

**Title:** Finite Element Analysis of the Influence of Microplate Spacing on the Stability of Mandibular Ramus Fracture Fixation

**Submission ID:** 052a1263-4d57-4e26-978c-e7795939d81a

**Submission version:** v.3.0

Dear Dr. Qamar and Reviewers,

Thank you sincerely for your valuable feedback and insightful suggestions on our manuscript. Your expert comments have significantly enhanced the academic rigor and clarity of our work. We have carefully addressed each of your concerns and implemented corresponding revisions throughout the manuscript.

### **Response to Handling Editor**

**Comment:**

“The article is interesting in exploring the role of elements influence Microplate Spacing. English editing is recommended for the article by the Language Editing Service of BMC..”

**Response:**

Thank you very much for handling our manuscript and for your positive feedback on our work. We are truly encouraged by your recognition of the significance of our research, as well as your recommendation to use the BMC Language Editing Service. We have decided to proceed with this service to ensure the language quality of our manuscript meets the journal's standards.

**Additional Inquiry:**

Could you kindly guide us on the following:

- 1.What is the specific procedure for using the BMC Language Editing Service?
- 2.Are there any discounts or waivers available for authors from our institution?

### **Response to Reviewer #1**

**Comment1:**

“In the Introduction:

1. Would you add the percentages of the ramus fracture versus other fractures of the mandible in the literature.”

**Response1:**

Add the following description(Page 2, line 4):

“The incidence of mandibular ramus fractures accounts for 17.5% of all mandibular fractures[2].”

**Reference:**

2. Lin KC, Peng SH, Kuo PJ, Chen YC, Rau CS, Hsieh CH: **Patterns Associated with Adult Mandibular Fractures in Southern Taiwan-A Cross-Sectional Retrospective Study.** *Int J Environ Res Public Health* 2017, **14**(7).

**Comment2:**

“Materials and methods:

Write the full name of the following abbreviations: DICOM format. CBCT”

**Response2:**

Add the full form of the abbreviation:

- 1.Cone Beam Computed Tomography(CBCT)
- 2.Digital Imaging and Communications in Medicine(DICOM)

**Comment3:**

Discussion:

“1. Remove :Open reduction internal fixation and leave ORIF“

**Response3:**

Remove the “Open reduction internal fixation (ORIF)” from the second paragraph of the discussion, leaving only “ORIF”

**Comment4:**

“2. Writing the authors should be corrected: “Champy [17, 18]” The 1st study included another author, while the other study included two more authors.

So, it should be: The studies of Champy and Lodde [17] and Champy et al [18] first proposed the concept of a tension band in the mandibular angle,...

This should be applied for all references.”

**Response4:**

The formatting requirements have been revised as requested, and the reference citations throughout the full text have been carefully reviewed and modified accordingly.

**Comment5:**

“3. From the manuscript: “Studies have shown that when the relative displacement between the fracture ends is within 0.15mm, direct healing can be achieved [28]. In this experiment, the fracture gap was set to 1mm, and the relative displacement of the fracture during functional activities was measured”

You have written that studies used 0.15 mm, while you put only one reference!

Do you mean 0.1 mm?

Justify why you selected 0.1 instead 0.15 which was applied in the literature.”

**Response5:**

We are very sorry for the misunderstanding caused by the citation issue. The description "In this experiment, the fracture gap was set to 1mm" is a specific experimental detail from the reference cited as number 28, and it is not the experimental data we used in our paper. We still adopt 0.15mm as the criterion in our study.

**Comment6:**

“4. Add a study pointed out that Risdon approach can be used for ramus fracture to put two plates with the distance between them is 20 mm. While other approaches are indicated when more distance is required.”

**Response6:**

According to our literature search, there are currently no studies on the application of the Risdon approach to mandibular ramus fractures. There are many options for surgical approaches in condylar surgery, and there are also many related studies, with anatomical locations being relatively close. Therefore, we refer to studies on surgical approaches for condylar fractures to investigate the surgical approach for mandibular ramus fractures. The neck of the condyle is approximately located at the sigmoid notch, while the base is located at the lower part of the condyle.

According to the research on surgical approaches for condylar fractures, the Risdon approach provides better exposure for the base of the condyle but poorer exposure for the condylar neck. This means that the Risdon approach is effective when the exposure distance is 20mm, but as the distance increases to the sigmoid notch, the exposure becomes less effective, necessitating a change in the surgical approach.

