Radiographic Union Score for Tibia (RUST) scoring system in adult diaphyseal femoral fractures treated with intramedullary nailing: an assessment of interobserver and intraobserver reliability

by

Pravesh Panchoo

MD (Algeria)
PNCPRA001

This study is a partial fulfilment of the requirements for the degree

Master of Medicine in Orthopaedic Surgery
University of Cape Town

Supervisor:
Prof Maritz Laubscher
Division of Orthopaedic Surgery
Groote Schuur Hospital
Department of Orthopaedic Surgery
maritz.laubscher@uct.ac.za

December 2021
The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.
## Table of Contents

Declaration page........................................................................................................................................3
Abstract.....................................................................................................................................................4
Acknowledgments..................................................................................................................................5
List of tables and figures............................................................................................................................6
Abbreviations.........................................................................................................................................7

**PART A: MANUSCRIPT IN ARTICLE FORMAT**

Title page................................................................................................................................................8
Abstract..................................................................................................................................................9
Main text of article.................................................................................................................................10-14
Tables and figures.................................................................................................................................15-17
References..........................................................................................................................................18-19
Declarations ............................................................................................................................................20

**PART B: ADDENDA**

Data collection sheet and table.................................................................................................................21-23
Relevant journal information and Instructions to Authors........................................................................24-38
EJOST reviewers’ comments....................................................................................................................39-41
Rebuttal document ..................................................................................................................................42
EJOST acceptance letter and publication confirmation .............................................................................43-44
DRC and HREC approval letter...............................................................................................................45-46
Turnitin: Plagiarism receipt and declaration............................................................................................47-49
Declaration: Student

I, Pravesh Panchoo, hereby declare that the work on which this thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university. I authorise the University to reproduce this work for the purpose of research, either the whole or any portion of the contents, in any manner whatsoever. I further declare the following:

1. I know that plagiarism is a serious form of academic dishonesty.
2. I have read the document about avoiding plagiarism, am familiar with its contents and have avoided all forms of plagiarism mentioned there.
3. Where I have used the words of others, I have indicated this by the use of quotation marks.
4. I have referenced all quotations and properly acknowledged other ideas borrowed from others.
5. I have not and shall not allow others to plagiarise my work.
6. I declare that this is my own work.
7. I am attaching the summary of the Turnitin match overview

Signature: [Signature] Signed by candidate …………………………… Date: …………………

Declaration: Supervisor

This study was conducted from April 2020 to October 2020 under the supervision of Professor Maritz Laubscher, Department of Orthopaedic Surgery, University of Cape Town.

As the candidate’s Supervisor, I have approved this dissertation for submission.

Signature: [Signature] Signed by candidate …………………………… Date: …………………
Abstract

Objectives
The Radiographic Union Score for Tibia (RUST) scoring system has been validated in multiple studies assessing the healing of tibial fractures. Our objective was to assess the inter and intraobserver reliability for the RUST in diaphyseal femoral fractures treated with intramedullary (IM) nailing.

Patients and Methods
A total of 60 sets of anteroposterior (AP) and lateral radiographs of diaphyseal femoral fractures treated by reamed IM nailing were randomly selected from a prospectively collected database. The 60 sets of radiographs were then scored by three reviewers using the RUST system. Interobserver reliability was measured at initial scoring. The 60 sets of radiographs were scored again by the three reviewers to calculate the intraobserver reliability.

Results
The RUST scores ranged from 4 to 12 with a mean score of 11.3 ± 1.3. The interobserver intraclass correlation coefficient (ICC) was 0.87 (95% CI, 0.81-0.92) and the intraobserver ICC was 0.91 (95% CI, 0.88-0.94), which indicated excellent agreement.

Conclusion
This study demonstrated that the RUST system can be used reliably in the assessment of healing in diaphyseal femur fractures treated by reamed intramedullary nailing, with excellent interobserver and intraobserver reliability.

Keywords
RUST; Score; Intraobserver; Interobserver; Reliability; Femur fractures; Intramedullary nail.
Acknowledgements

I would like to thank my supervisor, Professor Maritz Laubscher, and all the co-authors for their guidance and patience throughout this process.

This article has been published in the European Journal of Orthopaedic Surgery and Traumatology (EJOST) and is available at: https://doi.org/10.1007/s00590-021-03134-6
List of tables and figures

Table 1: Details of the Radiographic Union Score for Tibia fractures

Table 2: Intraobserver reliability of each reviewer showing almost perfect agreement for each reviewer.

Table 3: Interobserver and intraobserver agreement of previous studies involving the RUST and our current study.

Figure 1: Example of RUST score applied to an anteroposterior and lateral radiograph of an adult diaphyseal femur fracture three months post IM nailing.

Figure 2: Percentage distribution of the RUST score among 60 radiographs of adult diaphyseal femur fractures treated by IM nail
Abbreviations

AO: Association of Osteosynthesis
AP: Anteroposterior
CI: Confidence Interval
DRC: Department of Research Committee
EJOST: European journal of Orthopaedic surgery and Traumatology
HIV: Human Immunodeficiency Virus
HOST: HIV in Orthopaedic Skeletal Trauma
HREC: Human Research Ethics Committee
IBM: International Business Machine
ICC: Intraclass Correlation Coefficient
IM: Intramedullary
OTA: Orthopaedic Trauma Association
RUSH: Radiographic Union Score in Hip fractures
RUSHU: Radiographic Union Score in Humerus fractures
RUSS: Radiographic Union Scoring System
RUST: Radiographic Union Score in Tibia fractures
PART A: MANUSCRIPT IN ARTICLE FORMAT

Title
Radiographic Union Score for Tibia (RUST) scoring system in adult diaphyseal femoral fractures treated with intramedullary nailing: an assessment of interobserver and intraobserver reliability.

