

# Posterior Aspect Fracture of Tibia after Open Wedge Distal Tuberosity Osteotomy: A Case Report

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## Learning Point of the Article:

Orthopedic surgeons should know the existence of posterior aspect fracture of the tibia as a rare complication specific to open wedge distal tuberosity osteotomy.

## Abstract

**Introduction:** Open wedge distal tuberosity osteotomy (OWDTO) was the surgical treatment in which tibial tuberosity was attached proximal fragment to avoid an increase in patellofemoral joint pressure. The current paper reported a case of post-operative posterior aspect fracture of the tibia as a rare complication after OWDTO.

**Case Report:** A 52-year-old Asian man had been performing OWDTO for medial knee osteoarthritis. The patient was injured by the tibial posterior aspect fracture due to minor trauma 2 months after surgery. Bone union was completed by transient unloading and ultrasound therapy, but the anteroposterior screw remained in the bone due to screw breakage during removal.

**Conclusion:** Post-operative posterior aspect fracture of the tibia is a complication specific to OWDTO. It is difficult to detect the fracture on X-ray; therefore, the evaluation with computed tomography is recommended. It is possible that removal of the anteroposterior screw has become difficult in the event that this fracture occurs.

**Keywords:** Open wedge distal tuberosity osteotomy, complication, posterior aspect fracture of tibia, removal difficulty.

## Introduction

Knee osteotomy is a common surgery for young and active patients who have unicompartmental knee osteoarthritis. Open wedge high tibial osteotomy (OWHTO) [1] was the most popular osteotomy for medial unicompartmental knee osteoarthritis, but it was inevitable in OWHTO that patellofemoral joint pressure elevated due to distalization of tibial tuberosity [2].

Open wedge distal tuberosity osteotomy (OWDTO) was the surgical treatment reported by Gaasbeek et al. for the 1st time [3], tibial tuberosity was attached proximal fragment to avoid an increase of patellofemoral joint pressure. This technique was

usually applied to patients who had patellofemoral degeneration in addition to medial knee osteoarthritis. Akiyama et al. [4] has reported modified OWDTO, cutting medial tuberosity in an arc shape to prevent medial protrusion of the distal side. We have adopted this method in operating OWDTO so far, but we experienced a case of post-operative posterior aspect fracture of the tibia. This fracture was uncommon and has not been reported before to our knowledge. This is the first report about this rare complication specific to OWDTO.

## Case Report

A 52-years-old Asian man had right knee pain for 3 years. There

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Website:  
www.jocr.co.in

DOI:  
<https://doi.org/10.13107/jocr.2024.v14.i09.4738>

## Author's Photo Gallery



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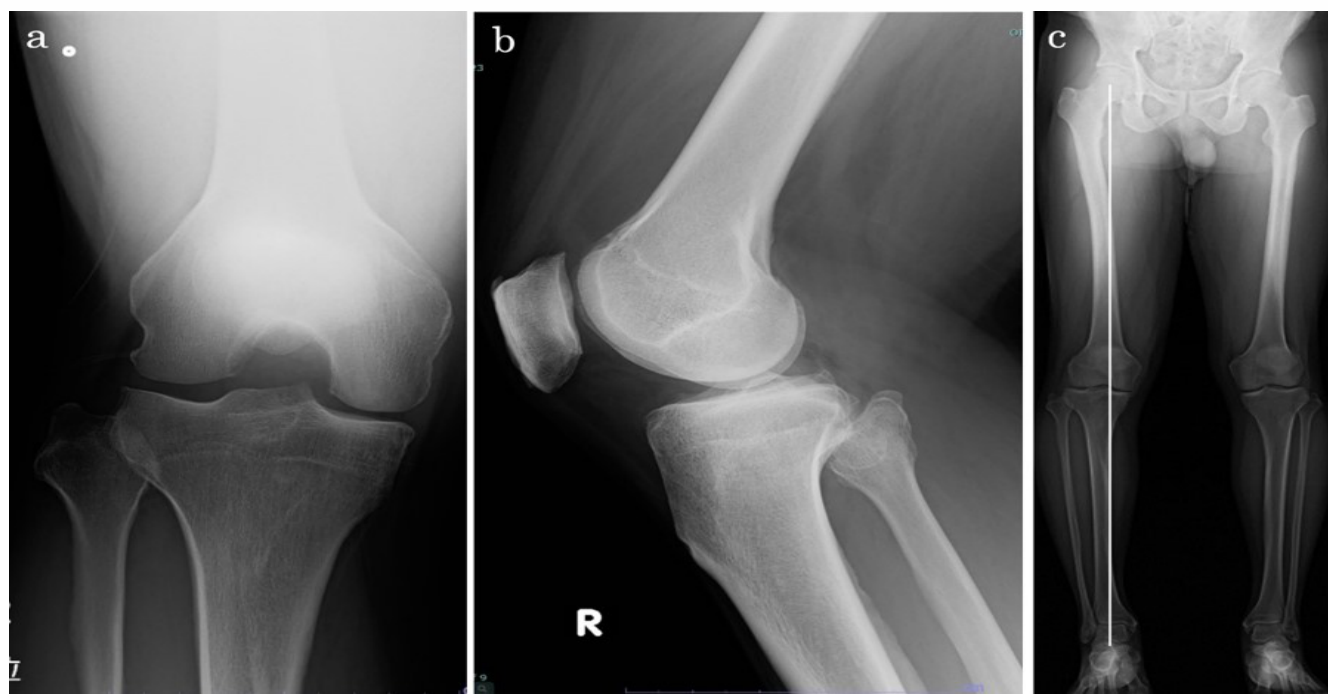
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Submitted: 23/06/2024; Review: 05/07/2024; Accepted: August 2024; Published: September 2024