Specifically, the following content has been added:

These findings demonstrate the Risdon approach's superior safety profile compared to the posterior approach, making it advantageous for complication mitigation. However, its applicability as the primary surgical route for mandibular ramus fracture fixation remains unclear. To our knowledge, no prior studies have specifically addressed ramus fracture approaches. Given the anatomical proximity of the sigmoid notch to the condylar region, we extrapolate insights from condylar fracture approaches to discuss ramus fracture management.

Ruiz et al[26] conducted a cadaveric study comparing the modified Risdon and rhytidectomy approaches. Using a 0–100 scoring system to assess exposure efficacy and accessibility, the Risdon approach achieved an average score of 55.88 (55.88% alignment between accessible and target areas), whereas the rhytidectomy approach scored 91.05 ( $p < 0.001$ ). The rhytidectomy approach demonstrated superior utility for high condylar fractures, offering broader exposure for reduction and fixation. However, it poses challenges in low condylar fractures and carries risks of parotid fistula. Conversely, while the Risdon approach provides limited exposure for high condylar fractures, it excels in accessing the condylar base.

Studies suggest that thorough detachment of the masseter muscle from the posterior mandibular ramus enables direct visualization, reduction, and fixation of condylar base fractures via the Risdon approach. For high condylar fractures, combining the Risdon approach with transbuccal trocar instrumentation facilitates reduction[27]. However, transbuccal techniques exhibit steep learning curves, technical sensitivity, and potential infection risks.[28]

In mandibular ramus fractures, securing the superior microplate to the apex of the sigmoid notch (equivalent to the condylar neck) demands extensive exposure, which the Risdon approach alone cannot provide. This limitation necessitates either alternative approaches with larger incisions or adjunctive trocar cannula use. Notably, when dual microplates are positioned 20 mm apart (satisfying primary healing criteria) with the superior plate placed inferior to the condylar base, the Risdon approach achieves adequate exposure without requiring high-risk transbuccal instrumentation. Compared to the posterior approach, this strategy minimizes complication rates while avoiding technically demanding adjuncts.

#### References:

26. Ruiz R, Schlund M, Raoul G, Kyheng M, Fontaine C, Nicot R: **Mandibular subcondylar fracture accessibility with transparotid approach by rhytidectomy and modified Risdon approach: An anatomical comparative study.** *J Craniomaxillofac Surg* 2018, **46**(12):2256-2260.
27. Nam SM, Lee JH, Kim JH: **The application of the Risdon approach for mandibular condyle fractures.** *BMC Surg* 2013, **13**:25.
28. Bhardwaj B, Singh J, Mahajan S: **Transbuccal Approach in Management of Mandible Angle Fracture.** *Indian J Otolaryngol Head Neck Surg* 2020, **72**(4):457-462.

#### Comment7:

“5. Compare your results with other studies.”

#### Response7:

Based on our literature search, there are currently no biomechanical studies on mandibular ramus fractures. Therefore, according to biomechanical phenomena, we cite biomechanical research on the mandibular angle for comparison. The concept of the tension band was first proposed by Champy, who identified the location of the tension band at the mandibular angle and proposed an ideal fixation route. However, the location of the tension band in mandibular ramus fractures remains unclear. Clarifying the presence and location of the tension band can help determine the fixation route. Our study found that in the fixation of mandibular ramus fractures, there is also a phenomenon of tension band, which is located at the sigmoid notch. Moreover, our conclusions

suggest that as the fixation position gradually approaches the tension band, a more stable fixation effect is achieved, which is consistent with Champy's research.

There is corresponding description in the original text:

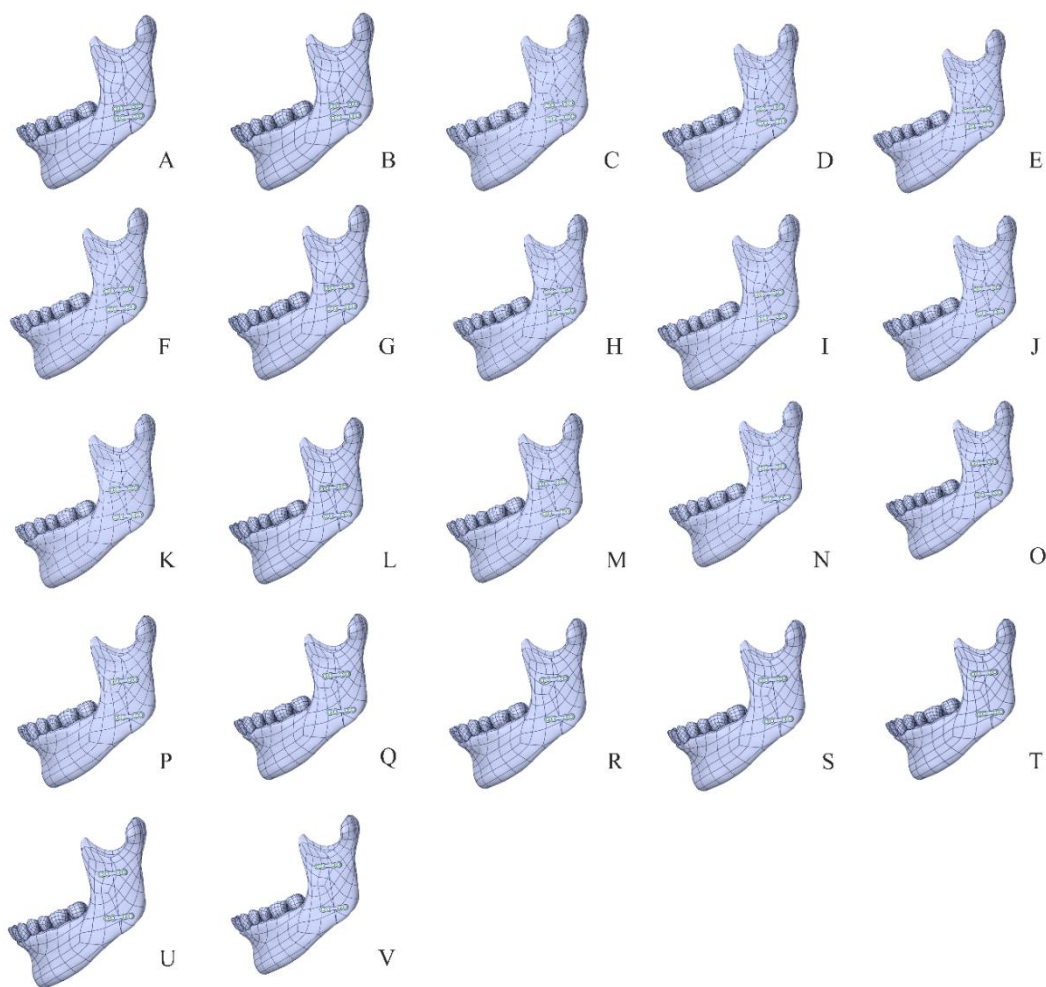
“The results of this study demonstrated that as the distance between the two microplates increased, the relative displacement between the two bone fragments gradually decreased, resulting in improved postoperative stability. During mastication, the anterior bone fragment exhibited forward and downward rotation, with the maximum displacement occurring at the sigmoid notch, i.e., the tension band. This finding aligns with Champy's research [17, 18]. When the upper microplate is located closer to the sigmoid notch, it significantly reduces displacement at this location, effectively stabilizing the bone fragment.”

**Comment8:**

“Figure 2: add a letter or number for each picture”

**Response8:**

The image has been modified to include annotations.



A~V:2mm~23mm Microplate Spacing  
Figure 2. Design of Microplate Spacing

**Comment9:**

“- List of abbreviations”

**Response9:**

Add the List of abbreviations

Abbreviation	Full form
<b>MMF</b>	Maxillomandibular Fixation
<b>ORIF</b>	Open Reduction Internal Fixation
<b>FEA</b>	Finite Element Analysis
<b>CBCT</b>	Cone Beam Computed Tomograph
<b>DICOM</b>	Digital Imaging and Communications in Medicine

## Response to Reviewer #2

### Comment1:

“Title: please mention the type of the study in the title”

### Response1:

The title has been modified to:

“The Influence of Microplate Spacing on Mandibular Ramus Fracture Fixation Stability: A Biomechanical Finite Element Analysis”

### Comment2:

“Introduction: While the introduction provides a good overview, it could benefit from a stronger focus on the controversies or gaps in the literature regarding microplate spacing.”

### Response2:

In the introduction, add the following content:

“Currently, there is limited research on the fixation methods for mandibular ramus fractures. Among them, A study mentions the use of two-point fixation in cases, but there is no clear quantitative standard for the selection of the spacing between double micro-titanium plates[11]. The spacing for double micro-titanium plate fixation in mandibular ramus fractures remains a research gap. The choice of spacing between double micro-titanium plates may affect the design of surgical plans, postoperative stability of fractures, and other issues. ”

References:

11. Agarwal P, Mehrotra D: **Mandibular Ramus Fractures: A Proposed Classification.** *Craniomaxillofac Trauma Reconstr* 2020, **13**(1):9-14.

Thank you very much for your attention and time. Look forward to hearing from you.

Yours sincerely,

JingXu Li

14 February, 2025

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