Authors
Pravesh Panchoo a, b
Maritz Laubscher a, b
Michael Held a, b
Sithombo Maqungo a, b, c
Nando Ferreira d
Hamish Simpson e
Simon Matthew Graham a, b, f, g, h

Affiliations
a. Division of Orthopaedic Surgery, Groote Schuur Hospital, Cape Town, South Africa
b. Orthopaedic Research Unit (ORU), University of Cape Town, Cape Town, South Africa
c. Division of Global Surgery, University of Cape Town, Cape Town, South Africa
d. Division of Orthopaedic Surgery, Stellenbosch University, Cape Town, South Africa
e. Department of Orthopaedics and Trauma, University of Edinburgh, Edinburgh, UK
f. Institute of Population Health Sciences, University of Liverpool, Liverpool, UK
g. Department of Orthopaedics and Trauma Surgery, Liverpool University Teaching Hospital Trust, Liverpool, UK
h. Institute of Population Health Sciences, University of Liverpool, Liverpool, UK

Corresponding author
Pravesh Panchoo
E mail. praveshpanchoo@gmail.com
Tel. +27828150238
ORCID https://orcid.org/0000-0003-1688-9214

Present address
H49 Old Main Building
Groote Schuur Hospital
Observatory, Cape Town
South Africa
Abstract:

Objectives

The Radiographic Union Score for Tibia (RUST) scoring system has been validated in multiple studies assessing the healing of tibial fractures. Our objective was to assess the inter and intraobserver reliability for the RUST in diaphyseal femoral fractures treated with intramedullary (IM) nailing.

Patients and Methods

A total of 60 sets of anteroposterior (AP) and lateral radiographs of diaphyseal femoral fractures treated by reamed IM nailing were randomly selected from a prospectively collected database. The 60 sets of radiographs were then scored by three reviewers using the RUST system. Interobserver reliability was measured at initial scoring. The 60 sets of radiographs were scored again by the three reviewers to calculate the intraobserver reliability.

Results

The RUST scores ranged from 4 to 12 with a mean score of 11.3 ± 1.3. The interobserver intraclass correlation coefficient (ICC) was 0.87 (95% CI, 0.81-0.92) and the intraobserver ICC was 0.91 (95% CI, 0.88-0.94), which indicated excellent agreement.

Conclusion

This study demonstrated that the RUST system can be used reliably in the assessment of healing in diaphyseal femur fractures treated by reamed intramedullary nailing, with excellent interobserver and intraobserver reliability.

Keywords

RUST; Score; Intraobserver; Interobserver; Reliability; Femur fractures; Intramedullary nail.
INTRODUCTION

Femoral shaft fractures account for 9% of all non-fatal injuries following motor vehicle accidents [1,2]. The worldwide incidence varies from 10 to 13 per 100000 per year [3,4]. The goal of fracture management is to enable bone healing and early functional rehabilitation [1,2]. Determining fracture union following any form of operative or non-operative treatment is challenging. Accurate confirmation that a fracture has healed optimizes rehabilitation and assists with early detection of delayed unions and non-unions [5-7].

Cortical bridging has been suggested to be a reliable indication of fracture healing in tibial fractures treated by intramedullary nails [5,6,8,9]. Clinicians use 3 out of 4 cortices of bridging callus on two orthogonal views to define union [8,10]. The Radiological Union Score for Tibial fractures (RUST) has shown substantial interobserver and intraobserver intraclass correlation coefficient (ICC) when it has been used to assess healing in tibial fractures treated with intramedullary nails [11-16]. Cekic et al. [17] found a good correlation between RUST and clinical outcomes. In addition, Fiset et al. [18] demonstrated that RUST had strong statistical correlations with both micro-CT and biomechanical parameters in an in-vivo rat model. In a recent study by Misir et al. [19], RUST has shown substantial reliability in assessing healing in paediatric and adult femoral shaft fractures treated with intramedullary devices. Other scoring systems exist for different anatomical sites; Radiological Union Score in Hip fractures (RUSH) [6], Radiological Union Score in Humerus fractures (RUSHU) [7] and Radiological Union Score in Distal radius fractures (RUSS) [20]. This study aimed to assess the inter and intraobserver reliability for the RUST in diaphyseal femoral fractures treated by reamed intramedullary (IM) nailing.

PATIENTS AND METHODS

Sixty patients who had reamed IM nailing for diaphyseal femur fractures (OTA/AO types 32-A, B, and C) [21] were randomly selected from a prospectively collected cohort of patients as part of the HIV in Orthopaedic Skeletal Trauma (HOST) study [22]. This database contains all cases (both HIV negative and positive, closed and open fractures) of femoral and tibial IM nailings performed in patients older than 18 years old during the period September 2017 to December 2018.
Post-operative anteroposterior (AP) and lateral femur radiographs at various stages of healing between three and six months were reviewed and scored by three independent reviewers ML (consultant orthopaedic surgeon), SG (consultant orthopaedic surgeon) and PP (specialist training orthopaedic registrar) using the RUST [14] scoring system. The reviewers were blinded and therefore unaware of patient history, age of the fracture, and all clinical information. Radiographs were simultaneously projected to all reviewers using an Epson projector (ELPLP® 78 1280 x 720) installed at a distance of three meters from the wall. A training session was organized before scoring the test set of radiographs to ensure similar interpretation of the RUST score.

The RUST, as described by Wheelan et al. [12] (Table 1 showing details of the RUST score), assigns a score based on the assessment of healing at each of the four cortices visible on the AP and lateral radiographs (medial and lateral cortices on the AP radiograph, anterior and posterior cortices on the lateral radiograph). Each cortex receives a score of 1 point if there is no callus; 2 points if there is callus present, but a fracture line is still visible, and 3 points if there is a continuous bridge of callus (Fig 1 showing RUST score applied to an anteroposterior and lateral radiograph of an adult diaphyseal femur fracture three months post IM nailing; score is 11).

The individual cortical scores are added to give a total for the set of films, with an overall score of 4 being the minimum score indicating that the fracture is definitely not healed and 12 being the maximum score indicating that the fracture is definitely healed.

