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## Case Report

# Profunda femoris artery perforator flap for lateral knee joint reconstruction: A report of two cases

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## ABSTRACT

The profunda femoris artery perforator flap (PAP) based on a proximal skin perforator is often used for breast reconstruction. We report two cases of lateral knee joint reconstruction using a PAP flap based on a distal skin perforator.

Case 1 is a 16-year-old male adolescent who underwent inappropriate resection of a synovial sarcoma on the lateral aspect of the right knee joint, which necessitated additional wide resection that led to a soft tissue defect measuring 11 × 5 cm. We elevated a propeller PAP flap (23 × 7 cm) for defect reconstruction, and the flap survived completely.

Case 2 is an 81-year-old woman who underwent wide resection of an undifferentiated pleomorphic sarcoma on the lateral aspect of the right knee joint showed a persistent soft tissue defect measuring 9 × 6 cm. We elevated a propeller PAP flap (25 × 7 cm) as described in Case 1, and the flap survived completely.

Skin perforators of the profunda femoris artery are present both in the proximal and distal thigh; therefore, a PAP flap can also be elevated in the distal thigh. However, a few reports have discussed PAP flap elevation in the distal thigh for knee joint reconstruction.

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The PAP flap with a distal skin perforator can be elevated with a relatively large volume of skin paddle and may be a useful option for lateral knee joint reconstruction.

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## Introduction

The profunda femoris artery perforator flap (PAP) is a perforator flap that was first described by Allen et al.<sup>1</sup> in 2012 based on flaps that were previously reported by Baek et al.,<sup>2</sup> Maruyama et al.,<sup>3</sup> and Song et al.<sup>4</sup> An advantage of the PAP flap is that it is possible to harvest a relatively large volume of skin paddle with minimal donor site morbidity, and recent studies have reported its usefulness for breast reconstruction. The PAP flap is often elevated as a flap that includes the skin perforators of the proximal to central thigh, which branch from the profunda femoris artery. We report two cases of lateral knee joint reconstruction using the propeller PAP flap based on a skin perforator of the distal thigh.

## Case Report

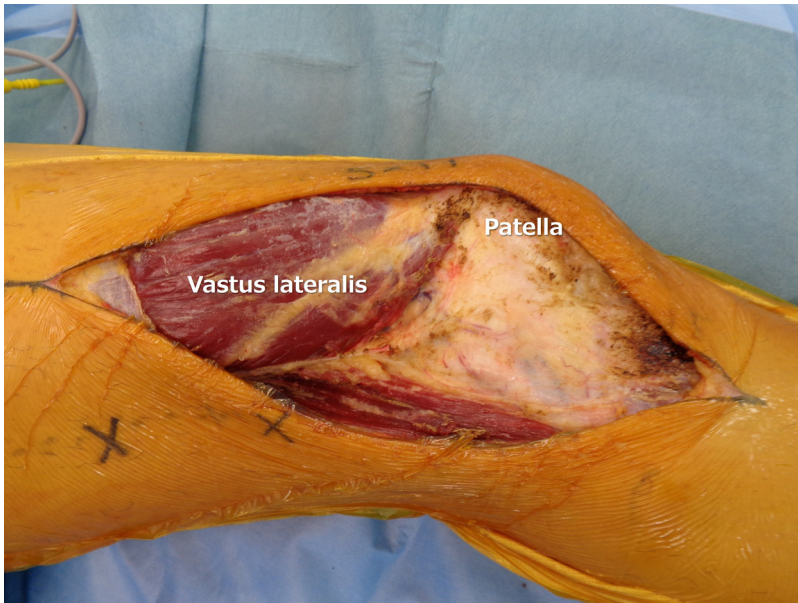
Flap elevation was performed as follows: Preoperative Doppler ultrasonography was used for the evaluation of skin perforators around the lateral femoral intermuscular septum, 10–15 cm proximal to the knee joint line, and the skin island was designed accordingly. The operation was performed with the patient placed in the supine position with both hips and knees flexed. The anterior border of the skin island was incised, and the flap was elevated posteriorly just above the tensor fasciae lata. The skin perforator was dissected and secured; subsequently, the posterior margin of the skin island was incised and elevated in the same plane. We identified several skin perforators that penetrated the biceps femoris muscle and ligated these vessels. We confirmed that flap rotation did not cause obstruction of perforator, and the wound was closed from both ends of the skin island. Finally, we performed a meticulous re-evaluation of the perforator to exclude any abnormalities, after which the wound was closed around the perforator.

Case 1: A 16-year-old male adolescent who underwent inappropriate resection of a synovial sarcoma on the lateral aspect of the right knee joint, which necessitated additional wide resection that resulted in a soft tissue defect measuring 11 × 5 cm (Figure 1). Using a distal skin perforator around the lateral femoral intermuscular septum, located 13 cm proximal to the knee joint line (Figure 2), we elevated a propeller PAP flap (23 × 7 cm), for defect reconstruction (Figure 3); the flap survived completely (Figure 4).

