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CASE REPORT
Reconstructive

Free Vascularized Osseous Fibula Flap for Vertebral Body Defect in a Patient with Tuberculosis Spondylitis

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Summary: In the context of tuberculous spondylitis, a rare form of extrapulmonary tuberculosis causing significant discomfort and neurological deficits, surgery becomes imperative to alleviate symptoms alongside antituberculosis treatment. However, the utilization of free vascularized fibula flaps for repairing vertebral deformities remains uncommon. This report presents the case of a 21-year-old man with limb weakness and sensory disturbances who was referred to our hospital, where contrast magnetic resonance imaging revealed a paravertebral abscess spanning several thoracic vertebrae. Collaborating with neurosurgeons, we performed decompression laminectomy, pedicle screw fixation, thoracic vertebrectomy, and restoration of the corporal defect using a free fibula flap. Utilizing a 2.5-cm fibula segment from the patient's left leg without a skin paddle, the surgery demonstrated a pedicle length of 12 cm and a total ischemic time of 183 minutes. The fibula was press-fitted, with recipient vessels identified as 1-mm artery and vein from the intercostal artery perforator. Postsurgery, flap vitality was assessed using Doppler ultrasound, showing positive signals immediately and at 1-month follow-up, with the patient experiencing reduced pain and improved leg strength. Despite its rarity, free fibula flap reconstruction for spinal defects proves effective, safe, and beneficial, necessitating thorough preoperative planning and interdisciplinary collaboration for successful outcomes, marking this case as the first reported instance in Indonesia. *(Plast Reconstr Surg Glob Open 2024; 12:e6169; doi: 10.1097/GOX.0000000000006169; Published online 16 September 2024.)*

Nonpulmonary tuberculous spondylitis, known as Pott disease, is more prevalent in regions with high rates of pulmonary tuberculosis, affecting primarily children, young adults, and those with HIV. It commonly involves the thoracolumbar junction, leading to vertebral collapse, kyphosis, abscesses, and neurological deficits. Symptoms include local discomfort, stiffness, abscesses, and spinal deformity, often progressing to neurological impairments such as paraplegia or tetraplegia.[1] The standard of therapy for tuberculosis-related vertebral abnormalities consists of a combination of antituberculosis drugs to cure the infection, as well as surgical intervention such as debridement, fusion, and spinal stabilization, but complications such as nonunion can occur.[2]

In the context of spinal reconstruction after vertebrectomy, the fibula emerges as a widely used vascularized osseous and osteocutaneous flap.[3] Vascularized bone flaps, particularly the fibula, remodel less and maintain osteocyte viability, enhancing primary bone repair and minimizing creeping replacement.[4] This approach leads to faster union rates, increased strength, lower susceptibility to infection, and a higher likelihood of reincorporation into existing structures.[4,5] Despite these advantages, there is a paucity of studies exploring the use of vascularized osseous fibula flaps for spinal reconstruction, emphasizing the need for further research in this domain.

CASE

A 21-year-old man came in with worsening leg weakness for 4 months, tingling, numbness from groin to toes, and mild back pain. He also had intermittent fever and night sweats for a month. Physical examination showed decreased strength in both legs, spasticity, and muscle atrophy. He

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Fig. 1. Preoperative clinical pictures and spine MRI with apparent mass on the sixth to 10th thoracic level in the midline.

had reduced sensation from the T10 level to the toes and poor two-point discrimination. A palpable mass was found from the sixth to the 10th thoracic vertebrae in the midline. Magnetic resonance imaging revealed damage from the eighth to 11th thoracic vertebrae and a paravertebral abscess from the seventh to the 11th thoracic level, compressing the spinal cord. Tuberculosis spondylitis was suspected (Fig. 1).

The neurosurgery team performed a decompression laminectomy and stabilized several thoracic vertebrae with pedicle screws. They also removed abscesses and performed a vertebrectomy at the ninth thoracic vertebra, including disk removal due to extensive tissue damage. A 2.5-cm section of the fibula was taken from the left leg without the skin paddle, and the harvested piece was press-fitted into the defect. The free fibula flap, with a 12-cm pedicle, used an intercostal artery perforator as the recipient vessel. Under magnification, a 1-mm artery and vein were utilized. The intercostal vessel was taken from the space between the eighth and ninth thoracic levels (Fig. 2). (**See figure, Supplemental Digital Content 1,** which displays an illustration of the vascularized osseous fibula flap in the antero-posterior position. **http://links.lww.com/PRSGO/D512**.)