STATISTICAL ANALYSIS
Intraclass correlation coefficient with 95% confidence interval (CI) was used to measure interobserver and intraobserver reliability. The ICC is used to quantify agreement for a continuous variable. A sample size of at least 30 and at least three
raters are required when conducting a reliability study [23]. For the ICC interpretation, we used the same guidelines used for the interpretation of kappa values for categorical data as both are numerically equivalent. Landis and Koch [24] suggested kappa of 0 to 0.2 represents “slight agreement,” 0.21 to 0.40 “fair agreement,” 0.41 to 0.60 “moderate agreement,” and 0.61 to 0.80 “substantial agreement.” A value above 0.80 is considered “almost perfect agreement.”

The ICC for interobserver and intraobserver reliability was calculated using the IBM® SPSS® Statistics for Windows, Version 26.0 (IBM® Corp. Armonk, New York) based on a two-way mixed model with absolute agreement.

RESULTS

For the 60 sets of radiographs scored by the three reviewers, the RUST scores ranged from 4 to 12 with a mean score of 11.3 ± 1.3. (Fig 2 showing Percentage distribution of the RUST score among 60 radiographs of adult diaphyseal femur fractures treated by IM nail).

The ICC for the interobserver agreement among the three reviewers was 0.87 (95% CI, 0.81-0.92). The intraobserver agreement ICC was 0.91 (95% CI, 0.88-0.94). Individual intraobserver agreement for each reviewer is shown in Table 2.

DISCUSSION

Our study showed almost perfect interobserver and intraobserver reliability (ICC of 0.87 and 0.91, respectively) when using the RUST score to assess healing in diaphyseal femoral fractures treated with intramedullary nailing. Our findings were consistent with previous agreement studies using the RUST score (Table 3 shows the interobserver and intraobserver agreement of previous studies involving the RUST and our current study). [12,13,16, 19]

Whelan et al. [12] developed and validated the RUST for tibial fractures using 45 sets of radiographs and seven reviewers (two orthopaedic surgeons, two orthopaedic
residents and three orthopaedic traumatologists). They observed near absolute interobserver agreement and intraobserver agreement (ICC 0.86 95% CI, 0.79-0.91 and ICC 0.88 95% CI, 0.80-0.96 respectively). Leow et al. [16] also found substantial interobserver agreement (ICC 0.75 95% CI, 0.65-0.84) and substantial intraobserver agreement (ICC 0.79 95% CI, 0.66-0.86) in 45 sets of radiographs with 5 reviewers. We used 60 sets of radiographs, and our reliability results were comparable.

Litrenta et al. [13] assessed RUST and Modified RUST's consistency in metadiaphyseal femur and tibia fractures treated either by IM nailing or plating. In the Modified RUST score, each cortex was scored from 1 to 4, where 1 was no callus, 2 was non-bridging callus, three was bridging callus, and 4 was remodeling. Interobserver agreement was substantial for the distal femur fractures intramedullary nail group with ICC of 0.67 (95% CI, 0.59-0.76) for RUST and ICC of 0.74 (95% CI, 0.68-0.81) for Modified RUST. Also, when assessing fracture union, among the 12 reviewers, 74% of the reviewers classified radiographs with a RUST score of 9 as united and 90% of reviewers classified radiographs with RUST scores of 10 as united.

Misir et al. recently published on the use of RUST and modified RUST for the assessment of healing in pediatric and adult femoral shaft fractures. For the adult population they found substantial interobserver and intraobserver reliability (ICC of 0.76 and 0.80 respectively). They also found that more than 90% of their reviewers classified a RUST of 10 as fracture union. Our study showed higher interobserver agreement (ICC of 0.87 95% CI, 0.81-0.92), and intraobserver agreement (ICC of 0.91 95% CI, 0.88-0.94) for the RUST score for femoral diaphyseal fractures. Our study included more patients (60 adult patients) compared to Misir et al. (24 adult patients) and our results are comparable.

LIMITATIONS

Interobserver and intraobserver agreement measures the precision of a score but not the accuracy [25]. The absence of a “gold standard” [12,15,17,25] in assessing fracture healing makes it difficult to validate the accuracy of RUST. Also, all our reviewers were from the orthopaedic department. However, we did not consider this to be problematic because the RUST score is mainly used by orthopaedic surgeons. Lastly, we only assessed RUST in diaphyseal femoral fractures treated with intramedullary nails. Plate fixation can affect visibility of cortices and therefore the score.
CONCLUSION
In conclusion, our study showed that the RUST can be reliably adopted to assess bone healing in diaphyseal femoral fractures treated by intramedullary nails, with an almost perfect interobserver and intraobserver agreement.
**Tables and figures**

**Table 1** Details of the Radiographic Union Score for Tibia fractures shown in the table below. A score of 1 is given when there is no callus formation, a score of 2 if callus is seen with persistence of the fracture line and a score of 3 is given when bridging callus is visible without a fracture line. This is repeated for each of the 4 cortices and the sum gives the RUST score.

<table>
<thead>
<tr>
<th>Cortex</th>
<th>Visible fracture line without callus</th>
<th>Visible fracture line with callus formation</th>
<th>No visible fracture line with bridging callus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>Score=1</td>
<td>Score=2</td>
<td>Score=3</td>
</tr>
<tr>
<td>Posterior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score (4-12)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2** Intraobserver reliability of each reviewer showing almost perfect agreement for each reviewer

<table>
<thead>
<tr>
<th>Reviewer</th>
<th>Intraobserver ICC (95% CI)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG</td>
<td>0.84 (0.69-0.91)</td>
<td>Almost perfect</td>
</tr>
<tr>
<td>ML</td>
<td>0.97 (0.94-0.98)</td>
<td>Almost perfect</td>
</tr>
<tr>
<td>PP</td>
<td>0.95 (0.92-0.97)</td>
<td>Almost perfect</td>
</tr>
</tbody>
</table>
Table 3 Interobserver and intraobserver agreement of previous studies involving the RUST and our current study. Previous studies and our study have shown either substantial or almost perfect interobserver and intraobserver agreement when using the RUST score in assessing fracture healing.