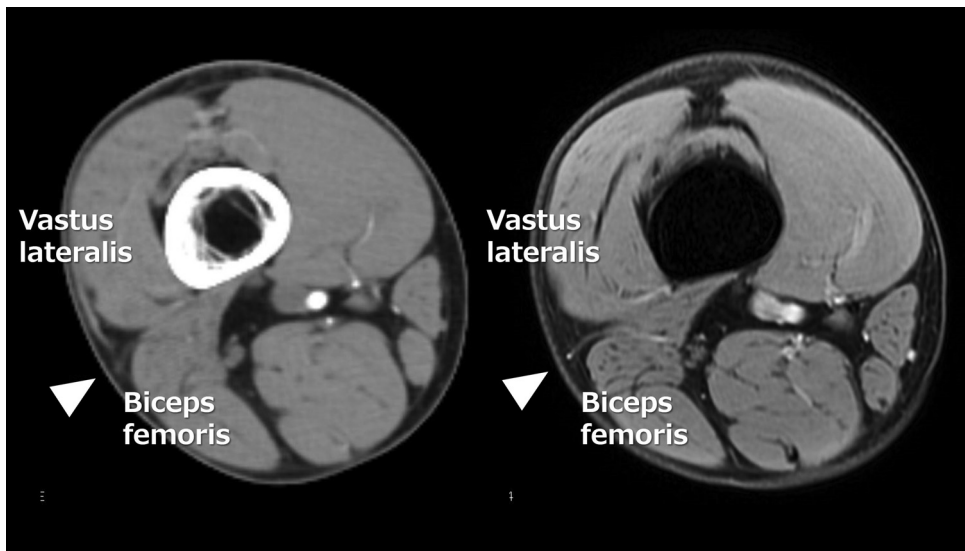
Case 2: An 81-year-old woman who underwent wide resection of an undifferentiated pleomorphic sarcoma on the lateral aspect of the right knee joint showed a persistent soft tissue defect measuring 9 × 6 cm. Using a distal skin perforator around the lateral femoral intermuscular septum, located 13 cm proximal to the knee joint line, we elevated a propeller PAP flap (25 × 7 cm) as described in Case 1; the flap survived completely.

## Discussion

As mentioned above, the PAP flap is often elevated as a flap that includes the skin perforators of the proximal to the central thigh. The PAP flap can also be elevated as a flap that includes skin perforator of the mid-to-distal thigh, i.e., a lateral thigh flap as reported by Baek et al.<sup>2</sup> However, only a few reports in the literature have described the use of a PAP flap for knee joint reconstruction. To



**Figure 1.** A soft tissue defect measuring 11 × 5 cm on the lateral aspect of the right knee joint.



**Figure 2.** Axial images of contrast-enhanced computed tomography (left) and magnetic resonance imaging (right). The distal skin perforators branched from the profunda femoris artery and then ran between the vastus lateralis and biceps femoris muscles to the skin.



**Figure 3.** Just after the elevation of the flap. White arrowhead is the distal skin perforator.

our knowledge, only two studies have reported knee joint reconstruction using this flap; one study included seven patients with soft tissue defects measuring 100–150 cm<sup>2</sup> around the knee joint<sup>5</sup>, and the other described a single patient who underwent the reconstruction of a soft tissue defect measuring 8 × 6 cm on the lateral aspect of the knee joint.<sup>6</sup>

In this study, we used the distal skin perforator around the lateral femoral intermuscular septum, and the perforators were located 13 cm from the knee joint line in both patients. Ahmadzadeh et al. reported that the mean number of skin perforators that originated from the profunda femoris artery was 5±2, and the most distal skin perforator was located 10 cm proximal to the lateral femoral condyle.<sup>7</sup> The location of the skin perforators in our study was consistent with the location described in the aforementioned study.

Reportedly, distal skin perforators originate from the third perforating artery. However, four perforating arteries as described in textbooks are identified in few patients, which is attributable to anatomical variations in the numbers of perforating arteries.<sup>8</sup> Although contrast-enhanced computed tomography confirmed that the distal skin perforator originated from the profunda femoris artery, we were unable to determine from which perforating artery the distal skin perforator originated.

Ha et al. reported successful the elevation of lateral thigh free flaps measuring 23 × 14 cm and 29 × 7 cm, which completely survived, although the epidermis of the distal portion sloughed off postoperatively.<sup>9</sup> We used skin islands measuring >20 cm in size in both our patients; both flaps completely survived, which suggests that a skin island measuring approximately 20 cm in its long axis can be elevated safely. Therefore, the propeller PAP flap can be used for reconstruction superior to the level of the lateral tibial condyle; however, the reconstruction of the anterior aspect of the knee joint, such as in the area of the patellar tendon might be challenging. A propeller flap using a skin perforator that branches directly from the popliteal or the superior lateral genicular artery should be considered for the reconstruction of the anterior aspect of the knee joint, as proposed by Laitung et al.<sup>10</sup>

In conclusion, an advantage of the distal skin perforator-based PAP flap is that it can be elevated with a relatively large volume of skin paddle and may be a useful option for lateral knee joint reconstruction.



**Figure 4.** Complete flap survival at the final follow-up.

### **Declaration of Competing Interest**

None of the authors have any conflict of interest in relation to this work.

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### **Guidelines**

This report was written in line with the STROBE guidelines.

### **Ethical approval statement**

This study was conducted after receiving approval from the Medical Ethics Committee of our university (approval No. 1786) and performed in accordance with the Helsinki Declaration. Written informed consent was obtained from all the patients.

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