DOI: <https://doi.org/10.13107/jocr.2024.v14.i09.4738>

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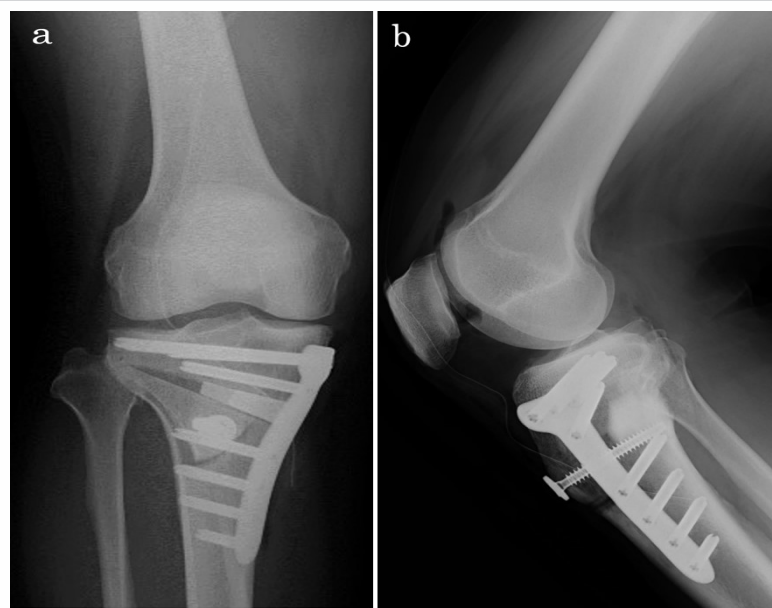


**Figure 1:** (a) Rosenberg view, (b) lateral view and (c) long leg radiographs prior to surgery. Medial femorotibial joint space was narrowed and weight bearing line was passing through medial plateau. For various measurement parameters, the hip-knee-ankle angle was  $3^\circ$  varus, the medial proximal tibial angle was  $83^\circ$ , the mechanical lateral distal femoral angle was  $86^\circ$ , the posterior tibial slope was  $12^\circ$ , the weight-bearing line ratio was 34.7%.

