

## Management of Lisfranc injury with anterolateral calcaneal compression fracture

Wenqi Gu<sup>1</sup>, Rui Zhang<sup>2</sup>, Wanjun Liu<sup>1</sup>, Zhongmin Shi<sup>1</sup>, Guohua Mei<sup>1</sup>, Jianfeng Xue<sup>1</sup>, Jian Zou<sup>1</sup>, Xiaokang Wang<sup>1</sup>, Jiantao Jiang<sup>1</sup>

<sup>1</sup>Department of Orthopedics, Shanghai Jiaotong University Affiliated Sixth People's Hospital, Shanghai 200233, China;

<sup>2</sup>Department of Orthopedics, The People's Hospital of Ludian County, Ludian, Yunnan 657100, China

*To the Editor:* The mechanism of Lisfranc injury is complex and may cause different patterns of fractures or dislocation of the midfoot complex. Abduction force injury is a special injury pattern, which may cause the fracture or (and) dislocation of the lateral column of the Lisfranc joint, especially the cuboid.<sup>[1-3]</sup> However, the anterolateral calcaneus is less commonly involved. Since the fragment of the calcaneocuboid (CC) joint facet is too un conspicuous to manifest on a plain X-ray, and surgeons always pay more attention to the Lisfranc joint, anterolateral calcaneal compression fracture and even Chopart joint injuries are often overlooked, which may lead to a delayed surgical management, chronic foot deformities, and functional disability.

Treatment for this special pattern of injury has rarely been reported and remains a challenge for foot and ankle surgeons. Gajendran *et al*<sup>[4]</sup> reported a case of an unusual variant of a nutcracker fracture of the anterolateral calcaneus and navicular, and resulting in the compromised final outcomes with a conservative treatment. The crucial and difficult point of the management for the lateral column injury is the reduction and fixation of the facet fragment, which is small, compressed, and sometimes comminuted. We hypothesized that the rafting fixation technique for the compression fragment with a minifragment plate could achieve a stable fixation and obtain an acceptable clinical outcome for this pattern of injury.

Thirteen patients were enrolled in our study. Among them, 5/13 cases (38.5%) of calcaneal involvement were missed on the initial X-ray. After a thorough evaluation, open reduction and internal fixation were performed in all patients until the soft tissue condition was improved.

In this study, all the patients underwent the final follow-up for a mean period of  $27.69 \pm 14.41$  months postoperatively (range: 12–60 months). Two patients suffered from an early soft-tissue complication and were cured by conservative management. The plain radiographs showed a bony union in all patients at 3rd month postoperatively [Figure 1D].

The average Visual Analogue Scale (VAS) score of the final follow-up was significantly improved ( $1.8 \pm 1.4$  postoperative *vs.*  $5.9 \pm 1.3$  pre-operative,  $t = 17.05$ ,  $P < 0.05$ ). The final American Orthopaedic Foot & Ankle Society (AOFAS) midfoot score was  $82.1 \pm 10.9$  (range: 56.0–97.0). All patients returned to work at an average of  $7.5 \pm 2.2$  months postoperatively (range: 5–12 months). The symptoms and AOFAS midfoot score had a correlation with the time of returning to work ( $r = 0.744$  and  $0.871$ , respectively,  $P < 0.05$ ).

Twelve cases obtained an implant removal on the average of 11th month postoperatively (range: 8–14 months), three of which was found an implant breakage during the removal with no obvious symptoms. Two cases (15.4%) of posttraumatic arthritis of the Lisfranc joint were observed and suffered from a moderate symptom, which was relieved by application of analgesic medication and orthosis support. Three patients (23.1%) complained about the midfoot rigidity. No complications of nonunion, malunion, or midfoot deformity were noted during the follow-up.

To our knowledge, the most common pattern of the lateral column compression fracture is the “nutcracker fracture” of cuboid, which may cause the shortening of the lateral column and forefoot deformity with a high complication

Wenqi Gu and Rui Zhang contributed equally to the work.

