Journal of Orthopaedics, Trauma and Rehabilitation 22 (2017) 52–56

Contents lists available at ScienceDirect

Journal of Orthopaedics, Trauma and Rehabilitation

Journal homepages: www.e-jotr.com & www.ejotr.org

Case Report

Transverse Incision for Minimally Invasive Plate Osteosynthesis of Osteoporotic Tibial Plateau Fractures
使用橫向切口來進行微創鋼板固定以治療骨質疏鬆性脛骨平台骨折

Saini Aaron K.*, Desai Ankit, Trompeter Alex J., Newman Kevin J., Elliott David S.

Rowley Bristow Orthopaedic Unit, Department of Trauma and Orthopaedics, St. Peter's Hospital, Chertsey, Surrey KT16 0PZ, UK

A R T I C L E I N F O

Article history:
Received 11 March 2015
Received in revised form
18 July 2016
Accepted 21 October 2016

Keywords:
internal fixation
locking plate
MIPO
tibial plateau
transverse incision

A B S T R A C T

Fractures of the tibial plateau frequently require surgical intervention. Open approaches are increasingly being replaced by minimally invasive techniques. Plate fixation may be uni- or bicondylar, and surgical incisions are traditionally orientated in the longitudinal plane. We describe osteoporotic fragility tibial plateau fractures managed with plate fixation applied through minimally invasive transverse incisions. All cases achieved acceptable fracture reduction, restoration of alignment, and timely bone union without infection or wound complications. This technique reduces the risk of wound complications at later arthroplasty, along with the established benefits of current minimally invasive techniques. This is the first report in the literature of the use of transverse incisions for minimally invasive plate fixation of the tibial plateau.

中 文 摘 要

脛骨平台的骨折通常需要外科手術。開放式手術越來越多地被微創技術所取代。鋼板固定可以是單髁或雙髁,並且手術切口通常是縱向平面的。我們描述了新方法,使用橫向的切口,來進行微創鋼板固定以治療骨質疏鬆性脛骨平台骨折。我們描述了在我們中心的兩個骨質疏鬆脆性脛骨平台骨折的病例,成功地通過微創橫向切口,來進行鋼板固定手術。兩個病例都達到可接受復位,下肢調準恢復和按時骨折愈合,並沒有出現感染或傷口併發症。這是第一次在文獻中,關於把橫向切口應用於骨質疏鬆性脛骨平台骨折微創鋼板固定的報導。該技術一方面達到微創技術的好處,另一方面降低了出現傷口併發症和長遠需要接受關節置換術的風險。

Introduction

Tibial plateau fractures account for 1% of all fractures and a reported 8% of fractures in elderly people.[1] Relative indications for surgical intervention include > 5 mm step of the articular surface, > 5 mm displacement between fracture fragments, varus or valgus instability, and open injuries.[2] Open reduction and internal fixation is considered the gold standard of treatment, aiming for anatomical reduction with absolute stability given the intra-articular personality of fractures. Soft tissue considerations are paramount, and may be an indication for temporising measures and delay of definitive fixation.[3] Intraoperatively, care is required to minimise disruption of the soft tissue envelope as this has direct implications for fracture and wound healing, as well as postoperative rehabilitation and recovery.

Minimally invasive plate osteosynthesis (MIPO) techniques have been shown to allow adequate reduction, stable fixation, bone healing, early rehabilitation, and appropriate restoration of function while minimising soft tissue disruption.[4–6] This has traditionally been performed using medial, lateral, or bilateral longitudinal incisions to accommodate L- or T-plates in buttress mode with or without compression and supplementary locking screws.[5,6] We describe a novel technique utilising small transverse incisions for plate placement and believe this further minimises soft tissue disruption compared with the traditional longitudinal MIPO technique, aiding early mobilisation and recovery. This technique is aimed at low energy osteoporotic

* Corresponding author. *E-mail:* aaronsaini@nhs.net.

http://dx.doi.org/10.1016/j.jotr.2016.10.002

fractures in elderly people, where restoration of axial alignment is the primary goal over articular surface reconstruction, given the likely need for expedited arthroplasty despite the adequacy of fixation in this patient group. The resulting minimal transverse scars have the added benefit of being at a tangent to, and away from, the likely incision sites for future arthroplasty, reducing the risk of poorly vascularised skin bridges and their associated complications.

