

**Case Report**

A Patient of Tibial Shaft Aseptic Hypertrophic Nonunion who Underwent A Serial Corrective Osteotomies with Clamshell Osteotomy Technique: A Case Report

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This is a 35 year-old male who was injured his left tibial and fibular shaft open fracture after a motorcycle accident in 2014, and he underwent debridement, an Open Reduction and Internal Fixation (ORIF) with subsequent free flap surgery at other hospital. After the operations, he still suffered from limping, pain of the left lower leg and weakness. Until 2018, he came to our hospital for help, our impression was left tibial and fibular shaft malunion and screws cut-out with plate protrusion, leg length discrepancy was 3 cm. We treated this patient initially with staged corrective osteotomy, but hypertrophic nonunion and plate broken was happened after 6 months of the middle third tibial shaft corrective osteotomy. We revised the complication with clamshell technique and fixed with an intramedullary nail, the clinical result was satisfied.

The Introduction

This is a 35 year-old male who was injured in a motorcycle accident which caused his left tibial and fibular shaft open fracture in 2014 and he was taken to other hospital and underwent operations such as debridement, ORIF with plate with subsequent free flap surgery. But after these treatments, he still suffered from complications such as limping gait, pain and weakness of left leg and leg length discrepancy until 2018 he went to our hospital for further evaluation.

The Case Report

His pre-operative examination revealed leg length discrepancy was 3cm, Active Range of Motion (AROM) of left knee was 0-100° and AROM of left ankle was in normal range. Appearance was old surgical scar of the left leg lateral side, no redness and hotness, tenderness of the middle third tibial shaft. Skin protrusion over the distal third left lower leg. X-ray of the left lower leg revealed malunion of the tibial shaft and screws cut-out and plate protruded (Figures 1,2).

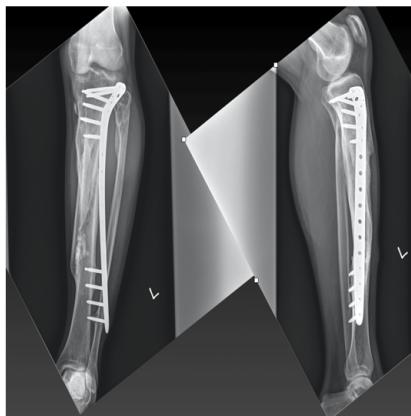


Figure 1: Pre-operation left leg x ray.



Figure 2: Pre-operation whole leg view.

Pre-operative whole leg view and mal-alignment test: left femoral shaft was 49.11 cm, right femoral shaft was 49.21 cm;

left tibial shaft was 37.15cm, right tibial shaft was 39.77cm, Leg Length Discrepancy (LLD) was 3 cm. In AP view: various angulation was 10°, lateral translation was 1 cm; in lateral view: anterior peak angulation was 15°. Lateral Distal Femoral Angle (LDFA) was 82°, Medial Proximal Tibial Angle (MPTA) was 79.5° and joint line convergence angle(JLCA) was 0.4°. Mechanical Axis Deviation (MAD) was 12 mm. Initial serum CRP was 0.7 mg/dL (Table 1).

	LDFA	MPTA	JLCA	MAD	LLD
Pre-operation	82°	79.5°	0.4°	12 mm medialized	3 cm

Table 1: Malalignment test result.

Our surgery plan was to correct the multiplanar tibial deformity from proximal to distal. The first stage surgery goal was to decompression of left knee medial compartment via Open-Wedge High Tibial Osteotomy (OWHTO). Removed the retention lateral tibial plate through the old lateral incision, and OWHTO was incised from a medial incision which has at least 7 cm distance to lateral incision to prevent soft tissue necrosis or ischemia change. 3 pins was inserted under fluoroscopic along the direction from the medial tibial metaphysis to fibula head, fragilized the osteotomy plane with 3.0mm drillbit and oscillating saw and kept the lateral hinge intact. Inserted the osteotome to the medial open-wedge with indirect \ reduction maneuver until the wedge length was 7 mm. Fixation with the locking plate of the OWHTO and refilled the wedge gap with demineralized bony material. Surgical wound irrigation and closed layer by layer and covered with Negative Pressure Wound Treatment (NPWT) and a cylinder cast for immobilization (Figures 3,4).



Figure 3: 6 months follow up of OWHTO.



Figure 4: 6 months follow up of OWHTO.