**Correspondence to:** Dr. Zhongmin Shi, Department of Orthopedics, Shanghai Jiao Tong University Affiliated Sixth People's Hospital, 600 Yishan Road, Shanghai 200233, China-  
E-Mail: 18930177323@163.com

Copyright © 2022 The Chinese Medical Association, produced by Wolters Kluwer, Inc. under the CC-BY-NC-ND license. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

Chinese Medical Journal 2022;135(6)

Received: 22-08-2021; Online: 22-12-2021 Edited by: Yanjie Yin and Xiuyuan Hao

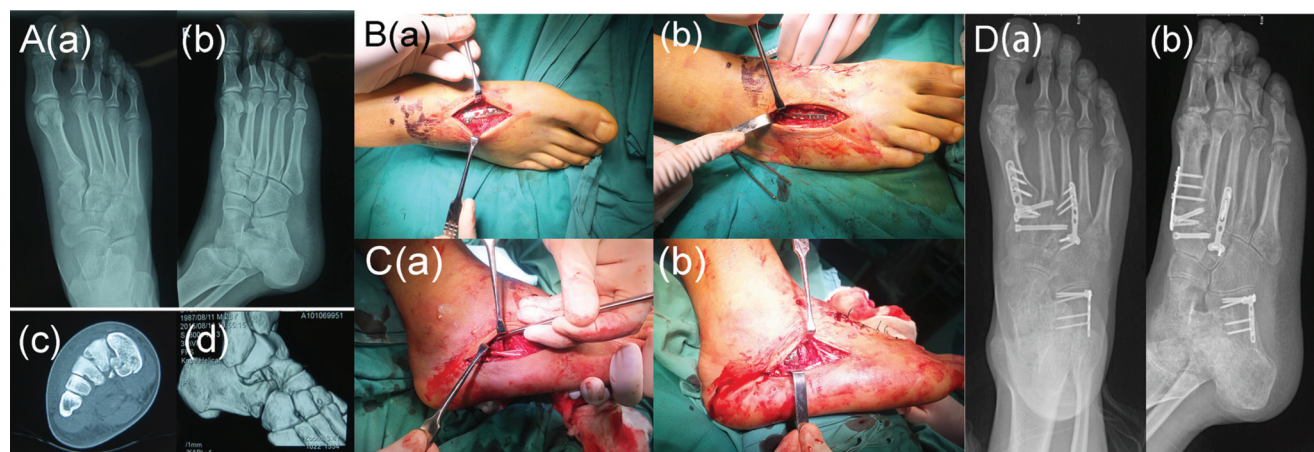
### Access this article online

Quick Response Code:



Website:  
www.cmj.org

DOI:  
10.1097/CM9.0000000000001924



**Figure 1:** (A) A 29-year-old manual laborer with a high activity demand suffered from a motor vehicle accident. The preoperative X-ray showed a Lisfranc injury with an unapparent anterolateral calcaneal fracture (a, b). 3D-CT showed the Lisfranc injury (c), and a compressed fragment of the CC joint on the anterolateral calcaneus (d). (B) A medial approach was used to access the first and second TMT joint. The instability of the medial-middle intercuneiform joint was detected, which was reduced and secured with an intercuneiform screw firstly. After the reduction and fixation of the medial cuneiform—second metatarsal base, the unstable medial column was also stabilized with a bridging plate (a). The third TMT joint was exposed *via* a lateral approach and fixed with another bridging plate (b). (C) An additional lateral longitudinal incision was made for the exposure of the CC joint. After the displaced articular fragment was accessed (a), reduction and rafting fixation with a mini-fragment plate was performed (b). (D) The postoperative X-ray of 3rd month demonstrated a solid bone union with an anatomical restoration of the midfoot alignment and the CC joint facet (a,b). 3D-CT: Three-dimensional computed tomography; CC: Calcaneocuboid; TMT: Tarsometatarsal.

