Peer Review File

Article information: https://dx.doi.org/10.21037/atm-22-750

Reviewer Comments

Comment 1: This is an interesting study which requires some work before it is suitable for publication.

Reply 1: Thank you for your comment.

Changes in the text: No corresponding changes were made.

Comment 2: The bulk of the work should be focused on improving the language used in the manuscript - it is largely understandable but is full of grammatical errors and does not meet the language requirements for a scientific article in an international peer-reviewed journal.

Reply 2: Thank you for your advice on the language. We carefully proofread the manuscript to correct grammatical errors and improve the language used in the manuscript.

Changes in the text: All changes have been highlighted in red in the whole text.

Comment 3: The aims and the conclusion of the study are discordant.

Reply 3: Thank you for this constructive comment.

Changes in the text: We have modified the aims and the conclusion as the following

comments (please see Page 3 Line 43-46, Page 4, Line 65-69 and Page 17, Line 346-350)

Comment 4: The authors cite the aim of the study to be the proposal and validation of a methodology to assess the effectiveness of proximal tibia posterolateral fragment fixation. This is inaccurate for several reasons. Firstly the assessments are based on theoretical fracture reduction of pre-operative CT scans rather than CT-scans post-fixation. It would be more accurate to say that the study aimed to assess the suitability of proximal tibia fractures involving the posterolateral quadrant for anterolateral plate fixation alone. Secondly the current methodology being described is not novel, as digital fracture reduction with plate application has been widely decribed in the literature, whether using the Materialise software or otherwise.

Reply 4: Thank you for your comments. The study aimed to evaluate the efficacy of the proximal tibial lateral plates in capturing the posterolateral fragments. The "suitability" and the "fixation effectiveness" express a similar meaning in this study. According to an evaluation study by Aneja et al. (1), published in *Injury*, we think that the latter expression may make the study easily understandable to orthopaedic surgeons and readers. Although similar methods have been mentioned in other literature (1-3) to evaluate the fixation effectiveness of the targeted plates, they are fundamentally different from our study. They placed the plates on Sawbone or cadaveric bone and used CT scans to project the location of screws. An axial CT image of a specific distance below or above the articular surface was compared with a two-dimensional fracture line

map. In other words, this is merely an assessment of the position relationship between the screw and the fracture line on an axial image. In our study, we placed each plate-screw construct on three-dimensional fracture models that based on actual cases to evaluate the ability of the targeted plates in capturing posterolateral fragments. The position of the plate-screw construct changed with different fracture morphology to simulate actual internal fixation surgery. Therefore, the three-dimensional digital method in our study has not been implemented before, and the method is more reliable and valuable in internal fixation evaluation. We expected to report the new digital tridimensional method and emphasize its significance. We separated the aim into two parts: 1) propose a new digital methodology of internal fixation evaluation that based on actual fracture cases and 2) evaluate the fixation effectiveness of four commercially available proximal tibial lateral plate-screw constructs for posterolateral fragments.

References

(1) Aneja A, Luo TD, Liu B, et al. Anterolateral distal tibia locking plate osteosynthesis and their ability to capture OTAC3 pilon fragments [J]. Injury, 2018, 49(2): 409-413.

(2) Penny P, Swords M, Heisler J, et al. Ability of modern distal tibia plates to stabilize comminuted pilon fracture fragments: Is dual plate fixation necessary? [J]. Injury, 2016, 47(8): 1761-1769.

(3) Mcgonagle L, Cordier T, Link BC, et al. Tibia plateau fracture mapping and its influence on fracture fixation [J]. Journal of Orthopaedics and Traumatology, 2019, 20(1): 12.

Changes in the text: We have revised the corresponding sentences in the Abstract part

and the Introduction part (please see Page 3, Line 43-46 and Page 5-6, Line 102-105).

Comment 5: These should be referenced and acknowledged in the manuscript (rather than just the sawbone papers) and if appropriate, comparisons should be drawn to highlight any novel methodology this study.