Surgical technique and case series

We report two cases of low energy osteoporotic fragility fractures managed utilising transverse incisions for bicondylar MIPO fixation. Although tibial plateau fractures are typically described by the Schatzker classification,[7] these osteoporotic fragility fractures show high energy patterns with low energy mechanisms and do not always fit the classic description.

Patient 1

A 74-year-old female presented having tripped while walking in woodland. She had a background of asthma, hypertension, and polymyalgia rheumatica for which she was taking long-term oral steroids (10 mg prednisolone daily). She lived alone and mobilised without aids. Computed tomography (Figure 1) showed a bicondylar fracture including a transverse component (Orthopaedic Trauma Association (OTA) Classification[8]: 41-C3). This was a closed injury and the limb had no clinical neurological or vascular deficit.

Patient 2

A 66-year-old female presented having fallen from standing height while walking. She had a background of asthma, herpes simplex, and a previously perforated gastric ulcer. She consumes approximately 80 units of alcohol per week and smokes five to six cigarettes per day. Although living in sheltered accommodation, she mobilises independently. This was a closed injury with no clinical evidence of neurological or vascular compromise. Initial radiographs showed a fracture of the right tibial plateau and this was confirmed with computed tomography (Figure 2), which showed a bicondylar injury with a transverse component (OTA Classification[8]: 41-C3).

Surgical technique

Once adequately prepared for theatre and anaesthetised, the patient is positioned supine on a radiolucent table. A small radiolucent bolster is used under the knee. A pneumatic tourniquet is used. Elevation of depressed articular fragments is achieved using a small punch through a metaphyseal cortical window via a percutaneous stab incision. As the fractures have a bicondylar element, a medial plate is used first. A 3-cm transverse incision is made at approximately the level of the apex of the fracture posteromedially, allowing the plate to be slid down and then up again under the skin into the appropriate position to work as a buttress. A locking guide is applied to the required periarticular plate and utilised as a handle to aid plate orientation and manoeuvring. Once the buttress screw is applied, and the medial condyle reduced, a second transverse incision is made on the lateral side at the level of the joint. A lateral plate is then applied in a similar fashion, although the incision at the level of the joint on this side allows direct visualisation of all three to four proximal horizontal screw holes. Compression of the articular block is achieved with a pelvic reduction clamp and then maintained with subchondral locking screws through the plate. Stab incisions < 5 mm are used for the insertion of distal screws. Plate position and reduction are confirmed using fluoroscopy (Figures 3 and 4). Closure is performed using staples.

Both patients were allowed full free range of motion immediately postoperatively. Toe-touch weight bearing was permitted from the 1st day, with increase to partial weight bearing at 4 weeks, and full weight bearing by 6–8 weeks.

Figure 1. Coronal CT scan of right knee of Patient 1 showing OTA Classification 41-C3 tibial plateau fracture. CT = computed tomography; OTA = Orthopaedic Trauma Association.

Figure 2. Coronal CT scan of right knee of Patient 2 showing OTA Classification: 41-C3 tibial plateau fracture. CT = computed tomography; OTA = Orthopaedic Trauma Association.