<table>
<thead>
<tr>
<th>References</th>
<th>Score</th>
<th>Interobserver ICC/agreement</th>
<th>Intraobserver ICC/agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whelan et al. [12]</td>
<td>RUST</td>
<td>0.86 Almost perfect</td>
<td>0.88 Almost perfect</td>
</tr>
<tr>
<td>Leow et al. [16]</td>
<td>RUST</td>
<td>0.75 Substantial</td>
<td>0.79 Substantial</td>
</tr>
<tr>
<td>Litrenta et al. [13]</td>
<td>RUST</td>
<td>0.67 Substantial</td>
<td>Not calculated</td>
</tr>
<tr>
<td></td>
<td>Modified RUST</td>
<td>0.74 Substantial</td>
<td></td>
</tr>
<tr>
<td>Misir et al [19]</td>
<td>RUST</td>
<td>0.71 Substantial</td>
<td>0.76 Substantial</td>
</tr>
<tr>
<td>(Adult patients)</td>
<td>Modified RUST</td>
<td>0.76 Substantial</td>
<td>0.80 Substantial</td>
</tr>
<tr>
<td>Current study</td>
<td>RUST</td>
<td><strong>0.87</strong> Almost perfect</td>
<td><strong>0.91</strong> Almost perfect</td>
</tr>
</tbody>
</table>
Fig 1 Example of RUST score applied to an anteroposterior and lateral radiograph of an adult diaphyseal femur fracture three months post IM nailing; score is 11.

Fig 2 Percentage distribution of the RUST score among 60 radiographs of adult diaphyseal femur fractures treated by IM nail. Sixty percent of the patients had a RUST score of 12 and 25.6% scored 11. The remaining radiographs scored between 4 and 10. The mean RUST score was 11.3 ± 1.3.
References


DECLARATIONS

Funding

- The authors did not receive support from any organization for the submitted work.
- No funding was received to assist with the preparation of this manuscript.
- No funding was received for conducting this study.
- No funds, grants, or other support was received.

Conflicts of interest/competing interests

- The authors have no relevant financial or non-financial interests to disclose.
- The authors have no conflicts of interest to declare that are relevant to the content of this article.
- All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.
- The authors have no financial or proprietary interests in any material discussed in this article.

Availability of data material

Data and all appropriate documentation are stored on an Excel document and are available for consultation if needed.

Consent to participate and publication
This is an extension of the HIV in Orthopaedic Skeletal Trauma (HOST) study and all patients of the HOST study group have given written consent related to further studies and publications from the collected data.

**Ethics approval**

Ethical approval was obtained by the Human Research Ethics Committee (HREC) of the University of Cape Town. HREC number 590/2016. This article does not contain any studies with human participants or animals performed by any of the author.

**Authors’ contribution**

- **P. Panchoo**: data collection, data analysis, writing of manuscript
- **M. Laubscher**: study design, data collection, review of manuscript
- **M. Held**: review of manuscript
- **S. Maqungo**: review of manuscript
- **N. Ferreira**: review of manuscript
- **H. Simpson**: review of manuscript
- **S. Graham**: study design, data collection, review of manuscript

**PART B: ADDENDA**

1. Data collection sheet
## HOST Study

### Data collection sheet

<table>
<thead>
<tr>
<th>HOST Study Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**RUST scale**

<table>
<thead>
<tr>
<th>Date of Xray</th>
</tr>
</thead>
<tbody>
<tr>
<td>--------------</td>
</tr>
</tbody>
</table>

### Anterior

- Fracture line, no callus
- Fracture line visible callus
- No Fracture line, bridging callus

### Posterior

- Fracture line, no callus
- Fracture line visible callus
- No Fracture line, bridging callus

### Lateral

- Fracture line, no callus
- Fracture line visible callus
- No Fracture line, bridging callus

### Medial

- Fracture line, no callus
- Fracture line visible callus
- No Fracture line, bridging callus

### Radiological Outcome

**Union outcome**

- Union
- Non union
- Delayed union
- Deceased (before union)
- Hardware failure
- LTFU (lost to follow-up, unknown)
- Other

**Type of non-union**

- Atrophic/oligotrophic
- Hypertrophic
- Pseudoarthrosis

**Reviewer name**

-  

**Reviewer sign & date**

-  

---

**Document 1: Data collection sheet**

2. **Data collection table**
<table>
<thead>
<tr>
<th>patient ID</th>
<th>ML</th>
<th>SG</th>
<th>PP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Document 2**: data collection table
3. EUROPEAN JOURNAL OF ORTHOPAEDIC SURGERY AND TRAUMATOLOGY

The European Journal of Orthopaedic Surgery and Traumatology (EJOST) aims to publish high quality Orthopaedic scientific work. The objective of our journal is to disseminate meaningful, impactful, clinically relevant work from each and every region of the world, that has the potential to change and or inform clinical practice.

1. Instructions to authors

Types of papers
The following types of articles will be considered for publication:
Original articles:
Original Articles should have no more than 2,500 words with an abstract of 150 words (in some cases, a maximum of 250 words is also acceptable), no more than 5 figures and 3 tables, and a maximum of 25 references.
Review articles:
These articles are exhaustive studies, either original papers or review of the literature. They should not exceed 20 typed written pages and the references should be limited to 50.
The PRISMA guidelines should be followed for reporting of systematic reviews: http://www.prisma-statement.org
Technical notes:
They should not normally exceed 1500 words. The articles should be introduced by an abstract with key words.
For Technical Notes, the abstract should have no subheadings. The abstract should be followed by three to five key words, which should be drawn from the Medical Subject Headings (MeSH) list of Index Medicus.
The technical notes can be illustrated by not more than 4 figures and 2 tables.
Letters to Editors:
These will be published at the discretion of the editor. Letters to the Editor are limited to 500 words and 5 references.
Case Reports and Up-to Date Review:
Exceptionally rare and well written case reports may be accepted as long as a thorough review of the literature is undertaken. The authors are encouraged to rethink and rewrite their work, structuring it as a review of the literature for the respective pathology and make the presentation of clinical facts as an example for this review. In this respect the number of references may be upgraded to 25. A table associated with this report should include the references, the year of publication, the particularity of the observation and remarks for each reading.