Reply 5: Thank you for your comment.

Changes in the text: We have modified the manuscript as advised (please see Page 12-13, Line 256-274). Besides, the reference also has been updated (please see Page 21 Line 443-445).

Comment 6: The comparisons of the various commercial plates is a novel finding and should be elaborated upon.

Reply 6: Thank you for your constructive comment. Some previous studies (1-3) have compared the fixation advantages of different commercial plates, and one of the new points in our study is the three-dimensional digital method as the explanation in Reply 4. Therefore, we did not elaborate the comparisons of the various commercial plates in the previous manuscript. The insightful suggestion may improve the readability of the paper, the relevant information has added in the manuscript.

References

(1) Aneja A, Luo TD, Liu B, et al. Anterolateral distal tibia locking plate osteosynthesis and their ability to capture OTAC3 pilon fragments [J]. Injury, 2018, 49(2): 409-413.

(2) Penny P, Swords M, Heisler J, et al. Ability of modern distal tibia plates to stabilize

comminuted pilon fracture fragments: Is dual plate fixation necessary? [J]. Injury, 2016, 47(8): 1761-1769.

(3) Mcgonagle L, Cordier T, Link BC, et al. Tibia plateau fracture mapping and its influence on fracture fixation [J]. Journal of Orthopaedics and Traumatology, 2019, 20(1): 12.

Changes in the text: We have modified the manuscript as advised (please see Page 3, Line 45-46 and Page 5-6, Line 103-105).

Comment 7: The conclusion should be rewritten to reflect all the above accordingly.

Reply 7: Thank you for your suggestion.

Changes in the text: We have rewritten the conclusion as advised (please see Page 4, Line 65-69 and Page 17, Line 346-350).

Comment 8: The methodology requires some clarification.

Reply 8: Thank you for your comment.

Changes in the text: We have modified the Method part of the manuscript as the following detailed comments (please see Page 6-9, Line 111~187 and Table 1).

Comment 9: The authors mention including all tibial plateau fractures which had some involvement of the posterolateral tibial plateau - these could include fractures including the entire anteroposterior width of the tibial plateau as well as those purely involving the posterolateral quadrant. In this latter group, anterolateral plating may not be a

suitable surgical fixation strategy.

Reply 9: Thank you for your comments. The 144 tibial plateau fractures included in this study all involved the posterolateral articular surface, but not limited to it. In other word, the fractures could involve the entire anteroposterior width of the tibial plateau, but they should be required the presented separate split fragments or collapsed center in the posterolateral quadrant of the tibial plateau.

Changes in the text: We have modified the manuscript as advised (please see Page 6, Line 120-121).

Comment 10: It would be useful to have a more detailed breakdown of the fractures included, particularly the proportion of those captured only by the posterior 1-2 screws (ie in Figure 1).

Reply 10: Thank you for your insightful comment. According to Luo's three-column classification (1), we added a detailed breakdown of these fractures and supplemented it in Table 1. Although these 144 tibial plateau fractures involved different columns, the study focused on the capturing rate of posterolateral fragments. The proportion of different types of three-column classification captured only by the posterior 1-2 screws in different plate systems was similar to the results shown in Table 2, and the former has little significance for clinical guidance. If necessary, please contact us to upload relevant tables as supplementary data.

Reference

(1) Luo CF, Sun H, Zhang B, et al. Three-column fixation for complex tibial plateau

fractures [J]. Journal of Orthopaedic Trauma, 2010, 24(11): 683-692.

Changes in the text: We have added the relevant data as advised (please see Table 1).

Comment 11: Was there formal delineation of the 'posterolateral quadrant'? Which landmarks were used to divide the tibial plateau?