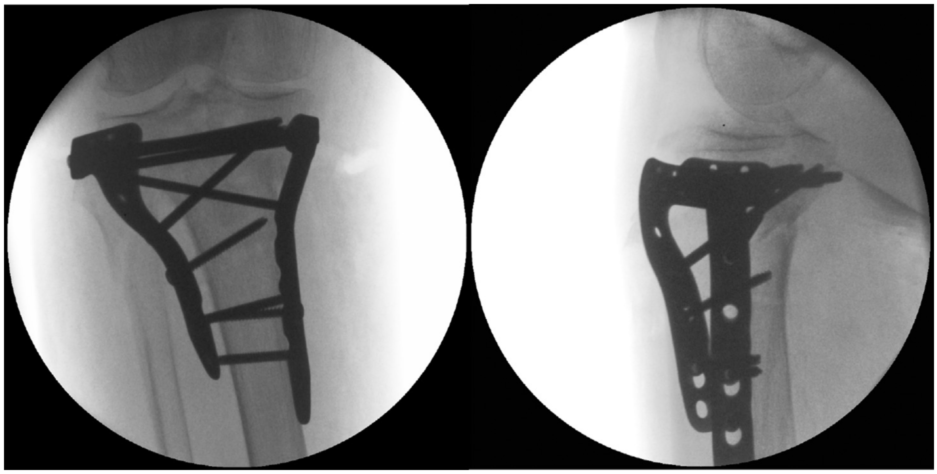

Figure 3. Patient 1 Anterior-posterior (AP) and lateral image intensifier intraoperative projections.

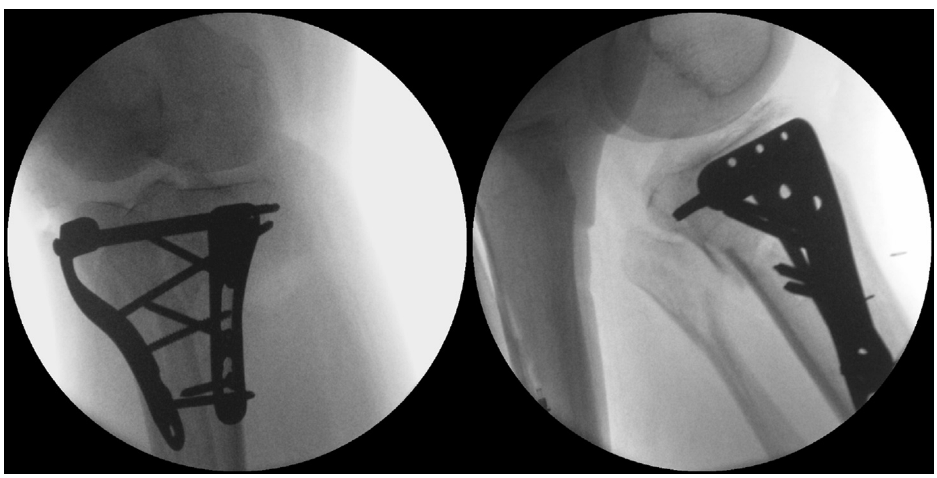

Figure 4. Patient 2 Anterior-posterior (AP) and lateral image intensifier intraoperative projections.

Both patients achieved clinical and radiological union by 3 months follow-up. There were no infections in either patient and all wounds healed well with minimal scar formation (Figure 5). At 2-year follow-up Patient 1 continues to mobilise pain-free without the use of mobility aids. There is minimal residual scarring (Figure 6). The patient is able to flex her knee to over 110° (Figure 7). Weight-bearing radiographs at 2 years show good preservation of the femorotibial joint space (Figure 8).

Patient 2 moved from the local area and was therefore unable to attend for subsequent follow-up.

Discussion

Respect of soft tissues continues to play a significant role in the success of surgical fracture stabilisation. Minimising periosteal stripping reduces the risk of vascular embarrassment of fracture fragments. Minimally invasive techniques compared with open procedures have been associated with reduced soft tissue trauma, and a possible reduction in wound and infective complications.[9] Detractors of minimally invasive surgery may argue that smaller incisions may result in inadequate exposure and more difficult fracture reduction, which takes longer to achieve. We have shown how adequate fracture reduction, and a favourable outcome can be achieved utilising a MIPO technique with small transverse incisions.

It is important to note that the technique described here is not necessarily appropriate for all patients. The patients reported sustained low energy osteoporotic fragility fractures. As these patients are older than 60 years, chasing perfect articular reduction was not deemed appropriate. More important was to correct the mechanical alignment of the limb and utilise a technique to allow the patient to mobilise and move the knee immediately postoperatively. Both our patients had significant risk factors for postsurgical complications such as surgical site infection and delayed wound healing. These included smoking, alcohol excess and concomitant steroid use. We did not observe any infections or wound complications in our patients utilising small transverse incisions.