Monophasic vascular Doppler ultrasound confirmed flap vitality postoperatively, persisting for 3 months. Pain decreased and sensation improved from the 10th thoracic level downward. We used the Medical Research Council scale for muscle strength to assess the patient's motor strength. The patient's motor strength in both legs has shown a significant improvement, progressing from an inability to move against gravity to being able to lift both legs against resistance (from 2222/2111 to 4444/4444), indicating enhanced function of muscles such as the quadriceps femoris, hamstrings, and hip flexors. Computed tomography (CT) scans showed well-positioned fibula and bony union between the fibula and vertebrae immediately postoperative and at 3 months (Fig. 3).

At long-term follow-up, 1 year after surgery, the patient was able to walk with a cane. The patient was still undergoing active treatment for tuberculosis. There were no complaints of back pain. The motor strength in both legs had improved to the point where the joint could be moved through its entire range of motion, even against the force of gravity and against the full resistance applied by the examiner, suggesting improved functionality of muscles such as the quadriceps femoris, gastrocnemius, and soleus muscles (from 4444/4444 to 5555/5555). The CT scan evaluation conducted 1 year postoperatively revealed a well-established bony union between the fibula and vertebrae, with the fixed position of the fibula becoming increasingly apparent (Fig. 4).

DISCUSSION

This study details the first use of a free vascularized fibula flap for vertebral body defect reconstruction in Indonesia, with simultaneous neurosurgery and fibula

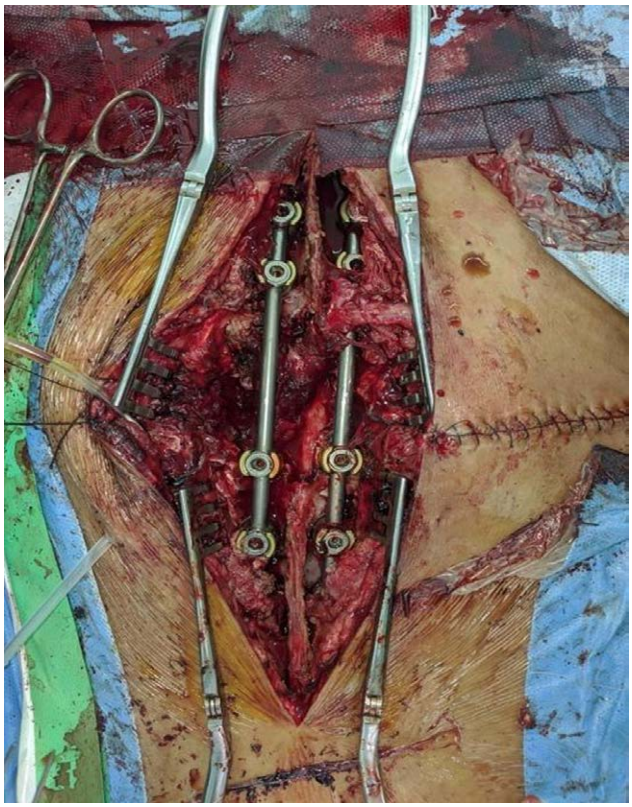

Fig. 2. A free vascularized osseous fibula flap was inserted by press-fit method along pedicle screw fixation on the sixth, seventh, 10th, and 11th thoracal spine.

