

Staged Reconstruction of Post-traumatic Medial Malleolus Bone Defects using Fibular Head Osteochondral Graft: A Report of Two Cases

Suneel Ramanujapuram¹ , Apurve Parameswaran² 

ABSTRACT

Aim: The aim of this study was to report a novel technique for reconstruction of post-traumatic medial malleolar bone defects, by the use of fibular head osteochondral grafting.

Background: Severe open ankle injuries involving loss of bone and soft tissue are challenging entities to treat. There are very few reports in literature on reconstruction of post-traumatic medial malleolar bone loss, and they predominantly describe the use of a composite vascularized pedicle-based flap.

Case description: We report two cases of post-traumatic medial malleolar fractures with bone and soft tissue loss, and ankle instability, managed by staged anatomic reconstruction using autologous ipsilateral fibular head osteochondral grafts without a composite vascular pedicle-based flap, following primary soft tissue reconstruction and ankle-spanning external fixation. At 2 years' follow-up, both patients had good functional outcomes with a stable, painless ankle joint and were able to ambulate unaided. They had no donor site morbidity. Both patients had nearly normal plantar flexion, while one had restriction of dorsiflexion. Radiographs showed bony union and graft incorporation with no signs of graft resorption or secondary ankle arthritis.

Conclusion: The use of fibular head osteochondral grafts for reconstruction of medial malleolar bone loss is a simpler alternative to microsurgical osseous reconstruction using vascular pedicle-based composite flaps in the management of complex ankle injuries with medial malleolar bone loss, and yields good mid-term results.

Clinical significance: Fibular head osteochondral grafting of medial malleolar bone defects could be a useful tool in the armamentarium of the trauma surgeon, especially at smaller trauma care centers, where access to infrastructure or a surgeon skilled and experienced in performing vascularized grafts is limited.

Keywords: Ankle defect, Ankle reconstruction, Bone graft, Complex ankle fracture, Fibular head osteochondral graft, Medial malleolus fracture, Medial malleolus reconstruction.

Journal of Foot and Ankle Surgery (Asia Pacific) (2022): 10.5005/jp-journals-10040-1244

INTRODUCTION

Ankle fractures are common, with a reported incidence of 122–184 cases per 100,000 adults per year.^{1–3} Treatment options for medial malleolar fractures include conservative management, screw fixation, tension band wiring, and plate fixation, with or without deltoid ligament reconstruction.⁴ Severe open ankle injuries with bone and soft tissue loss, however, are complex entities to treat. They require good surgical planning, early debridement, skeletal stabilization or reconstruction, and appropriate soft tissue cover to achieve optimal outcomes.^{5,6}

The use of vascular pedicle-based fibular head or iliac crest composite grafts for reconstruction of medial malleolar defects has been described in literature.^{7–10} There are also case reports describing the use of cortical iliac crest bone grafting to reconstruct the medial malleolus,^{5,6} and a report illustrating a bone-sliding technique from the distal tibia.¹¹ Following an extensive literature search, however, we found no reports describing reconstruction of post-traumatic medial malleolar defects using a fibular head osteochondral graft.

We report two cases of post-traumatic medial malleolar fracture with bone loss, wherein osseous reconstruction and ankle stability were successfully achieved by means of staged autologous ipsilateral fibular head osteochondral grafts without composite vascular pedicle-based flaps, following primary soft

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How to cite this article: Ramanujapuram S, Parameswaran A. Staged Reconstruction of Post-traumatic Medial Malleolus Bone Defects using Fibular Head Osteochondral Graft: A Report of Two Cases. *J Foot Ankle Surg (Asia Pacific)* 2022;xx(xx):1–5.

Source of support: Nil

Conflict of interest: None

tissue reconstruction. Both patients had good functional outcomes and graft incorporation, with no donor site morbidity at 2 years' follow-up.