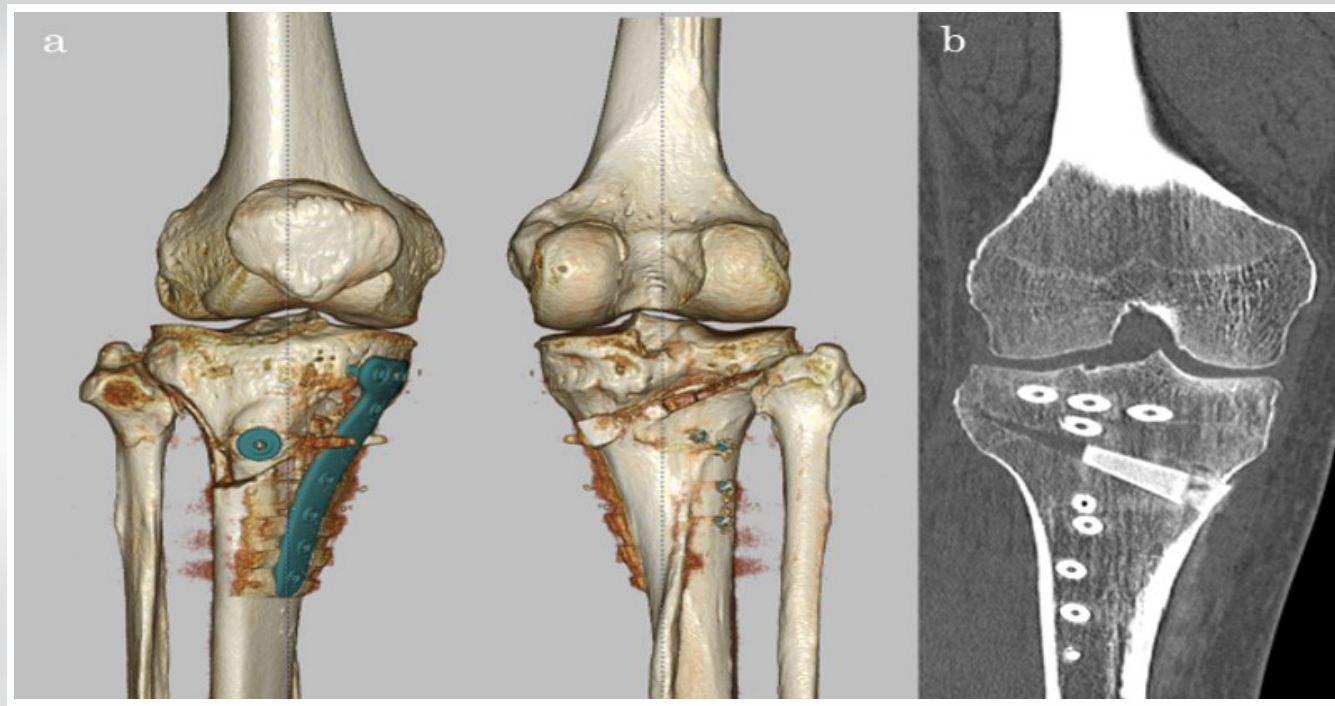
was no history of previous trauma. There were diabetes mellitus as a history and obese (height 1.75 m weight 93.0 kg body mass index  $30.4 \text{ kg/m}^2$ ). Before refer to our hospital, the patient had undergone an arthroscopic medial meniscectomy in another hospital, but the symptoms had not improved. The pain was localized medial joint line, but there was also mild

patellofemoral joint tenderness. Joint instability tests, such as the Lachman test and posterior drawer test, were negative. In a radiographic examination, the medial femorotibial joint space was narrowed obviously, and we were diagnosed with Kellgren-Lawrence grade 2 knee osteoarthritis. For various measurement parameters, hip-knee-ankle angle was  $3^\circ$  varus, medial proximal tibial angle (MPTA) was  $83^\circ$ , mechanical lateral distal femoral angle was  $86^\circ$ , posterior tibial slope (PTS) was  $12^\circ$ , weight-bearing line ratio (WBL ratio) was 34.7% (Fig. 1). In MRI, there weren't any other finding causing symptom other than osteoarthritis, such as ligament and lateral meniscus injury. He was a cleaning staff, which required high activity. Hence, we planned OWDTO with fewer activity restrictions.

The correction angle was measured as  $9^\circ$  with the Miniaci method [5] so that the WBL ratio was 62.5%. The osteotomy site was fixed with a locking plate (Olympus Terumo Biomaterials, Tokyo, Japan) and cannulated cancellous screw (HOLLYX, Shizuoka, Japan) was inserted at the tuberosity anteroposteriorly for the purpose of stabilizing the sagittal plane. Post-operative X-ray showed Fig. 2. MPTA increased  $83^\circ$ – $92^\circ$ , planned correction angle was got and PTS was decreased from  $12^\circ$  to  $10^\circ$ . Two weeks later, we evaluated computed tomography, any fracture including lateral hinge fracture did not exist (Fig. 3).