2. Manuscript Submission

Manuscript Submission
Submission of a manuscript implies: that the work described has not been published before; that it is not under consideration for publication anywhere else; that its publication has been approved by all co-authors, if any, as well as by the responsible authorities – tacitly or explicitly – at the institute where the work has been carried out. The publisher will not be held legally responsible should there be any claims for compensation.
Permissions
Authors wishing to include figures, tables, or text passages that have already been published elsewhere are required to obtain permission from the copyright owner(s) for both the print and online format and to include evidence that such permission has been granted when submitting their papers. Any material received without such evidence will be assumed to originate from the authors.

Online Submission
Please follow the hyperlink “Submit manuscript” on the right and upload all of your manuscript files following the instructions given on the screen. Please ensure you provide all relevant editable source files. Failing to submit these source files might cause unnecessary delays in the review and production process.

3. References

The reference style as described in the Instructions for Authors is mandatory.

Title Page

4. Title Page

Please make sure your title page contains the following information.

Title
The title should be concise and informative.

Author information
The name(s) of the author(s)
The affiliation(s) of the author(s), i.e. institution, (department), city, (state), country
A clear indication and an active e-mail address of the corresponding author
If available, the 16-digit ORCID of the author(s)
If address information is provided with the affiliation(s) it will also be published. For authors that are (temporarily) unaffiliated we will only capture their city and country of residence, not their e-mail address unless specifically requested.

5. Abstract

Please provide a structured abstract of 150 to 250 words which should be divided into the following sections:
Purpose (stating the main purposes and research question)
Methods
Results
Conclusion
For life science journals only (when applicable)
Trial registration number and date of registration for prospectively registered trials
Trial registration number and date of registration followed by “retrospectively registered”, for retrospectively registered trials

Keywords
Please provide 4 to 6 keywords which can be used for indexing purposes.

6. Statements and Declarations

The following statements should be included under the heading " Statements and Declarations" for inclusion in the published paper. Please note that submissions that do not include relevant declarations will be returned as incomplete.

Competing Interests: Authors are required to disclose financial or non-financial interests that are directly or indirectly related to the work submitted for publication. Please refer to “Competing Interests and Funding” below for more information on how to complete this section.
Please see the relevant sections in the submission guidelines for further information as well as various examples of wording. Please revise/customize the sample statements according to your own needs.

**Important Note:**
Please don't forget to add a summary statement, that reflects what is recorded in the potential conflict of interest disclosure form(s).

### 7. Text

**Text Formatting**
Manuscripts should be submitted in Word.
Use a normal, plain font (e.g., 10-point Times Roman) for text.
Use italics for emphasis.
Use the automatic page numbering function to number the pages.
Do not use field functions.
Use tab stops or other commands for indents, not the space bar.
Use the table function, not spreadsheets, to make tables.
Use the equation editor or MathType for equations.
Save your file in docx format (Word 2007 or higher) or doc format (older Word versions).
Manuscripts with mathematical content can also be submitted in LaTeX. We recommend using Springer Nature’s LaTeX template.

**Headings**
Please use no more than three levels of displayed headings.

**Abbreviations**
Abbreviations should be defined at first mention and used consistently thereafter.

**Footnotes**
Footnotes can be used to give additional information, which may include the citation of a reference included in the reference list. They should not consist solely of a reference citation, and they should never include the bibliographic details of a reference. They should also not contain any figures or tables.
Footnotes to the text are numbered consecutively; those to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data). Footnotes to the title or the authors of the article are not given reference symbols.
Always use footnotes instead of endnotes.

### 8. Acknowledgments

Acknowledgments of people, grants, funds, etc. should be placed in a separate section on the title page. The names of funding organizations should be written in full.

**Please note:** Submit your manuscript without line numbers (line numbers will be added automatically later).

### 9. References
Citation
Reference citations in the text should be identified by numbers in square brackets. Some examples:
1. Negotiation research spans many disciplines [3].
2. This result was later contradicted by Becker and Seligman [5].
3. This effect has been widely studied [1-3, 7].

Reference list
The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text.
The entries in the list should be numbered consecutively.
If available, please always include DOIs as full DOI links in your reference list (e.g. “https://doi.org/abc”).
Journal article
https://doi.org/10.1007/s00421-008-0955-8
Ideally, the names of all authors should be provided, but the usage of “et al” in long author lists will also be accepted:

10. Tables
All tables are to be numbered using Arabic numerals.
Tables should always be cited in text in consecutive numerical order.
For each table, please supply a table caption (title) explaining the components of the table.
Identify any previously published material by giving the original source in the form of a reference at the end of the table caption.
Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.

11. Artwork
For the best quality final product, it is highly recommended that you submit all of your artwork – photographs, line drawings, etc. – in an electronic format. Your art will then be produced to the highest standards with the greatest accuracy to detail. The published work will directly reflect the quality of the artwork provided.

Electronic Figure Submission
Supply all figures electronically.
Indicate what graphics program was used to create the artwork.
For vector graphics, the preferred format is EPS; for halftones, please use TIFF format. MS Office files are also acceptable.
Vector graphics containing fonts must have the fonts embedded in the files.
Name your figure files with “Fig” and the figure number, e.g., Fig1.eps.