CASE DESCRIPTION 1

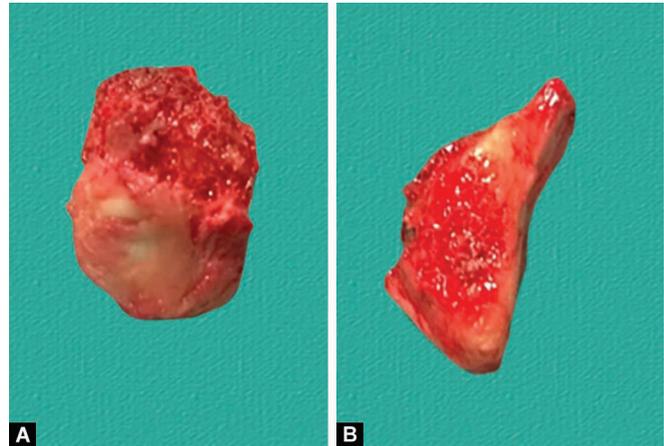
A 45-year-old male, diabetic and nonsmoker, presented 1 hour following a road traffic accident, with ankle instability secondary to an open right medial malleolus fracture with bone loss. He had a grossly contaminated 20 × 10 cm open wound with composite soft tissue loss over the medial ankle and the entire span of the medial

aspect of the foot, with no tendinous or neurovascular injuries. Mangled Extremity Severity Score was 4, and Ganga Hospital Open Injury Severity Score was 11 (Figs 1 and 2).

Following preliminary care in the emergency department, which included a wound wash and administration of intravenous broad-spectrum antibiotics, he underwent emergency surgery-debridement, ankle-spanning external fixation, and wound coverage using a reverse sural artery-based flap. The external fixator was removed 3 weeks after surgery. At 3 months following the primary surgery, he underwent anatomic reconstruction of the medial malleolus by means of an autologous ipsilateral fibular head osteochondral graft. The graft was harvested in the supine position from the ipsilateral leg, using the lateral approach, while protecting the common peroneal nerve. The graft was trimmed to match the contour of the dome of the ankle mortise using a rongeur and bone file. The articular facet of the fibular head was made to face the medial surface of the talar body (Fig. 3). The graft was fixed using a 4 mm cannulated cancellous screw and a 1.5 mm k-wire.

The soft tissue healed well without any signs of infection, donor site morbidity, or knee instability. Radiographic evidence of graft union was noted at 3 months following osseous reconstruction. He was able to ambulate with support and unaided wearing normal footwear, at 3 and 6 months following osseous reconstruction,

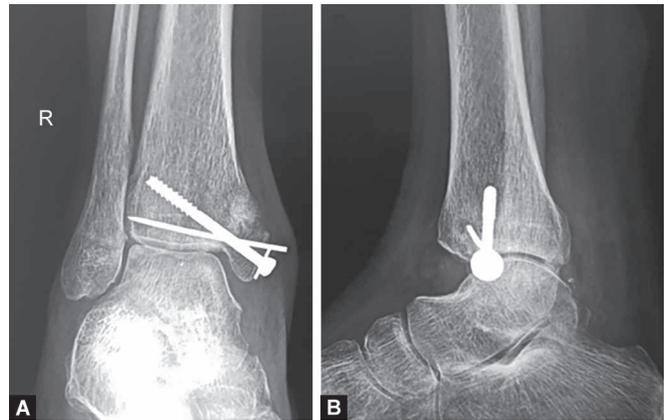
respectively. At 2 years' follow-up, he had an American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score of 78, and Foot and Ankle Disability Index (FADI) of 78.8; and radiographs showed no evidence of graft resorption or ankle arthritis (Fig. 4). His ankle range of movement was 0–50° of plantar flexion (Fig. 5).