Arthroplasty of the knee is typically performed through a midline skin incision, regardless of the subsequent approach utilised for entry into the joint, usually described in relation to the patella. When prior surgery has been performed on a knee, any surgeon hoping to perform subsequent arthroplasty is faced with either trying to incorporate any previous scars, or leaving a viable skin bridge between the new and old incisions. This is particularly precarious around the knee given the circumferential blood supply coursing from posterior to anterior. Any skin bridge formed,

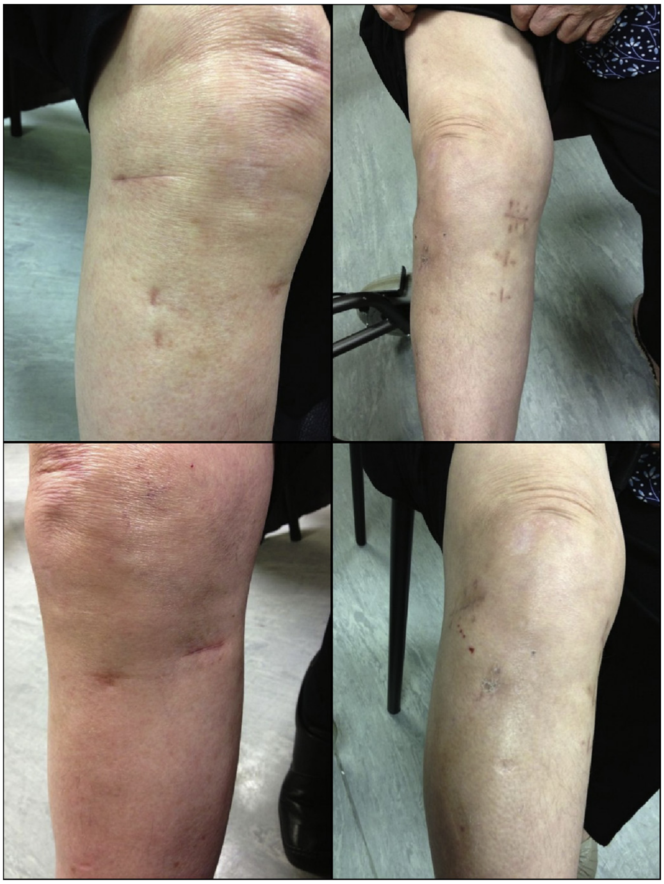

Figure 5. Healed wounds at 3-month follow-up with minimal scar formation.

particularly between long longitudinal incisions is at risk of avascular necrosis and its sequelae. Our technique utilises short transverse incisions relatively far from the midline. This should reduce the risk of wound complications when subsequent arthroplasty is performed through a longitudinal midline incision.

We acknowledge the small number of patients and the relatively short follow-up period. A larger sample size, recruited prospectively, in a controlled study would be required to further validate our technique.

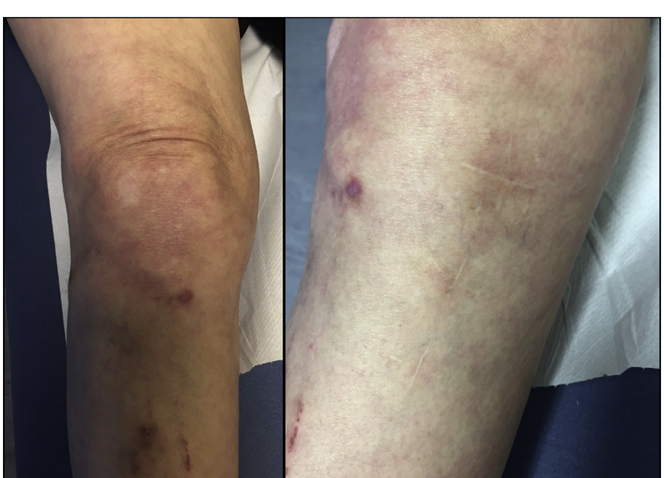

Figure 6. Minimal residual scar for Patient 1 at 2-year follow-up.