rate. However, the injury involving both the Chopart joint and Lisfranc joint is not so common. In Ponkilainen *et al*'s<sup>[5]</sup> study, they reported that only 5.8% of midfoot injuries involved both of these joints. The detailed mechanism of this special fracture is still unknown. We considered that an abduction force still played an important role. The calcaneal compression fracture is easily neglected. Any misdiagnosis and improper management may lead to a symptomatic posttraumatic arthritis and functional limitation. Diagnosis from an X-ray sometimes is difficult. In this study, 5/13 cases (38.5%) of anterolateral calcaneal fracture were neglected on the initial plain X-ray. We considered that two reasons might cause the misdiagnosis. First, surgeons tend to pay more attention to the Lisfranc joint and possible involvement of the Chopart joint could be overlooked; thus, detailed physical examination is also a crucial method to avoid misdiagnosis. The anterolateral calcaneal fracture should be strongly suspected when any tenderness is detected on the lateral side of the foot. Furthermore, the fragment sometimes might be too small to be manifested on the plain X-ray. Therefore, we suggest that three-dimensional computed tomography scanning be routinely applied to evaluate midfoot injuries.

The essence of the management of midfoot complex injuries is the anatomical restoration of midfoot alignment and facet with a stable fixation. Reduction and fixation of the Lisfranc joint are generally performed first. Although a primary arthrodesis for ligamentous Lisfranc injury is recommended in recent years,<sup>[6,7]</sup> we still prefer an open reduction and internal fixation (ORIF) than primary arthrodesis for prevention of an early degeneration of the adjacent joints. Moreover, the patients in our country have a low acceptance level of primary arthrodesis. Management of the anterolateral calcaneal compression fracture is not easy, since the facet fragments are

sometimes very small and comminuted. Dhillon *et al*<sup>[8]</sup> reported three cases of crush fractures of the anterior end of the calcaneus, in which acceptable clinical outcomes were achieved. In their study, K-wires were implanted for fixation of fractures, and a fixator was used to restore the length of the lateral column. However, we consider that this fixation technique still remains controversial. K-wire fixation or fixator is not stable enough and may cause some soft tissue problems, that is, pin tract infection. Screw fixation is an alternative for small fragment fixation. Nevertheless, if the fragment is too small or comminuted, or the patient also has osteoporosis, screw fixation may cause a high rate of failure. The mini-fragment plate system is our preference, which has several advantages. First, rafting fixation along the CC joint may provide rigid support for the fragment to prevent further re-displacement. Additionally, the compression effect of the plate can stabilize the fragment even without screw fixation into the fragment, which also could limit displacement. No cases of implant failure and redisplacement of compression fragments occurred in our patients. Furthermore, plate fixation also facilitates implant removal in the future. We achieved satisfactory outcomes by virtue of the anatomical reduction and stable fixation. The average VAS score was significantly improved than the preoperative one ( $P < 0.05$ ) and most patients obtained a good to excellent AOFAS midfoot score. And all of them returned to work at an average of 7.5 months postoperatively. Furthermore, we found that limited symptoms and satisfactory AOFAS score indicated less time of returning to work, which had a significant correlation.

The complications still remain an issue for midfoot injury. For Lisfranc complex injuries, by consequence of high-energy trauma, the postoperative complication rate is still relatively high despite of a proper treatment.<sup>[9,10]</sup> In the present study, although we achieved a satisfactory clinical

outcome in most of our patients, two cases (15.4%) of the three-column Lisfranc complex injury still developed into posttraumatic arthritis during follow-up. However, the symptoms were moderate and controlled conservatively, therefore no salvage procedure was needed. Implant removal is another point. Removing the implant too early may cause the instability of the midfoot, while a long period of bridging fixation may cause a too rigid joint with no difference of arthrodesis. Three patients who removed their implants over 12 months postoperatively complained about a rigid midfoot. It may also cause an implant breakage. In this study, the implant breakage was demonstrated in three cases who removed the implants over 10 months without any symptoms. We suggest that the Lisfranc screw and intercuneiform screw should be removed before the full weight-bearing, while the final removal procedure should be performed earlier than 10 months. The clinical evidence of best removal time is still limited and attempted to be discovered in the future studies.

This study still had some limitations. First, the sample size was small because of the rarity of this pattern of injury. Second, we did not perform a comparative analysis, and our evaluation is not comprehensive. Third, the long-term clinical outcomes of this pattern of injury remain unclear. Furthermore, the current classification system is another problem. The three-column classification system is simple and precise in its description of tarsometatarsal joint disruption.<sup>[11]</sup> However, this system only limits to the Lisfranc injury. For the midfoot complex injury involving the Chopart joint, whether this theory could extend to it is still under discussion. We attempt to modify the classification system based on more cadaver anatomy research and biomechanical study. Finally, the detailed mechanism of this pattern of injury is still undiscovered. We hope to overcome these limitations in our future work.