**Figure 2:** (a) Anteroposterior and (b) lateral view X-ray immediately after the operation. The correction angle was got as planned (medial proximal tibial angle:  $83^\circ$ – $92^\circ$ ) and the posterior tibial slope was decreased by  $12^\circ$ – $10^\circ$ . No findings concerning any fracture exist.

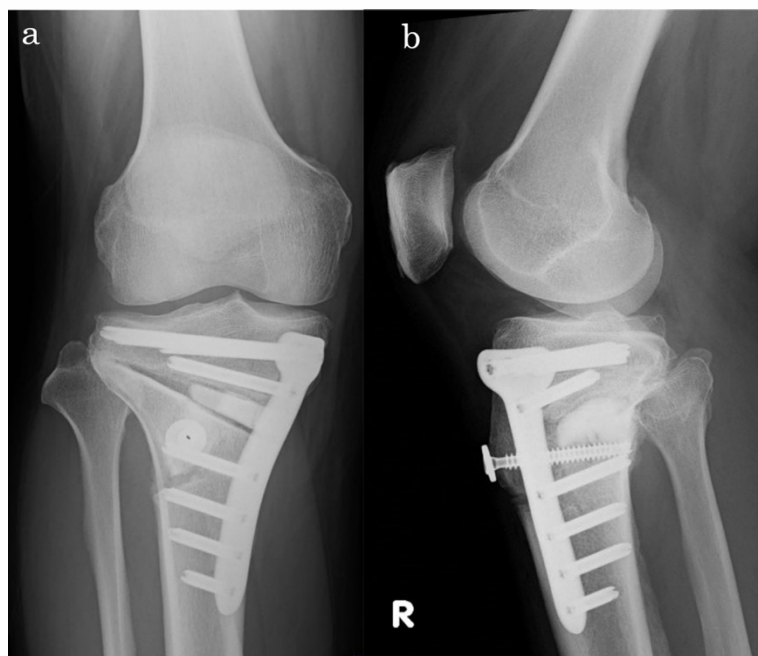


**Figure 3:** (a) 3-dimensional and (b) coronal plane of computed tomography 2 months after surgery. No fracture was found.

Postoperatively, Range of motion and quadriceps strengthening exercise was started on the following day. The patient was allowed half partial weight-bearing a week later, full weight-bearing was permitted from 6 weeks later as much as the pain wasn't terrible.

The patient spent performing rehabilitation and acquired a stable gait 2 months later. On discharge day, he injured an operative limb by stepping on the ground when he got out of the car. His knee pain got worse than ever, however, we weren't able to detect any fracture sign on X-ray (Fig. 4).

Because his symptoms were severe to be considered a sprain, we evaluated on computer tomography and detected the fracture on the tibial posterior aspect of distal fragment. The fracture line penetrated between the screws and occurred only on the posterior surface, which was different from a typical axial pressure injury such as a tibial plateau fracture. Moreover, a lateral hinge fracture that had not ever been found appeared (Fig. 5). We instructed him to unload with a cane for a month and began low-intensity pulsed ultrasound. After that, healing was delayed, but the osteotomy gap was gradually filled. Bone union was completed in post-operative 20 months. The implant removal was performed 22 months after surgery due to the irritation of the locking plate. However, the cannulated cancellous screw was broken in the junction of the head and thread during removal, the part of the thread remained in bone. Although coronal alignment has not changed from primary surgery to implant removal, PTS increased from 10° to 13° in recent X-ray compared to the time of surgery (Fig. 6). His knee pain was relieved;