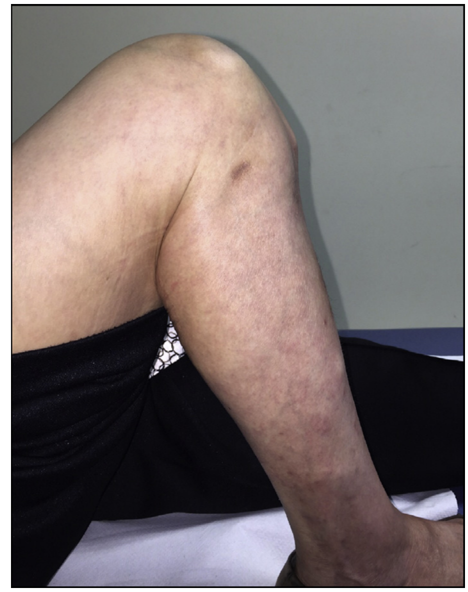

Figure 7. Patient 1 with active flexion to over 110° at 2-year follow-up.

Traditional approaches to the medial or lateral tibial plateau, whether open or minimally invasive, are orientated in the longitudinal plane. This contrasts against the basic surgical principle of orientating incisions where possible along the direction and orientation of collagen fibres in the dermis of the skin, originally described in German by Langer[10] in 1861, and translated to English in 1978. Our transverse incision technique is given further credence by the words of Hoppenfeld[11] when he reports that "The lines of cleavage of the skin run roughly transversely across the knee joint. Therefore, the more the transverse the incision, the more cosmetic the resulting scar."

We believe our approach to these fragility fractures to be safe, reliable, and reproducible, and ideal when alignment restoration with early patient mobilisation and rehabilitation is the goal. This is hugely significant in the context of providing a bone and soft tissue "canvas" for future arthroplasty.

Figure 8. Patient 1 Anterior-posterior (AP) and lateral radiographs at 2-year follow-up.

Conflicts of interest

There are no conflicts of interest for any of the authors.

Funding/support

No funding was received for the work described in this article.

References

1. Bucholz RW, Heckman JD, Court-Brown CM, et al. *Rockwood and Green's fractures in adults*. 7th ed. Philadelphia: Lippincott Williams and Wilkins; 2009.
2. Miller MD, Thompson SR, Hart R. *Review of orthopaedics*. 6th ed. Philadelphia: Saunders; 2012.
3. Dirschl DR, Del Gaizo D. Staged management of tibial plateau fractures. *Am J Orthop* 2007;**36**:12–7.
4. Kankate RK, Singh P, Elliott DS. Percutaneous plating of the low energy unstable tibial plateau fractures: a new technique. *Injury* 2001;**32**:229–32.
5. Raza H, Hashmi P, Abbas K, et al. Minimally invasive plate osteosynthesis for tibial plateau fractures. *J Orthop Surg (Hong Kong)* 2012;**20**:42–7.
6. Biggi F, Di Fabio S, D'Antimo C, et al. Tibial plateau fractures: internal fixation with locking plates and the MIPO technique. *Injury* 2010;**41**:1178–82.
7. Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The Toronto experience 1968–1975. *Clin Orthop Relat Res* 1979;**138**:94–104.
8. Marsh JL, Slongo TF, Agel J, et al. Fracture and dislocation classification compendium — 2007: orthopaedic trauma association classification, database and outcomes committee. *J Orthop Trauma* 2007;**21**(Suppl. 10):S1–163.
9. Barei DP, Nork SE, Mills WJ, et al. Complications associated with internal fixation of high-energy bicondylar tibial plateau fractures utilizing a two-incision technique. *J Orthop Trauma* 2004;**18**:649–57.
10. Langer K. On the anatomy and physiology of the skin. I. The cleavability of the cutis. *Br J Plast Surg* 1978;**31**:3–8.
11. Hoppenfeld S, De Boer P, Buckley R. *Surgical exposures in orthopaedics: the anatomic approach*. 4th ed. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins; 2001. p. 543.