Color Art
Color art is free of charge for print and online publication.
Color illustrations should be submitted as RGB.
**Figure Lettering**
To add lettering, it is best to use Helvetica or Arial (sans serif fonts). Keep lettering consistently sized throughout your final-sized artwork, usually about 2–3 mm (8–12 pt). Variance of type size within an illustration should be minimal, e.g., do not use 8-pt type on an axis and 20-pt type for the axis label. Avoid effects such as shading, outline letters, etc. Do not include titles or captions within your illustrations.

**Figure Numbering**
All figures are to be numbered using Arabic numerals. Figures should always be cited in text in consecutive numerical order. Figure parts should be denoted by lowercase letters (a, b, c, etc.). If an appendix appears in your article and it contains one or more figures, continue the consecutive numbering of the main text. Do not number the appendix figures, "A1, A2, A3, etc." Figures in online appendices [Supplementary Information (SI)] should, however, be numbered separately.

**Figure Captions**
Each figure should have a concise caption describing accurately what the figure depicts. Include the captions in the text file of the manuscript, not in the figure file. Figure captions begin with the term Fig. in bold type, followed by the figure number, also in bold type. No punctuation is to be included after the number, nor is any punctuation to be placed at the end of the caption. Identify all elements found in the figure in the figure caption; and use boxes, circles, etc., as coordinate points in graphs. Identify previously published material by giving the original source in the form of a reference citation at the end of the figure caption.

**Figure Placement and Size**
When preparing your figures, size figures to fit in the column width. For large-sized journals the figures should be 84 mm (for double-column text areas), or 174 mm (for single-column text areas) wide and not higher than 234 mm. For small-sized journals, the figures should be 119 mm wide and not higher than 195 mm.

**12. Permissions**
If you include figures that have already been published elsewhere, you must obtain permission from the copyright owner(s) for both the print and online format. Please be aware that some publishers do not grant electronic rights for free and that Springer will not be able to refund any costs that may have occurred to receive these permissions. In such cases, material from other sources should be used.

**13. Accessibility**
In order to give people of all abilities and disabilities access to the content of your figures, please make sure that All figures have descriptive captions (blind users could then use a text-to-speech software or a text-to-Braille hardware)
Patterns are used instead of or in addition to colors for conveying information (color-blind users would then be able to distinguish the visual elements) Any figure lettering has a contrast ratio of at least 4.5:1

14. Supplementary Information (SI)
Springer accepts electronic multimedia files (animations, movies, audio, etc.) and other supplementary files to be published online along with an article or a book chapter. This feature can add dimension to the author’s article, as certain information cannot be printed or is more convenient in electronic form. Before submitting research datasets as Supplementary Information, authors should read the journal’s Research data policy. We encourage research data to be archived in data repositories wherever possible.

15. Submission
Supply all supplementary material in standard file formats. Please include in each file the following information: article title, journal name, author names; affiliation and e-mail address of the corresponding author. To accommodate user downloads, please keep in mind that larger-sized files may require very long download times and that some users may experience other problems during downloading. High resolution (streamable quality) videos can be submitted up to a maximum of 25GB; low resolution videos should not be larger than 5GB.

16. Audio, Video, and Animations
Aspect ratio: 16:9 or 4:3
Maximum file size: 25 GB for high resolution files; 5 GB for low resolution files
Minimum video duration: 1 sec
Supported file formats: avi, wmv, mp4, mov, m2p, mp2, mpg, mpeg, flv, mxf, mts, m4v, 3gp

17. Text and Presentations
Submit your material in PDF format; .doc or .ppt files are not suitable for long-term viability. A collection of figures may also be combined in a PDF file.

Spreadsheets
Spreadsheets should be submitted as .csv or .xlsx files (MS Excel).

Specialized Formats
Specialized format such as .pdb (chemical), .wrl (VRML), .nb (Mathematica notebook), and .tex can also be supplied.

Collecting Multiple Files
It is possible to collect multiple files in a .zip or .gz file.

Numbering
If supplying any supplementary material, the text must make specific mention of the material as a citation, similar to that of figures and tables.
Refer to the supplementary files as “Online Resource”, e.g., "... as shown in the animation (Online Resource 3)", "... additional data are given in Online Resource 4". Name the files consecutively, e.g. “ESM_3.mpg”, “ESM_4.pdf”.

**Captions**
For each supplementary material, please supply a concise caption describing the content of the file.

**Processing of supplementary files**
Supplementary Information (SI) will be published as received from the author without any conversion, editing, or reformatting.

**Accessibility**
In order to give people of all abilities and disabilities access to the content of your supplementary files, please make sure that
- The manuscript contains a descriptive caption for each supplementary material
- Video files do not contain anything that flashes more than three times per second (so that users prone to seizures caused by such effects are not put at risk)

**18. Competing Interests**
Authors are requested to disclose interests that are directly or indirectly related to the work submitted for publication. Interests within the last 3 years of beginning the work (conducting the research and preparing the work for submission) should be reported. Interests outside the 3-year time frame must be disclosed if they could reasonably be perceived as influencing the submitted work. Disclosure of interests provides a complete and transparent process and helps readers form their own judgments of potential bias. This is not meant to imply that a financial relationship with an organization that sponsored the research or compensation received for consultancy work is inappropriate.

**Editorial Board Members and Editors** are required to declare any competing interests and may be excluded from the peer review process if a competing interest exists. In addition, they should exclude themselves from handling manuscripts in cases where there is a competing interest. This may include – but is not limited to – having previously published with one or more of the authors, and sharing the same institution as one or more of the authors. Where an Editor or Editorial Board Member is on the author list they must declare this in the competing interests section on the submitted manuscript. If they are an author or have any other competing interest regarding a specific manuscript, another Editor or member of the Editorial Board will be assigned to assume responsibility for overseeing peer review. These submissions are subject to the exact same review process as any other manuscript. Editorial Board Members are welcome to submit papers to the journal. These submissions are not given any priority over other manuscripts, and Editorial Board Member status has no bearing on editorial consideration.