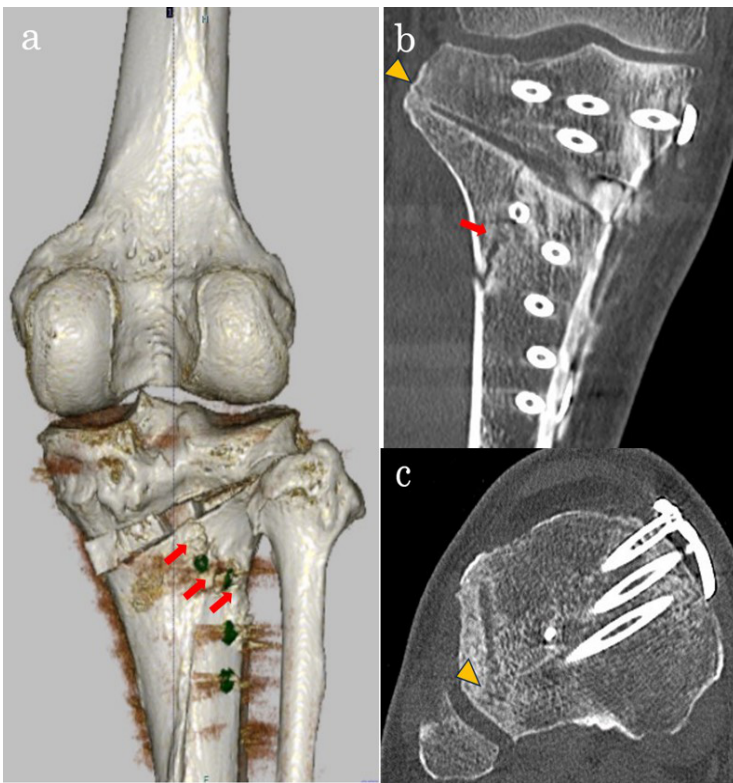


**Figure 4:** (a) Anteroposterior and (b) lateral view X-ray after the injury (2 months post-operative). The callus had been formed at near tuberosity. No obvious findings of fracture exist.

**Discussion**

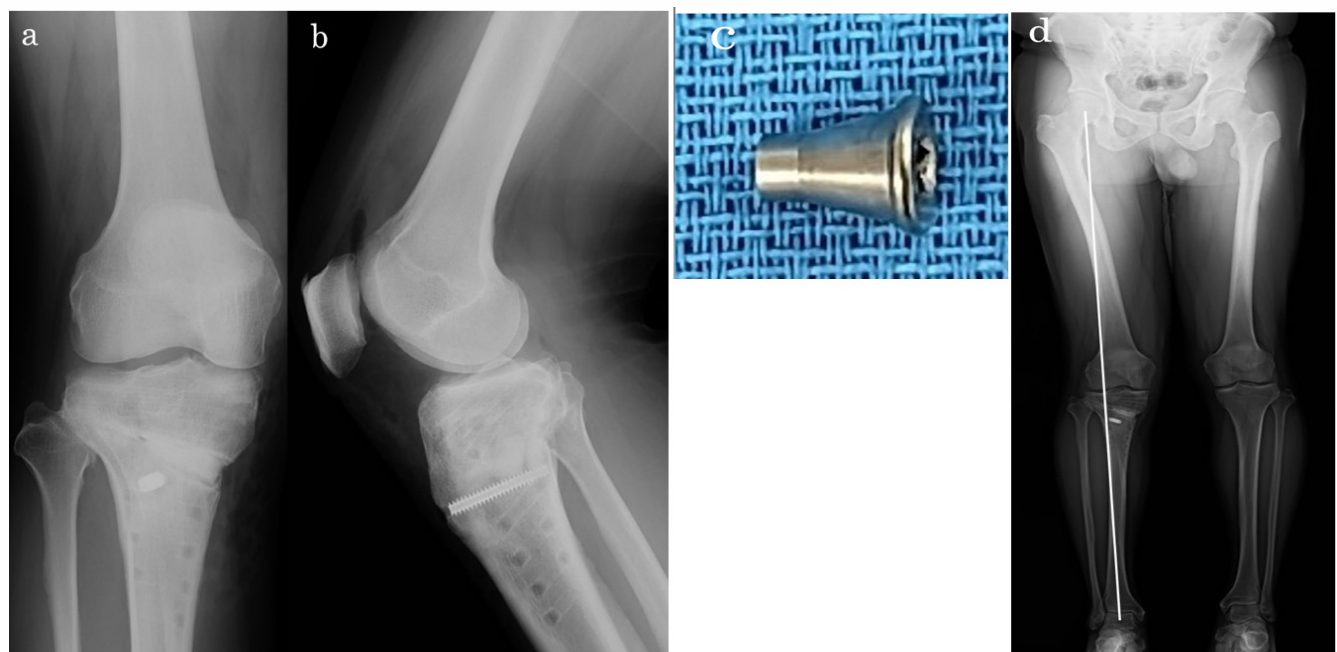
Overall complication rates were 37–55% after OWHTO in a previous study [6]. Among those, lateral hinge fracture was the most common complication in OWHTO, reported 19.8–25.0% [6,7]. Regarding OWDTO, tuberosity fracture was characteristic, the incidence had been reported as 11.5% [7,8]. However, there were few reports on other fractures except these fractures, and no report showing posterior aspect fracture of the tibia after OWDTO existed.