Reply 11: Thank you for your comment. According to Luo's three-column classification (1), on the axial view, the tibial plateau is divided into three areas, which are defined as the lateral column, the medial column, and the posterior column. These three columns are separated by three connecting lines, namely OA, OC, and OD. Point O is the center of the knee (midpoint of two tibial spines). Point A represents the anterior tibial tuberosity. Point C is the most anterior point of the fibular head. Point D is the posteromedial ridge of proximal tibia. Point B is the posterior sulcus of the tibial plateau. Line OB intersects the posterior column into the posteromedial and posterolateral column. The area bounded by lines OB, OC and the tibial plateau edge is the posterolateral quadrant of the tibial plateau. The three-column classification is a useful supplement to the present classification systems for tibial plateau fractures and has been widely used in clinical practice.

Reference

(1) Luo CF, Sun H, Zhang B, et al. Three-column fixation for complex tibial plateau fractures [J]. Journal of Orthopaedic Trauma, 2010, 24(11): 683-692.

Changes in the text: No corresponding changes were made.

Comment 12: Did the assessment of fragment capture involve all fracture fragments or only those in the posterolateral quadrant?

Reply 12: Thank you for your insightful comment. The assessment was performed on the basis of a stimulation of the actual surgery for the tibial plateau fracture. The implants were placed on fracture models at the most suitable position to allow for the fixation of all fracture fragments as much as possible. However, this study focused on the positional relationship between intra-articular posterolateral fragments and proximal rafting screws (as stated on page 8, line 157-158 of the manuscript). Therefore, only the capturing rate of the posterolateral fragment was calculated to evaluate the fixation effectiveness of the lateral proximal tibial plates for posterolateral fragments.

Changes in the text: No corresponding changes were made.

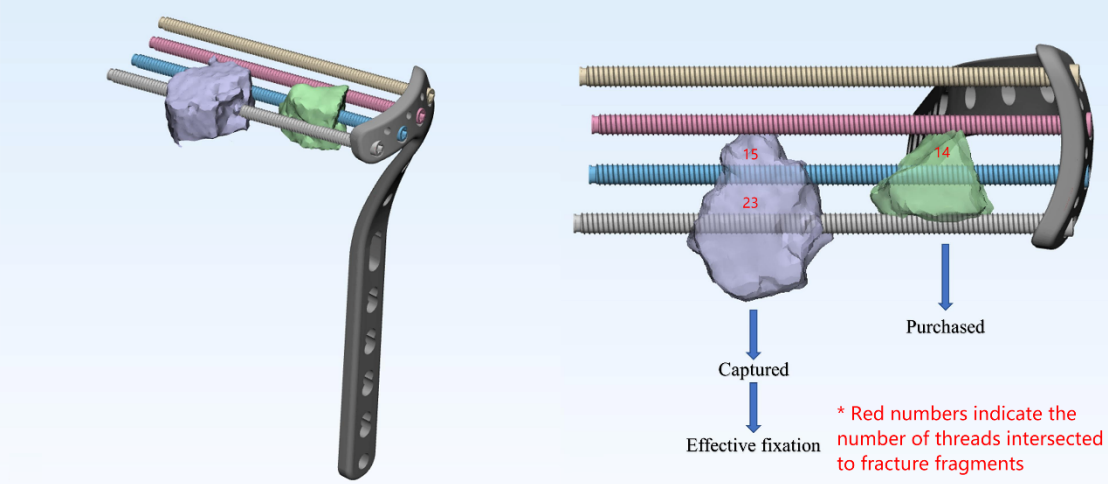
Comment 13: 3mm seems like an impossibly small distance to account for soft tissue around the fibular head - how did authors decide on this figure?

Reply 13: Thank you for your comment. No relevant anatomical studies or MRI imaging studies have explored the thickness of the upper tibiofibular capsule. The joint capsule is usually 3-5mm thick. Based on our knee trauma team's clinical experience, and measurement of the minimum distance between the fibular head and the plate in postoperative CT images of previous tibial plateau fracture cases, we considered that 3mm is an acceptable restriction.

