

# A Patient with Multiple Unfavorable Reconstruction Options: What Is the Best Choice?

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The method of lower limb reconstruction surgery is selected based on a patient's underlying conditions, general conditions, and wound status, and it usually varies from direct closure to skin graft and flap coverage. Herein, we describe a patient with Duchenne muscular dystrophy who developed critical limb ischemia after femoral cannulation for extracorporeal membrane oxygenation was used during knee disarticulation, which was followed by reconstruction of the defect around the knee using a pedicled anterolateral thigh flap and skin graft.

**Key Words:** Duchenne muscular dystrophy, Surgical flaps, Extracorporeal membrane oxygenation

Lower limb reconstruction comprises direct closure and skin graft and flap reconstruction, which includes local flap reconstruction and free flap reconstruction.<sup>1</sup> The patients' age and specific underlying diseases should be noted before reconstruction surgery, and factors that affect anesthesia such as the patients' cardiac, respiratory disease, and vasculature statuses; wound location; nutritional status; and function and rehabilitation postoperatively should be considered when deciding the surgical procedure.<sup>1</sup> We describe a patient with Duchenne muscular dystrophy who developed critical limb ischemia after femoral cannulation for extracorporeal membrane oxygenation (ECMO) was used during knee disarticulation. It was followed by reconstruction of the defect around the knee by using a pedicled anterolateral thigh (ALT) flap and skin graft.

## CASE REPORT

An 11-year-old male patient with Duchenne muscular dystrophy was diagnosed as having a left femur destructive fracture, so staff in our orthopedic department performed closed reduction and intramedullary nailing under general anesthesia. Cardiac arrest of an unknown cause occurred in the recovery room, so after cardiopulmonary resuscitation, staff in the thoracic surgery department inserted an ECMO catheter into the right femoral artery and vein. A venoarterial assessment was performed, and the patient remained in the intensive care unit. On the third day after ECMO catheter insertion, cyanotic skin color change was observed in the right lower limb. On the fourth day, multiple ulcerations and gangrene were observed, and ECMO catheter removal was performed followed by arteriotomy from the arterial cannulation site to the distal, right superficial femoral artery and right deep femoral

artery. A 5-French Fogarty catheter was inserted to destroy the thrombus, and the arteriotomy site was covered with a bovine pericardial patch, using angioplasty (Fig. 1). After observation, necrotic change progressed to the lower limb (knee area), and staff in the orthopedic department performed right knee disarticulation. Postoperatively, there was a soft tissue defect (13×7 cm) around the stump area, exposing the medial and lateral condyle, so the case was reported to our department (Fig. 2). Repetitive ulceration around the loading area and stable coverage of the stump were required because of the location of the wound. However, the options for reconstruction were unfavorable.

There was a risk of muscle dissection with flap surgery due to Duchenne muscular dystrophy, and it was difficult to perform a vascular computed tomography (CT) scan with a contrast agent because the patient had rhabdomyolysis and was receiving continuous renal replacement therapy (CRRT) due to acute kidney injury (AKI). Femoral cannulation was performed for ECMO followed by arteriotomy, thrombectomy, and angioplasty, but the status of the vessels was not good. The patient's general condition worsened due to atelectasis and pneumonia, and he was bedridden. Considering these conditions, we performed pedicled ALT fasciocutaneous flap coverage with a meshed, split-thickness skin graft. But six hours postoperatively, cyanotic color change was observed in the skin flap. Two days postoperatively, significant necrotic color change

progressed to the entire flap, and this change was observed during treatment with dressing without debridement (Fig. 3). Two weeks postoperatively, the necrotic skin flap was debrided, and the exposed bone was covered with ALT flap fascia and a meshed, split-thickness skin graft. Postoperative care included dressing treatment. The suture stitches were removed after 2 weeks postoperatively. Nine months postoperatively, we confirmed that the stump was stable (Fig. 4).

## DISCUSSION

Lower limb reconstruction is a type of reconstruction commonly faced in plastic surgery, but it is challenging and difficult. Critical limb ischemia is defined as impending limb loss due to severely compromised blood flow to the extremity. The main causes are atherosclerosis and arterial stenosis, and the treatment options include medical therapy, revascularization, amputation, etc.<sup>2</sup> The current patient developed critical limb ischemia after femoral cannulation for ECMO. Usually approximately 15% of patients who undergo femoral cannulation, using ECMO, develop limb ischemia, and it is common for 14% of them to undergo amputation due to critical limb ischemia.<sup>3</sup> The current patient had unfavorable conditions, so we had to consider different surgical procedures.

There were four points to consider before deciding the surgical procedures to use in this case. First, the patient had



**Fig. 1.** Critical limb ischemia of the right lower extremity after femoral cannulation catheter removal.



**Fig. 2.** Stump with 13×7 cm sized defect after disarticulation.



**Fig. 3.** Status of the stump on day 2 after a pedicled anterolateral thigh flap and meshed split thickness skin graft were used.

Duchenne muscular dystrophy; this rare disease causes severe, progressive muscle weakness and atrophy, and it affects 1 in 3,600 to 6,000 live male births.<sup>4</sup> In the case of muscle damage, there is a possibility of muscle weakness and contracture,<sup>5</sup> and in our case, there was a risk of donor site muscle dissection during free flap coverage. Second, it was difficult to evaluate the status of the blood vessels, as a contrast agent for vessel CT scan could not be used since the patient had rhabdomyolysis and was receiving CRRT for AKI. Third, due to arteriotomy, thrombectomy, and angioplasty, the vessels around the wound did not have a good condition. Fourth, since there was cardiac risk, atelectasis, and respiratory disease (pneumonia) associated with ECMO catheter insertion postoperatively, we discouraged long duration of general anesthesia.<sup>1</sup>

Generally, ALT free flap coverage of the opposite side should be performed in similar cases, but when there is a previous amputation defect, free flap reconstruction is challenging and highly unlikely to lead to a successful outcome.<sup>6</sup> Therefore, to prevent the occurrence of repetitive ulceration when using a prosthesis that with stands weight-bearing loading,<sup>7</sup> we decided to perform pedicled ALT fasciocutaneous flap to avoid muscle dissection. The pedicled ALT fasciocutaneous flap does not require microvascular anastomosis; hence, it reduces the operative time, has minimal donor site morbidity, involves simple dissection, and it is relatively longer, enabling the coverage of medium to large defects.<sup>8</sup>

Moreover, in the case of flap failure, the reconstructive



**Fig. 4.** Image of the stable stump 9 months postoperatively.

ladder can be down graded, making it a reliable option during reconstruction.<sup>9</sup> In the current case, the skin flap became necrotic; thus, there was total loss of the flap, but as the flap fascia was viable, a meshed skin graft was used as the fascia base. The flap healed completely without the need for repeat flap coverage.

The current case report suggests that in cases of reconstructive surgery, it may be more favorable to use the reconstructive pie (i.e., all the reconstructive surgical procedures are carefully considered according to the transitional situation) than the reconstructive ladder.<sup>10</sup> Additionally, for a more successful reconstruction surgery, it is important for physicians to carefully identify all the patients' conditions preoperatively and to consider these factors in surgical planning.

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