perforators mostly originated from the DB in 65%, from the OB in 22.5%. The average length of the ALT flap pedicle was 11.6 ± 2.4 cm, the average diameter of the artery was 2.51 ± 0.52 mm and the average diameter of the bigger vein was 2.95 ± 0.56 mm. The maximum size of Methylene blue in the thigh was 27 × 15 cm.

Ethical Approval
Ethical approval was obtained from institutional review board of local faculty and the participating hospital.

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Author contribution
Ngo Thai Hung: study concept, data collection, data interpretation, and writing the paper.
Le Van Doan: data collection, data interpretation and writing the paper.
Vu Huu Trung: data interpretation and writing the paper.
Nguyen Van Cuong: data interpretation and writing the paper.

Consent
None.

Registration of Research Studies
Name of the registry: Unique Identifying number or registration ID: Hyperlink to your specific registration (must be publicly accessible and will be checked):

Guarantor
Ngo Thai Hung.
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Declaration of competing interest
The authors declare that there is no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103416.

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