Interests that should be considered and disclosed but are not limited to the following:

**Funding**: Research grants from funding agencies (please give the research funder and the grant number) and/or research support (including salaries, equipment, supplies, reimbursement for attending symposia, and other expenses) by organizations that may gain or lose financially through publication of this manuscript.
Employment: Recent (while engaged in the research project), present or anticipated employment by any organization that may gain or lose financially through publication of this manuscript. This includes multiple affiliations (if applicable).

Financial interests: Stocks or shares in companies (including holdings of spouse and/or children) that may gain or lose financially through publication of this manuscript; consultation fees or other forms of remuneration from organizations that may gain or lose financially; patents or patent applications whose value may be affected by publication of this manuscript.

It is difficult to specify a threshold at which a financial interest becomes significant, any such figure is necessarily arbitrary, so one possible practical guideline is the following: "Any undeclared financial interest that could embarrass the author were it to become publicly known after the work was published."

Non-financial interests: In addition, authors are requested to disclose interests that go beyond financial interests that could impart bias on the work submitted for publication such as professional interests, personal relationships or personal beliefs (amongst others). Examples include, but are not limited to: position on editorial board, advisory board or board of directors or other type of management relationships; writing and/or consulting for educational purposes; expert witness; mentoring relations; and so forth.

Primary research articles require a disclosure statement. Review articles present an expert synthesis of evidence and may be treated as an authoritative work on a subject. Review articles therefore require a disclosure statement. Other article types such as editorials, book reviews, comments (amongst others) may, dependent on their content, require a disclosure statement. If you are unclear whether your article type requires a disclosure statement, please contact the Editor-in-Chief.

Please note that, in addition to the above requirements, funding information (given that funding is a potential competing interest (as mentioned above)) needs to be disclosed upon submission of the manuscript in the peer review system. This information will automatically be added to the Record of CrossMark, however it is not added to the manuscript itself. Under ‘summary of requirements’ (see below) funding information should be included in the ‘Declarations’ section.

19. Summary of requirements

The above should be summarized in a statement and included on a title page that is separate from the manuscript with a section entitled “Declarations” when submitting a paper. Having all statements in one place allows for a consistent and unified review of the information by the Editor-in-Chief and/or peer reviewers and may speed up the handling of the paper. Declarations include Funding, Competing interests, Ethics approval, Consent, Data, Materials and/or Code availability and Authors’ contribution statements. Please use the title page for providing the statements.

Once and if the paper is accepted for publication, the production department will put the respective statements in a distinctly identified section clearly visible for readers. Please see the various examples of wording below and revise/customize the sample statements according to your own needs. When all authors have the same (or no) competing interests and/or funding it is sufficient to use one blanket statement.

Examples of statements to be used when funding has been received:
Partial financial support was received from [...]

The research leading to these results received funding from […] under Grant Agreement No[...].
This study was funded by […]
This work was supported by […] (Grant numbers […] and […]

**Examples of statements to be used when there is no funding:**
The authors did not receive support from any organization for the submitted work.
No funding was received to assist with the preparation of this manuscript.
No funding was received for conducting this study.
No funds, grants, or other support was received.

**Examples of statements to be used when there are interests to declare:**

**Financial interests:** Author A has received research support from Company A.
Author B has received a speaker honorarium from Company Wand owns stock in
Company X. Author C is consultant to company Y.

**Non-financial interests:** Author C is an unpaid member of committee Z.

**Financial interests:** The authors declare they have no financial interests.

**Non-financial interests:** Author A is on the board of directors of Y and receives no
compensation as member of the board of directors.

**Financial interests:** Author A received a speaking fee from Y for Z. Author B
receives a salary from association X. X where s/he is the Executive Director.

**Non-financial interests:** none.

**Financial interests:** Author A and B declare they have no financial interests. Author
C has received speaker and consultant honoraria from Company M and Company N.
Dr. C has received speaker honorarium and research funding from Company M and
Company O. Author D has received travel support from Company O.

**Non-financial interests:** Author D has served on advisory boards for Company M,
Company N and Company O.

**Examples of statements to be used when authors have nothing to declare:**
The authors have no relevant financial or non-financial interests to disclose.
The authors have no competing interests to declare that are relevant to the content of
this article.
All authors certify that they have no affiliations with or involvement in any
organization or entity with any financial interest or non-financial interest in the
subject matter or materials discussed in this manuscript.
The authors have no financial or proprietary interests in any material discussed in
this article.
Authors are responsible for correctness of the statements provided in the manuscript.
See also Authorship Principles. The Editor-in-Chief reserves the right to reject
submissions that do not meet the guidelines described in this section.

**20. Ethical standards**

Manuscripts submitted for publication must contain a declaration that the
experiments comply with the current laws of the country in which they were
performed. Please include this note in a separate section before the reference list.

**Experimental Subjects/Animals**

All authors are expected to abide by accepted ethical standards. In investigations that
involve human subjects or laboratory animals, authors should provide an explicit
statement in Materials and Methods that the experimental protocols were approved
by the appropriate institutional review committee and meet the guidelines of their
responsible governmental agency. In the case of human subjects, informed consent is
essential.
All randomized controlled clinical trials (RCTs) should conform to the CONSORT criteria. The corresponding author should indicate whether the RCT has been registered or not.

**CONSORT (Consolidated Standards of Reporting Trials)**

For Information on the most updated Consort Statement and to download the Consort E-Checklist and the E-flowchart, go to:

If relevant, the below reporting guidelines should be followed:

- **STARD** (for reporting of diagnostic accuracy studies)
- **STROBE** (for reporting of observational studies in epidemiology) [http://www.strober-statement.org](http://www.strobe-statement.org)
- **PRISMA** (for reporting of systematic reviews) [http://www.prisma-statement.org](http://www.prisma-statement.org)
- **MOOSE** (for reporting of meta-analyses of observational studies)

**Clinical Trial Registration**

All trials must be registered in a public trials registry that is acceptable to the International Committee of Medical Journals Editors (ICMJE):

**Research Data Policy**

This journal operates a [type 1 research data policy](http://www.plosone.org). The journal encourages authors, where possible and applicable, to deposit data that support the findings of their research in a public repository. Authors and editors who do not have a preferred repository should consult Springer Nature’s list of repositories and research data policy.