Figs 3A and B: Case 1. Osteochondral fibular head graft, trimmed to match the contour of the talar dome. The articular facet of the fibular head faces the medial surface of the talar body



Fig. 1: Case 1. Preoperative clinical image of the ankle and foot at the time of presentation, showing soft tissue loss over the medial aspect of the foot and ankle



Figs 4A and B: Case 1. Radiographs of the ankle at 2 years' follow-up, showing graft incorporation. (A) Anteroposterior view; (B) lateral view



Figs 2A and B: Case 1. Preoperative radiographs of the ankle, showing fractured medial malleolus with bone loss. (A) Anteroposterior view; (B) lateral view



Figs 5A and B: Case 1. Range of motion of the ankle at 2 years' follow-up. (A) Maximum plantar flexion; (B) attempted dorsiflexion

CASE DESCRIPTION 2

A 22-year-old male, nonsmoker, with no comorbidities presented 1 hour following a road traffic accident, with ankle instability secondary to an open left medial malleolus fracture with bone loss. He had a grossly contaminated 10 × 6 cm open wound with composite soft tissue loss over the posteromedial aspect of the ankle. All tendons were intact, but the posterior tibial artery and nerve were injured (Figs 6 and 7). Mangled Extremity Severity Score was 5 and Ganga Hospital Open Injury Severity Score was 11.

Following preliminary care in the emergency department, which included a wound wash and administration of intravenous broad-spectrum antibiotics, he underwent emergency surgery-debridement, posterior tibial artery repair, neurolysis of the contused posterior tibial nerve, and wound coverage using a transposition flap with split-thickness skin grafting. The ankle was stabilized using a spanning external fixator, which was removed 4 weeks following the primary surgery. At 3 months postoperatively, in view of an adherent scar with nonpliable skin, he underwent scar excision and reconstruction with a radial forearm free flap to facilitate

future osseous reconstruction. Six months following the primary surgery, he underwent anatomic reconstruction of the medial malleolus using an autologous ipsilateral fibular head osteochondral graft using the same technique as in Case 1 (Fig. 8). During the same surgery, posterior tibial nerve graft using the sural nerve was performed since the nerve was scarred and had not recovered following initial neurolysis. The osteochondral graft was fixed using a 4 mm cannulated cancellous screw and two 1.5 mm k-wires.

The flap healed well with no signs of infection. The ankle joint remained stable. There was no donor site morbidity. Radiographic evidence of graft union was noted at 3 months following osseous reconstruction. The patient was able to ambulate with support and unaided wearing normal footwear, at 3 and 6 months following osseous reconstruction, respectively. At 2 years' clinical follow-up, radiographs showed no signs of graft resorption or secondary ankle arthritis (Figs 9 and 10). His ankle range of movement was 10° of dorsiflexion and 40° of plantar flexion (Fig. 11), AOFAS ankle-hindfoot score was 97 and FADI was 92.4.

DISCUSSION

Both reported patients presented with severe ankle injuries with loss of the medial malleolus and the surrounding soft tissue, and medial ankle instability. Supple soft tissue cover is essential prior to



Fig. 6: Case 2. Preoperative clinical image of the ankle at the time of presentation; patient had a posteromedial soft tissue defect, with injured posterior tibial artery and nerve