In conclusion, Lisfranc injury with an anterolateral calcaneal compression fracture is not common with a high rate of misdiagnosis. Thorough evaluation of the entire midfoot complex including both Lisfranc and Chopart joints is vital in clinical work. ORIF remains the gold standard for this pattern of injury, and acceptable clinical outcomes can be obtained with proper management.

### Conflicts of interest

None.

### Funding

This study was supported by grants from the Biomedicine Supporting Program of Shanghai ‘Science and Technology Innovation Plan’ (No. 19441902400), the Key Research and Development Program of National Ministry of Science and Technology (No. 2018YFC2001504), the scientific research project of Shanghai Municipal Health Commission (No. 201940367), the scientific research project of Health and Family Planning Commission of Pudong New Area (No. PW2018B-01).

### References

- Engelmann EWM, Rammelt S, Schepers T. Fractures of the cuboid bone: a critical analysis review. *JBJS Rev* 2020;8:e0173. doi: 10.2106/JBJS.RVW.19.00173.
- Kaiser PB, Briceno J, Kwon JY. Complete cuboid dislocation with associated lisfranc injury: a case report and review of the literature. *J Foot Ankle Surg* 2019;58:398–402. doi: 10.1053/j.jfas.2018.08.060.
- Pountos I, Panteli M, Giannoudis PV. Cuboid injuries. *Indian J Orthop* 2018;52:297–303. doi: 10.4103/ortho.IJOrtho\_610\_17.
- Gajendran VK, Yoo BJ, Hunter JC. Unusual variant of the nutcracker fracture of the calcaneus and tarsal navicular. *Radiol Case Rep* 2008;3:208. doi: 10.2484/rcr.v3i3.208.
- Ponkilainen VT, Laine HJ, Mäenpää HM, Mattila VM, Haapasalo HH. Incidence and characteristics of midfoot injuries. *Foot Ankle Int* 2019;40:105–112. doi: 10.1177/1071100718799741.
- Peters W, Panchbhavi V. Primary arthrodesis versus open reduction and internal fixation outcomes for Lisfranc injuries: an analysis of conflicting meta-analyses results. *Foot Ankle Spec* 2020; 1938640020971417. doi: 10.1177/1938640020971417.
- Ponkilainen VT, Mattila VM, Laine HJ, Paakkala A, Mäenpää HM, Haapasalo HH. Nonoperative, open reduction and internal fixation or primary arthrodesis in the treatment of Lisfranc injuries: a prospective, randomized, multicenter trial - study protocol. *BMC Musculoskelet Disord* 2018;19:301. doi: 10.1186/s12891-018-2222-4.
- Dhillon M, Khurana A, Prabhakar S, Sharma S. Crush fractures of the anterior end of calcaneum. *Indian J Orthop* 2018;52:244–252. doi: 10.4103/ortho.IJOrtho\_575\_17.
- Dubois-Ferriere V, Lubbeke A, Chowdhary A, Stern R, Dominguez D, Assal M. Clinical outcomes and development of symptomatic osteoarthritis 2 to 24 years after surgical treatment of tarsometatarsal joint complex injuries. *J Bone Joint Surg Am* 2016;98:713–720. doi: 10.2106/JBJS.15.00623.
- Kapoor C, Patel A, Jhaveri M, Golwala P. Post-traumatic arthritis of the tarsometatarsal joint complex: a case report. *Cureus* 2016;8: e923. doi: 10.7759/cureus.923.
- Chiodo CP, Myerson MS. Developments and advances in the diagnosis and treatment of injuries to the tarsometatarsal joint. *Orthop Clin North Am* 2001;32:11–20. doi: 10.1016/s0030-5898(05)70190-5.

**How to cite this article:** Gu W, Zhang R, Liu W, Shi Z, Mei G, Xue J, Zou J, Wang X, Jiang J. Management of Lisfranc injury with anterolateral calcaneal compression fracture. *Chin Med J* 2022;135:727–729. doi: 10.1097/CM9.0000000000001924