Technical Note

Expanding indications of the horizontal belt plate: A technical note

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Abstract
Background: Although the standard treatment for articular fractures usually involves open anatomic reduction and internal fixation with the concept of absolute stability, achieving adequate fracture stabilisation in multifragmentary patterns is always challenging. Several anatomical implants were developed to improve stabilisation and improve clinical outcomes in articular fractures. However, these modern implants, especially in developing countries, are expensive and not always available for routine use. Horizontal rafting plate has recently emerged as an alternative technique to treat complex tibial plateau fractures using simple implants that function as a large washer.

Objective: This technical note aims to describe horizontal belt plate use for treatment of periarticular fractures including the tibial plateau, thereby expanding its initial indication.

Conclusion: Horizontal belt plate is an effective, safe, and inexpensive treatment alternative for complex articular fractures. However, the surgeon must carefully analyse the fracture pattern to verify if the horizontal belt plate can be used alone or with traditional techniques.

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Introduction

Articular fractures require absolute stability that can be achieved using open or percutaneous reduction, interfragmentary compression, and early mobilisation. However, in multifragmentary patterns, fracture compression is contraindicated due to articular surface shortening [1–5]. In this situation, positioning screws can be applied to sustain the reduction. Several modern periarticular precontoured locking compression plates were developed to fix periarticular fractures. Implants with low profile, anatomical shape, and several locking screws in different planes promote adequate stability, allowing early articular mobilisation and ultimately improving functional outcomes.

However, sophisticated implants are frequently unavailable for fracture fixation, especially in countries with limited financial resources.

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Bermúdez et al. [1] described the use of a horizontal rafting plate for treatment of complex tibial plateau fractures. In the original technique, the authors bent a traditional reconstruction plate contouring the tibial plateau. The implant functioned as a large washer. The objective of the technique was to enable several screws in different planes through the plate, functioning as a raft to prevent articular depression. The authors also emphasised the possibility to avoid additional posterior approaches for complex tibial plateau fractures when using this technique.

The present study aims to report horizontal belt plate use in periarticular fractures including the tibial plateau, consequently expanding its indication.

Discussion

The standard treatment for articular fractures is anatomical reduction and fracture compression achieving absolute stability [6,7].

Precontoured locking plates increase stability and allow early articular mobilisation, improving functional outcomes. However,
due to their elevated cost, sophisticated implants are sometimes unavailable for the orthopaedic surgeon.

Horizontal rafting plate has emerged as an inexpensive and effective technique, using traditional bent plates to follow the epiphyseal outline. Since the horizontal rafting plate description by Bermúdez et al. [1], its use has gradually become more popular among orthopaedic surgeons worldwide.

The technique consists of fracture reduction and temporary fixation with K-wires. Subsequently, the fracture is fixed with 1/3 tubular plate which is bent to follow the epiphyseal outline, thereby functioning as a large washer. This construction increases stability with several screws in different planes, avoiding secondary fracture depression (Figs. 1 and 2).

Complex fractures of the distal femur are sometimes difficult to fix, even using modern implants. Considering the Hoffa pattern present in 38% of distal femur fractures, treatment remains challenging and almost always requires different techniques to fix all fracture fragments [4]. Especially in this particular fracture pattern, the horizontal belt plate is a valuable treatment alternative in combination with traditional anterior to posterior fixation using lag or positioning screws (Fig. 3).

The same concept could be applied to tibial pilon fractures. High-energy trauma usually leads to complex fracture patterns (AO type C), and the treatment can require more than one approach and several plates in different positions [8]. The horizontal plate can be either used isolatedly or in combination with other implants as an alternative method, notably in comminuted fractures involving the anterior rim of the tibial pilon (Fig. 4).

Another unusual application of the horizontal belt plate is to improve stability in fractures around intramedullary implants and periprosthetic fractures. In these cases, the fixation is frequently possible only using unicortical locking screws. Depending on the screw number in the proximal part of the locking compression plate, cerclage wiring may be necessary to complement fixation, achieving adequate stability. Alternatively, the horizontal belt plate can be used perpendicularly over the locking compression plate, allowing fixation with bicortical screws at the anterior and posterior cortices of the femur (Fig. 5).

The present study showed the broadening of horizontal belt plate use, not only applied to tibial plateau fractures, but also to tibial pilon, distal femur, proximal humeral fractures (Fig. 6), and
Fig. 3. (A and B) CT-scan showing a Leteneur Type 2 Hoffa fracture. (C and D) Perioperative images showing fracture reduction and provisional fixation with K-wires. (E) Fracture fixation with horizontal rafting plate. (F and G) Postoperative images in anteroposterior and lateral views showing fracture reduction and fixation with horizontal rafting plate and screws placed from anterior to posterior.

Fig. 4. (A and B) X-ray in anteroposterior and lateral views showing complex tibial pilon fracture. (C) Provisional reduction and fixation using bone clamp and K-wire. (D) Fracture fixation with lag screw and horizontal belt plate. (E and F) Postoperative X-ray in anteroposterior and lateral views showing a complex pilon fracture. Observe the fracture fixation with a medial locking compression plate (DePuy Synthes) and a horizontal rafting plate at the anterior rim of the tibial pilon.
as an augmentation technique to increase stability in fractures around intramedullary implants.

The authors recommend orthopaedic surgeons should be familiar with this alternative and inexpensive method, especially in complex fractures with small bone fragments. Therefore, the correct analysis of the fracture pattern is essential to identify when the horizontal belt plate could be successfully applied. Possible pitfalls when using this technique include

Fig. 5. (A and B) Distal femur X-ray in anteroposterior and lateral views showing distal femur fracture at the end of the intramedullary nailing. (C) X-ray in anteroposterior view showing fracture fixation with Less Invasive Stabilisation System (DePuy Synthes®). (D) X-ray in lateral view showing fracture healing.

Fig. 6. (A) X-ray in anteroposterior view showing fracture-dislocation of the proximal humerus. (B) X-ray after fracture-dislocation reduction. (C) CT-scan with 3D reconstruction showing comminuted fracture of the greater tuberosity. (D) Fracture fixation by applying a lag screw plus horizontal belt plate. (E) X-ray showing fracture healing in satisfactory position.
intra-articular screw penetration and soft tissue discomfort caused by the periarticular hardware. Perioperative images to confirm the correct positioning of the screws and careful soft tissue management to adequately cover the plate are essential to prevent such complications.

Conclusion

Horizontal belt plate is a safe, inexpensive, and effective method for complex articular fracture fixation. The authors advocate this technique for complex articular fractures with small bone fragments. This technique would be especially beneficial in pilon fractures and distal femoral fractures with Hoffa patterns.

Conflict of interest statement

The authors declare that they have no conflict of interest.

References