Changes in the text: No corresponding changes were made.

Comment 14: Who performed the assessments of screw capture/purchase? Were these objective?

Reply 14: Thank you for your comment. The authors Xuetao Xie and Yukai Wang performed the assessments of screw capture/purchase, and they are experienced orthopaedic surgeons. Professor Congfeng Luo, an experienced orthopaedic trauma surgeon validated the results to ensure the quality. Our team has sufficient experience in the clinical diagnosis and treatment of knee trauma. The evaluation process was objective, and the criteria for evaluation were strictly defined. The fragment was considered to be purchased if it intersects with one screw at least three complete threads and deemed to be "captured" if it was purchased by at least two screws (please see the following figure).



Changes in the text: We have modified the manuscript as advised (please see Page 8, Line 158-159).

Comment 15: The discussion and the concluding statements need to be more balanced.

Reply 15: Thank you for your comment.

Changes in the text: We have modified the discussion and the concluding statements as advised (please see Page 12-17, Line 254-350).

Comment 16: It is a well known fact that current proximal tibia locking plates do not capture all fragments particularly well, however the outcomes following fixation of these fractures remains satisfactory - this is worth mentioning in the study.

Reply 16: Thank you for your constructive suggestion. It is undeniable that the fixation effectiveness and clinical outcomes of current lateral proximal tibial plates have been improved a lot compared with traditional plates.

Changes in the text: We have modified the manuscript as advised (please see Page 14, Line 283-286).

Comment 17: The authors also unfairly criticise current plate design without considering the design limitations nor suggesting improvements to this design. The screws in the plates of course cannot be angled sufficiently posterior to capture more peripheral fragements without weakening the construct (as mentioned in the manuscript), while the plate itself cannot be made too long anteriorly such that it abuts and impinges upon the soft tissue. Both of these contribute to the poor fragment capture via the anterolateral approach alone.

Reply 17: Thank you for your insightful comments. Agree with your comments and the reasons for poor posterolateral fragments fixation. Posterolateral tibial plateau fractures are special because of their anatomical relationship, and some of which are

accompanied by anterolateral column fractures (1). The posterior buttress plate should be required in case of high flexion stress, posterolateral wall rupture, or anteroposterior width widening of the tibial plateau. In most other cases, the lateral plate via the extended anterolateral approach remains the safer and more common method of fixing posterolateral fractures (2-3). Therefore, we expected that the design of the lateral plate could be improved to optimize the fixation of the posterolateral fractures. Based on the results of this study, our team is conducting a study on improving the design of the lateral proximal tibial plate. One of the design ideas is adding one proximal rafting screw to the most posterior end of the plate. The specific screw direction and size and the suitability of the soft tissue need to be further verified. The results will be published later, and that is the reason why we didn't offer design suggestions.

Reference

(1) Yang G, Zhai Q, Zhu Y, et al. The incidence of posterior tibial plateau fracture: an investigation of 525 fractures by using a CT-based classification system [J]. Archives of Orthopaedic and Trauma Surgery, 2013, 133(7): 929-934.

(2) Frosch KH, Korthaus A, Thiesen D, et al. The concept of direct approach to lateral tibial plateau fractures and stepwise extension as needed. Eur J Trauma Emerg Surg. 2020 Dec;46(6):1211-9. Epub 2020/07/02.

(3) Kfuri M, Schatzker J, Castiglia MT, et al. Extended Anterolateral Approach for Complex Lateral Tibial Plateau Fractures. J Knee Surg. 2017 Mar;30(3):204-11.

Changes in the text: We have modified the corresponding sentence as advised (please see Page 14, Line 289-290).

Comment 18: The concluding statement should recommend alternative fixation approaches in these identified cases.

Reply 18: Thank you for your constructive comment.

Changes in the text: We have modified the concluding statement as advised (please see Page 4, Line 65-69 and Page 17, Line 346-350).