The direct cause of this fracture was extreme axial load in the period that bone healing was incomplete. In addition, it was possible as another cause that the hole 1 screw of the tris plate and the cannulated cancellous screw were in close proximity (Fig. 5). Actually, this fracture continued these screws. Furthermore, a lateral hinge fracture was also present when this fracture happened. The lateral hinge fracture was classified as type 1 in the Takeuchi classification [7], a previous study described this type didn't decline stability of the osteotomy site [9]. On the other hand, Lee showed that the PTS was increased by almost 2° in the posterior subtype, fracture line pierced through the posterior to the midline, compared to the anterior subtype among type 1 lateral hinge fracture [10]. This result indicated when type 1 lateral hinge fracture occurred posteriorly, the posterior part of the osteotomy site suffered additional compressive force. In fact, PTS increased compared to an early post-operative period at the past

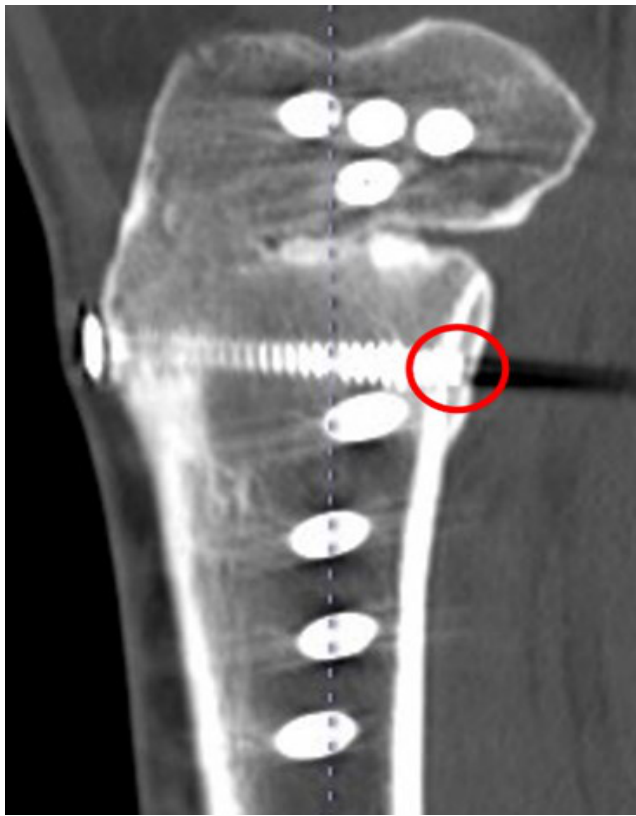


**Figure 5:** (a) 3-dimensional, (b) coronal plane, and (c) axial plane of computed tomography at the time of getting worse knee pain. There was the fracture of the tibial posterior aspect (arrow). This fracture line was continuous to hole 1 screw and anteroposterior screw. Moreover, type 1 lateral hinge fracture that had never existed before appeared (arrowhead).

the Lysholm score was improved from 48 to 78 points in post-operative 2 years.



**Figure 6:** (a) Anteroposterior and (b) lateral view X-ray after implant removal. Bone union was completed, but the shaft part of cannulated cancellous screw remained in the bone. Although coronal alignment hasn't changed, but posterior tibial slope increased from 10° to 13° between primary surgery and implant removal. (c) Photograph of broken screw. (d) long leg radiographs in the present showed appropriate whole leg alignment (weight-bearing line ratio 63.3%).



**Figure 7:** Sagittal plane of computed tomography before implant removal. The screw tip was surrounded by formed sclerotic bone.

follow-up in this case, the fracture might have been a trigger in the posterior aspect fracture.

