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Rotation arc of pedicled anterolateral thigh flap for abdominal wall reconstruction: How far can it reach?



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Summary Purpose: The aim of this study was to elucidate the extent to which pedicled anterolateral thigh (ALT) flaps can reach in reconstruction of abdominal wall defects.

Methods: A total of 60 pedicled ALT flaps were raised from cadavers and were experimentally transferred to the abdominal region. The distance between the umbilicus and the most cranial point of the flap after transfer was defined as cranially reachable distance (CRD). Three issues were evaluated: (1) the difference in the CRD when the flap pedicle was positioned superficial or deep into the rectus femoris (RF) and sartorius (SA) muscles; (2) the difference in the CRD in those cases where the main artery of RF arises from the descending branch of the lateral femoral circumflex artery, and is preserved or severed; and (3) maximum values of CRD.

Results: (1) CRD was significantly greater when the pedicle was passed deep into the muscles (-2.5 ± 3.8 SD cm) compared with superficial (-5.8 ± 3.3 SD cm), indicating placement of pedicles beneath the two muscles enables additional extension. (2) CRD was significantly greater for the severed condition (-0.3 ± 4.0 SD cm) than for the preserved condition (-3.3 ± 4.1 SD cm), indicating severing the main artery of RF allows additional extension. (3) Out of the 60 specimens, the CRD was cranial to the umbilicus in 17 flaps, indicating pedicled ALT flaps can reach the umbilicus in less than one-third (17/60) of cases.

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Conclusion: Pedicled ALT flaps can reliably reach regions inferior to the umbilicus. However, for defects superior to the umbilicus, other reconstructive options should be considered.

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Introduction

Full-thickness abdominal wall defects may arise following injury or tumor resection. When the defects cannot be directly closed, coverage requires flaps – such as external oblique abdominal muscle,¹ groin,^{2–4} tensor fascia lata (TFL),^{5–7} and anterior lateral thigh.^{8–13} Among these reconstructive options, this study focuses on the antero-lateral thigh (ALT) flap, which can achieve simultaneous reconstruction of the skin and fascial defect with limited donor morbidity. The ALT flap can be transferred to the abdomen in two ways: as a pedicled flap or free flap. The former is simpler, because it avoids vascular anastomoses and saves operation time and cost. However, pedicled flaps cannot cover the defects present in the upper abdominal region. In that case, the operating team must plan the need for a free flap in advance and not during surgery. For effective performance, the operator should be able to predict whether the defect could be covered with a pedicled ALT flap.

Prior knowledge on how far a pedicled ALT flap can reach in the abdominal region is essential in making such a prediction. Hence, this study aims to elucidate the extent to which pedicled ALT flaps can reach in the cranial direction.

Materials and methods

Experimental conditions

Specimens

Of the 62 preserved lower limbs (32 male and 30 female) donated to the department of anatomy at our institute for ALT dissection, two (both female) were unsuitable, because of absence of perforators. Therefore, 60 ALT flaps raised from the remaining 60 limbs were involved in this study (Figure 1).

Flap elevation

The skin and deep fascia were incised in the anterior midline of the middle-third region of each cadaver's thigh medial to the anticipated line of perforators. The subfascial dissection was developed to identify the perforators. Having determined the largest perforator, a skin paddle was then designed symmetrically with the perforator at its center point (Figure 2). The length of the skin island was arbitrarily determined to be one-third of the length of the line drawn from the anterior superior iliac spine (ASIS) to the superolateral margin of the patella. For instance, for a thigh whose distance between the ASIS and the

superolateral margin of the patella was 39 cm, the length of the skin paddle was set as 13 cm. The more distal the main perforator, the more distal is the flap and, consequently, the longer its arc of rotation. Distances between the ASIS and the superolateral margin of the patella were 41.8 ± 2.8 and 37.1 ± 1.9 SD cm for male ($n = 32$) and female limbs ($n = 28$), respectively. Dissection proceeded along the main perforator to its source from the descending branch of the lateral circumflex femoral artery. The isolation of the vascular pedicle enables mobilization of the flap in the cranial direction.

Measurement of reachable distances

After complete mobilization of the pedicle, flaps were transferred to the abdominal region through a subcutaneous tunnel made in the inguinal region. The transfer was performed in the cranial direction as far as possible, avoiding excessive tension on their vascular pedicles. The distance between the most cranial point of the flap (i.e., the tip of the skin paddle) and the umbilicus was defined as cranially reachable distance (CRD). The measured distances were positive when the tips of the skin paddles were extended beyond the umbilicus, and negative when they did not reach the umbilicus. For example, when the tip of the skin paddle reached a point more cranial than the umbilicus by 5 cm, CRD for that flap was evaluated as +5 cm, but when it fell short of the umbilicus by 2 cm, CRD was evaluated as –2 cm. Hence, CRD is a parameter that indicates how far a flap can reach in the cranial direction. That is, the greater the CRD, the more cranially the flap can be transferred.

Data evaluation

The data collected in the above-described measurement system were evaluated to clarify the following three issues.

Influence of pedicle positioning on reachable distances

In transferring pedicled ALT flaps, the vascular pedicles can be positioned using two approaches. In the first approach, vascular pedicles were positioned superficial to the rectus femoris (RF) and sartorius (SA) muscles (Figure 3A). This method was called superficial positioning. In the second approach, vascular pedicles were placed beneath the two muscles (Figure 4) to avoid hindrance of the pedicles by the two muscles during cranial transfer. This method was called deep positioning (Figure 3B). Each of those 60 flaps was transferred to the abdominal region via any of the two approaches, and CRD was measured for each transfer. Thereafter, the data for the two different approaches were compared.

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