After OWHTO, the result of malalignment test was LDFA= 82°, MPTA= 87.8°. JLCA was 0° and MAD was lateral deviation 15.5 mm. LLD was 2.4 cm (Table 2).

	MPTA	JLCA	MAD	LLD
Pre-operation	79.5°	0.4°	12 mm medialized	3 cm
Status post OWHTO	87.8°	0°	15.5 mm lateralized	2 cm

Table 2: Malalignment test result.

The second staged surgery was aim to correct the tibial diaphyseal deformity after 10 months of OWHTO. Approached through the lateral incision and drilled multiple bicortical holes with 3.0 mm drillbit of the deformity tibial and fibular segment along the oblique direction. Separated the deformity segment with oscillating saw, osteotome and closed indirect maneuver. Decorticated the unhealthy bone tissue and recannulization with flexible reamer. Internal fixation with a locking plate and interfragment screws. The surgical wound was covered with NPWT and the leg was immobilized with a cylinder cast (Figure 5).



Figure 5: 6 months follow up, plate was broken.

6 months after the second staged surgery, the patient suffered from pain of the left leg after a falling down injury, X-ray showed hypertrophic nonunion and plate broken, pre-operative serum CRP was 0.6 mg/dL, impression was aseptic hypertrophic nonunion and implant broken. We removed the plate and fixed with reamed Intramedullary Nail (IMN) with clamshell osteotomy technique, we removed the broken plate and well decorticated the unhealthy bony tissue. Drilled several bicortical holes with 3.0mm drill bit along the longitudinal direction of the deformity segment. Separated the segment with oscillating saw, osteotomes and laminar spreader. Recannulization with flexible reamer, and reduction with indirection method, placed the guide wire to the distal segment under fluoroscopy assisted locating, and inserted the IMN (12mm in diameter and 360mm in length). Rechecked the position and rotation again under the fluoroscopy before the interlocking screws inserted, inserted the proximal interlocking screws with jig assisted and distal interlocking screw with freehand technique. Fulfill the gap with the local bone graft which harvested

from the reaming and autograft which harvested from anterior superior iliac spine. Covered the surgical wound with NPWT and the leg was protected with cylinder cast after surgery (Figures 6-8)(Table 3).



Figure 6: 12 months follow up, whole leg view.



Figure 7: 12 months follow up, AP and lateral view of left leg.



Figure 8: A serial of the whole leg view.

	MPTA	JLCA	MAD	LLD
Pre-operation	79.5°	0.4°	12 mm medialized	3 cm
Status post OWHTO	87.8°	0°	15.5 mm lateralized	2 cm
Status post clamshell osteotomy	87.8°	0°	10.2 mm lateralized	0.5 cm

Table 3: Malalignment test result.

The patient recovered well after the final surgery, AROM of the left knee was 0-110° and AROM of ankle was normal, MPTA was 87.8°, JLCA was 0°, MAD was 10.2mm lateralized, LLD was 0.5 cm.

The Discussion

In this case, clamshell osteotomy technique is not indicated for a single staged surgery to correct for the proximal and tibial shaft multiplanar deformity, because clamshell osteotomy technique is contraindicated for a metaphyseal malunion [1]. This was the main reason that we decided to do the staged surgery to correct metaphyseal and diaphyseal deformity separately. The first staged OWHTO for proximal tibia can decrease the contact stress of medial compartment of knee and did not have the risk of perineal nerve injury which compared with lateral Close-Wedge HTO (CWHTO) [2]. OWHTO also has advantage to increase the leg length, on the other hand, CWHTO has no benefit of the leg length discrepancy [3]. The second staged corrective osteotomy we chose to plating, because intramedullary nail and plate fixation are ideal options since there were no significant differences between them in time of union and the post-operative complications [4,5]. Also the retention plate of OWHTO at the medial proximal tibia which may cause the interference for intramedullary nail insertion. Plate broken of the second staged corrective osteotomy with aseptic hypertrophic nonunion, which indicated stability was not enough. We replaced the implant from plate(weight sharing device) to reamed intramedullary nail(weight bearing device). To correct the tibial aseptic hypertrophic nonunion with reamed intramedullary nail has much more satisfactory result and the lower soft complications than plating [6]. The clamshell osteotomy is not a sound technique for bone lengthening, but it can be used to shorten a segment of bone. Union times can be long, complications are not uncommon, and some patients will require secondary procedures [7].

References

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