At the time of removal, the cannulated cancellous screw was broken. The incident was caused to the sclerotic bone surrounding the screw tip which had formed during healing in addition to a long period of time until removal (Fig. 7). This bone was usually formed in the bone fusion process, so particular attention should be paid to removal difficulty when posterior aspect fracture of the tibia was happened.

### Conclusion

Post-operative posterior aspect fracture of the tibia is an uncommon complication after OWDTO. This complication is specific to OWDTO, and it's difficult to detect the fracture on X-ray. If the knee pain gets worse triggered by some kind of trauma post-operatively, evaluation with computed tomography is recommended to avoid missing this fracture. It could be a factor that the hole 1 screw and the anteroposterior screw are nearby, we need caution about the plate position and the direction of the anteroposterior screw. Moreover, it is possible that removal of the anteroposterior screw has become difficult in the event that this fracture occurs.

### Clinical Message

Post-operative posterior aspect fracture of the tibia is a specific complication after OWDTO. If the sudden onset of pain happens postoperatively, performing computed tomography is recommended with the possibility of this fracture in mind.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conflict of interest:** Nil **Source of support:** None

### References

1. Staubli AE, Simoni CD, Babst R, Lobenhoffer P. Tomofix: A new LCP-concept for open wedge osteotomy of the medial proximal tibia-early results in 92 cases. *Injury* 2003;34:55-62.
2. Yang JS, Fulkerson JP, Obopilwe E, Voss A, Divenere J, Mazzocca AD, et al. Patellofemoral contact pressures after patellar distalization: A biomechanical study. *Arthroscopy* 2017;33:2038-4.
3. Gaasbeek RD, Sonneveld H, Heerwaarden RJ, Jacobs WC, Wymenga AB. Distal tuberosity osteotomy in open wedge high tibial osteotomy can prevent patella infera: A new technique. *Knee* 2004;11:457-61.
4. Akiyama T, Osano K, Mizu-Uchi H, Nakamura N, Okazaki K, Nakayama H, et al. Distal tibial tuberosity arc osteotomy in open-wedge proximal tibial osteotomy to prevent patella infra. *Arthrosc Tech* 2019;8:655-62.
5. Miniaci A, Ballmer FT, Ballmer PM, Jakob RP. Proximal tibial osteotomy. A new fixation device. *Clin Orthop Relat Res* 1989;246:250-9.
6. Martin R, Birmingham TB, Willits K, Litchfield R, Lebel

ME, Giffin R. Adverse event rates and classifications in medial opening wedge high tibial osteotomy. *Am J Sports Med* 2014;42:1128-6.

7. Takeuchi R, Ishikawa H, Kumagai K, Yamaguchi Y, Chiba N, Akamatsu Y, et al. Fractures around the lateral cortical hinge after a medial opening-wedge high tibial osteotomy: A new classification of lateral hinge fracture. *Arthroscopy* 2012;28:85-94.

8. Ogawa H, Matsumoto K, Yoshioka H, Sengoku M, Akiyama H. Fracture of the tibial tubercle does not affect clinical outcomes in medial opening wedge high tibial osteotomy with

distal tibial tubercle osteotomy. *Arch Orthop Trauma Surg* 2022;142:607-13.

9. Kang KT, Koh YG, Lee JA, Lee JJ, Kwon SK. Biomechanical effect of a lateral hinge fracture for a medial opening wedge high tibial osteotomy: Finite element study. *J Orthop Surg Res* 2020;15:63.

10. Lee SS, Nha KW, Lee DH. Posterior cortical breakage leads to posterior tibial slope change in lateral hinge fracture following opening wedge high tibial osteotomy. *Knee Surg Sports Traumatol Arthrosc* 2019;27:698-706.

**Conflict of Interest:** Nil

**Source of Support:** Nil

**Consent:** The authors confirm that informed consent was obtained from the patient for publication of this case report

#### How to Cite this Article

Akase H, Hirakawa M, Nagashima Y, Matsuda S, Kaku N. Posterior Aspect Fracture of Tibia After Open Wedge Distal Tuberosity Osteotomy: A Case Report. *Journal of Orthopaedic Case Reports* 2024 September;14(9): 81-86.