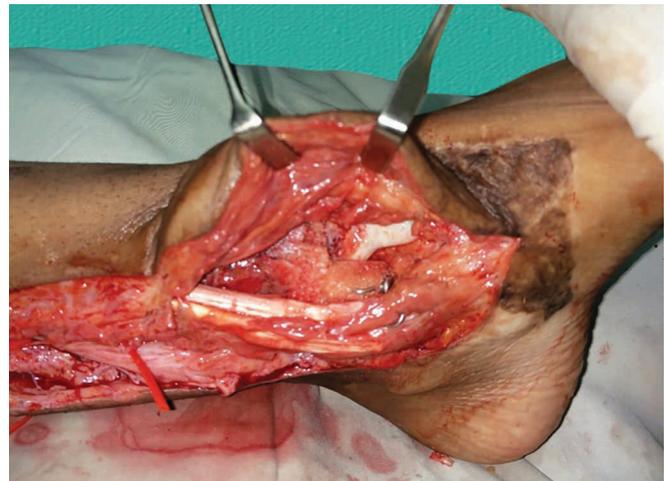
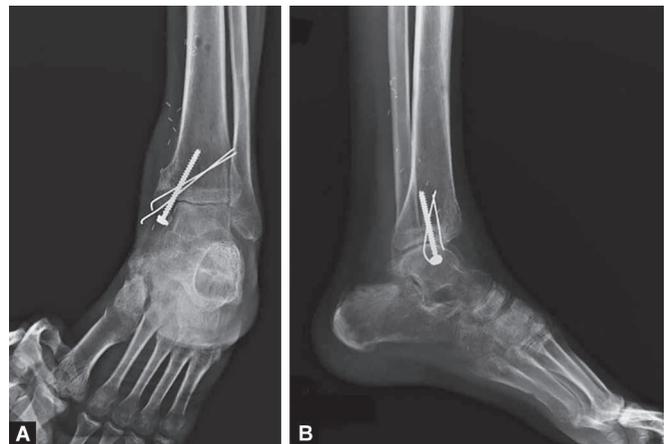


Fig. 8: Case 2. Intraoperative image showing posterior tibial nerve grafting and the fibular head osteochondral graft *in situ*



Figs 7A and B: Case 2. Preoperative radiographs of the ankle showing medial malleolar fracture with bone loss. (A) Anteroposterior view; (B) lateral view



Figs 9A and B: Case 2. Radiographs at 2 years' follow-up showing graft incorporation and union. (A) Anteroposterior view; (B) lateral view



Figs 10A and B: Case 2. Radiographs at 2 years following primary surgery, after implant removal. (A) Anteroposterior view; (B) lateral view



Figs 11A and B: Case 2. Range of motion at the ankle at 2 years' follow-up. (A) Plantar flexion; (B) dorsiflexion

bony reconstruction. Once soft tissue reconstruction was achieved, it was possible to restore ankle stability by skeletal reconstruction alone, using fibular head osteochondral grafts in both cases. No attempt to reconstruct the medial deltoid ligament was undertaken. Both patients had good functional outcomes, and were able to return to their daily activities. There were no signs of infection, graft resorption, or symptomatic ankle arthritis at the 2-years' follow-up.

Severe ankle injuries with loss of the medial ankle structures lead to ankle instability, progressive varus deformity, and early degenerative changes if inadequately treated.¹⁰ There are reports in literature of the use of vascular pedicle-based fibular head and iliac crest composite flaps for the reconstruction of medial malleolar defects in children.⁷⁻⁹ Wu et al.¹⁰ described the use of vascularized fibular head composite osseo-tendinous flaps for the reconstruction of medial malleolar defects in adults. Kow et al. and Nithyananth et al.^{5,6} have reported the use of autologous iliac crest bone grafting to reconstruct medial malleolar defects. Huang et al. described a technique of bone-sliding from the distal tibia to reconstruct traumatic medial malleolar defects.¹¹ To our knowledge, however, there are no reports describing fibular head osteochondral grafts for medial malleolar reconstruction.

Like all the other reported techniques, the use of fibular head osteochondral grafting provided a stable joint with timely graft incorporation, permitting timely painless full-weight-bearing,

without significant donor site morbidity. Though larger studies need to be undertaken to assess and compare the long-term outcomes of each of these procedures, our technique resulted in good short- and mid-term clinical outcomes similar to patients treated by the other aforementioned techniques; moreover, our patients also had a better range of movement and no signs of ankle arthritis at 2 years' follow-up.

Our technique of medial malleolar osseous reconstruction is novel and has certain distinct advantages. It involves the use of an ipsilateral fibular head osteochondral graft without a composite vascular pedicle-based flap, which provides an anatomically contoured graft with a cartilaginous articular surface. It is a simpler procedure and reduces not only donor site morbidity, but also the operating time, and complications and costs thereof, in comparison with composite vascular pedicle-based flaps. It can also be performed at smaller trauma care centers, where access to infrastructure or a surgeon skilled and experienced in performing vascularized grafts is limited.