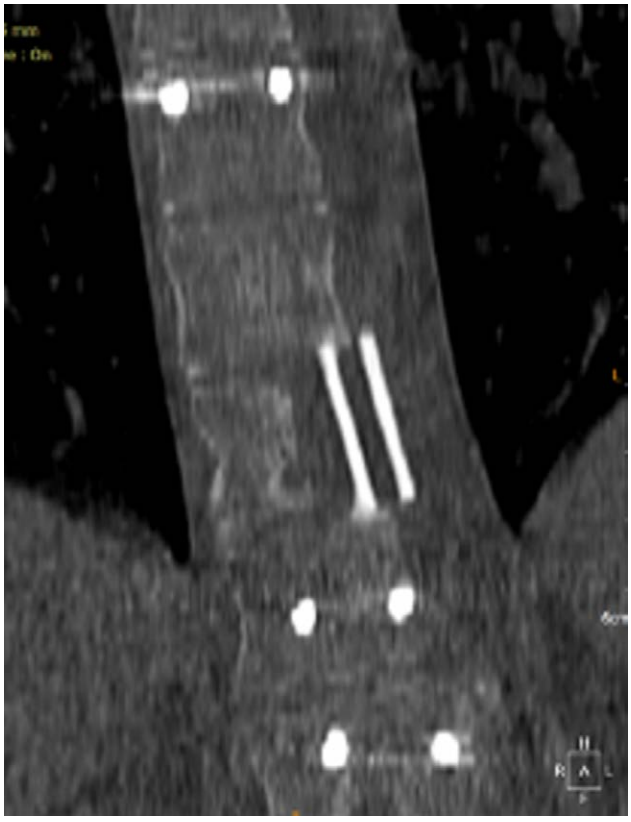

Fig. 3. CT scan evaluation 3 months postoperative (note the bony union).

harvesting. Despite the challenge of prone positioning for fibula harvesting, the 60-minute duration was comparable to supine procedures.[3] Utilizing the press-fit method ensured precise placement without spinal cord compression.

Bone flap in spine reconstruction can be used for osteomyelitis, oncology, trauma, and progressive symptomatic spinal deformity cases. Patients at a young age with a high survival rate will also benefit from the use of bone flap. Another indication is for patients in whom the soft tissue bed is compromised, such as after radiation therapy, scarring from multiple prior procedures, wide resection, or chronic infections.[4,5] In terms of secondary outcomes, wound infection was the most prevalent postoperative complication after spinal restoration with free vascularized fibula graft. Nevertheless, previous studies have shown that it has a lower percentage of nonunion rate and complications in spine reconstruction.[4]

In this case, the 3-month follow-up CT scan showed that there was already bony union of the fibula to the adjacent vertebrae. This is in line with a study by Ackerman et al,[5] which found that the average time to union for the vascularized osseous fibula flap was 3.2 months. The accelerated bone union is a major advantage of the vascularized bone flap compared with bone graft. Bone grafts need to be replaced by creeping substitution, which can take months to years to complete. Another disadvantage of bone grafts is that they will have a significant loss in the structural integrity in the resorption phase, which can lead to a risk of mechanical failure and nonunion.[5]

The fibula, because of its shape, was our choice to be the vascularized osseous flap. It is mechanically more suitable compared with rib because of its membranous origin and curved shape. Fibula is stronger than the iliac crest flap, and dissection is easier, can be done in a two-team approach, and will have less donor-site morbidity.[4,5] Nevertheless, finding the recipient vessels was also a challenging aspect. We initially planned to anastomose the vessels to the thoracal segmental or thoracodorsal artery and vein, but then we decided to use the intercostal artery perforator as a recipient vessel, with a diameter of 1 mm. The choice of recipient vessels was based on the approach (anterior or posterior). The lumbar segmentals, iliac vessels, inferior mesenteric vessels, superior gluteal artery, or aorta via end-to-side anastomosis have been the options for recipient vessels for thoracolumbar reconstruction traditionally. Intra-abdominal vessels can also be used as recipients for thoracolumbar reconstruction, although it is uncommon. The thoracic area is a difficult and challenging area to find recipient vessels. Sometimes it needs two or three ribs to be removed to find the recipient vessels.[6,7]

Our method for postoperative monitoring was done using Doppler ultrasound. It is one of the simplest ways to assess the viability of the flap.[7,8] CT scan was also done immediately and 3 months postoperative to observe the

Fig. 4. CT scan evaluation 1 year postoperative (note the increasingly apparent bony union).

position and bony union of the flap. This monitoring is important to prove the viability of the flap.[9]

CONCLUSIONS

Free fibula flap reconstruction in a spine defect due to heavy tuberculosis infection, although not regularly performed, is effective, safe, and valuable. The free vascularized osseus fibula flap has been proven to be superior to bone graft in spinal reconstruction. It adds structural support, accelerates wound healing, and has a lower percentage of complication and mechanical failure, so that morbidity will be reduced.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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