CLINICAL SIGNIFICANCE

Fibular head osteochondral grafting of medial malleolar bone defects could be a useful tool in the armamentarium of the trauma surgeon, especially at smaller trauma care centers. It could potentially reduce not only donor site morbidity but also the operating time, in comparison with composite vascular pedicle-based flaps. It is a simpler alternative to microsurgical osseous reconstruction using vascular pedicle-based composite flaps in the management of complex ankle injuries with medial malleolar bone loss, and yields good short-term and mid-term results. Moreover, osteochondral grafts would be better suited for reconstruction of weight-bearing joints by preventing progression to arthritis, and could potentially demonstrate better long-term viability.

CONCLUSION

Fibular head osteochondral grafting is a simple and effective alternative to microsurgical reconstruction of medial malleolus defects, with good clinical outcomes.

INFORMED CONSENT

Prior informed written consent for surgery, and for publication of case details and clinical images were taken from both patients.

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REFERENCES

1. Goost H, Wimmer MD, Barg A, et al. Fractures of the ankle joint: investigation and treatment options. *Dtsch Arztebl Int* 2014;111(21): 377-388. DOI: 10.3238/arztebl.2014.0377
2. Carter TH, Oliver WM, Graham C, et al. Medial malleolus: operative or non-operative (MOON) trial protocol—a prospective randomized controlled trial of operative versus non-operative management of associated medial malleolus fractures in unstable fractures of the ankle. *Trials* 2019;20(1):565. DOI: 10.1186/s13063-019-3642-7
3. Donken CCMA, Al-Khateeb H, Verhofstad MHJ, et al. Surgical versus conservative interventions for treating ankle fractures in adults. *Cochrane Database Syst Rev* 2012;(8):CD008470. DOI: 10.1016/j.jopan.2013.12.001

4. Carter TH, Duckworth AD, White TO. Medial malleolar fractures: current treatment concepts. *Bone Jt J* 2019;101-B(5):512–521. DOI: 10.1302/0301-620x.101B5.BJJ-2019-0070
5. Kow RY, Yuen JC, Ahmad Alwi AA, et al. Surgical reconstruction of an open medial malleolus fracture using a novel technique: a case report. *JBJS Case Connect* 2019;9(2):e0163. DOI: 10.2106/JBJS.CC.18.00163
6. Nithyananth M, Cherian VM, Jepegnanam TS. Reconstruction of traumatic medial malleolus loss: a case report. *Foot Ankle Surg* 2010;16(2):e37–e39. DOI: 10.1016/j.fas.2009.07.004
7. Fu X, Fan S, Liu Y, et al. A preliminary study on repairing defects at medial malleolus in children by vascularized fibular head composite flap. *Chin J Reparative Reconstr Surg* 2013;27(11):1305–1308. PMID: 19431984.
8. Chen Z, Zhang F, Xu W. Basis and clinical applications of vascularized epiphyseal transplantation. *Chin J Reparative Reconstr Surg* 2011;25(11):1281–1284. PMID: 22229176.
9. Liu X, Zhang C, Wang C, et al. Repair and reconstruction of traumatic defect of medial malleolus in children. *Chin J Reparative Reconstr Surg* 2009;23(4):444–447. PMID: 24501887.
10. Wu SP, Zhang FH, Yu FB, et al. Medial malleolus and deltoid ligament reconstruction in open ankle fractures with combination of vascularized fibular head osteo-tendinous flap and free flap transfers. *Microsurgery* 2009;29(8):630–635. DOI: 10.1002/micr.20689
11. Huang D, Wang J, Ye Z, et al. Reconstruction of traumatic medial malleolus loss using the bone sliding technique: a case report. *Int J Surg Case Rep* 2022;90:106677. DOI: 10.1016/j.ijscr.2021.106677