General repositories - for all types of research data - such as figshare and Dryad may also be used.

Datasets that are assigned digital object identifiers (DOIs) by a data repository may be cited in the reference list. Data citations should include the minimum information recommended by DataCite: authors, title, publisher (repository name), identifier.

If the journal that you’re submitting to uses double-blind peer review and you are providing reviewers with access to your data (for example via a repository link, supplementary information or data on request), it is strongly suggested that the authorship in the data is also blinded. There are [data repositories that can assist with this](http://www.datarepository.com) and/or will create a link to mask the authorship of your data.

Authors who need help understanding our data sharing policies, help finding a suitable data repository, or help organising and sharing research data can access our [Author Support portal](http://www.plosone.org) for additional guidance.

**Ethical Responsibilities of Authors**

This journal is committed to upholding the integrity of the scientific record. As a member of the Committee on Publication Ethics (COPE) the journal will follow the COPE guidelines on how to deal with potential acts of misconduct. Authors should refrain from misrepresenting research results which could damage the trust in the journal, the professionalism of scientific authorship, and ultimately the entire scientific endeavour. Maintaining integrity of the research and its presentation is helped by following the rules of good scientific practice, which include*:

- The manuscript should not be submitted to more than one journal for simultaneous consideration.
- The submitted work should be original and should not have been published elsewhere in any form or language (partially or in full), unless the new work concerns an expansion of previous work. (Please provide transparency on the re-use of material to avoid the concerns about text-recycling (“self-plagiarism”).
A single study should not be split up into several parts to increase the quantity of submissions and submitted to various journals or to one journal over time (i.e. ‘salami-slicing/publishing’).

Concurrent or secondary publication is sometimes justifiable, provided certain conditions are met. Examples include: translations or a manuscript that is intended for a different group of readers.

Results should be presented clearly, honestly, and without fabrication, falsification or inappropriate data manipulation (including image based manipulation). Authors should adhere to discipline-specific rules for acquiring, selecting and processing data.

No data, text, or theories by others are presented as if they were the author’s own (‘plagiarism’). Proper acknowledgements to other works must be given (this includes material that is closely copied (near verbatim), summarized and/or paraphrased), quotation marks (to indicate words taken from another source) are used for verbatim copying of material, and permissions secured for material that is copyrighted.

**Important note: the journal may use software to screen for plagiarism.**

Authors should make sure they have permissions for the use of software, questionnaires/(web) surveys and scales in their studies (if appropriate).

Research articles and non-research articles (e.g. Opinion, Review, and Commentary articles) must cite appropriate and relevant literature in support of the claims made.

Excessive and inappropriate self-citation or coordinated efforts among several authors to collectively self-cite is strongly discouraged.

Authors should avoid untrue statements about an entity (who can be an individual person or a company) or descriptions of their behavior or actions that could potentially be seen as personal attacks or allegations about that person.

Research that may be misapplied to pose a threat to public health or national security should be clearly identified in the manuscript (e.g. dual use of research). Examples include creation of harmful consequences of biological agents or toxins, disruption of immunity of vaccines, unusual hazards in the use of chemicals, weaponization of research/technology (amongst others).

Authors are strongly advised to ensure the author group, the Corresponding Author, and the order of authors are all correct at submission. Adding and/or deleting authors during the revision stages is generally not permitted, but in some cases may be warranted. Reasons for changes in authorship should be explained in detail. Please note that changes to authorship cannot be made after acceptance of a manuscript.

*All of the above are guidelines and authors need to make sure to respect third parties rights such as copyright and/or moral rights.

Upon request authors should be prepared to send relevant documentation or data in order to verify the validity of the results presented. This could be in the form of raw data, samples, records, etc. Sensitive information in the form of confidential or proprietary data is excluded.

If there is suspicion of misbehavior or alleged fraud the Journal and/or Publisher will carry out an investigation following COPE guidelines. If, after investigation, there are valid concerns, the author(s) concerned will be contacted under their given e-mail address and given an opportunity to address the issue. Depending on the situation, this may result in the Journal’s and/or Publisher’s implementation of the following measures, including, but not limited to:

If the manuscript is still under consideration, it may be rejected and returned to the author.
If the article has already been published online, depending on the nature and severity of the infraction:
- an erratum/correction may be placed with the article
- an expression of concern may be placed with the article
- or in severe cases retraction of the article may occur.
The reason will be given in the published erratum/correction, expression of concern or retraction note. Please note that retraction means that the article is maintained on the platform, watermarked “retracted” and the explanation for the retraction is provided in a note linked to the watermarked article.
The author’s institution may be informed
A notice of suspected transgression of ethical standards in the peer review system may be included as part of the author’s and article’s bibliographic record.

21. Fundamental errors
Authors have an obligation to correct mistakes once they discover a significant error or inaccuracy in their published article. The author(s) is/are requested to contact the journal and explain in what sense the error is impacting the article. A decision on how to correct the literature will depend on the nature of the error. This may be a correction or retraction. The retraction note should provide transparency which parts of the article are impacted by the error.

22. Suggesting / excluding reviewers
Authors are welcome to suggest suitable reviewers and/or request the exclusion of certain individuals when they submit their manuscripts. When suggesting reviewers, authors should make sure they are totally independent and not connected to the work in any way. It is strongly recommended to suggest a mix of reviewers from different countries and different institutions. When suggesting reviewers, the Corresponding Author must provide an institutional email address for each suggested reviewer, or, if this is not possible to include other means of verifying the identity such as a link to a personal homepage, a link to the publication record or a researcher or author ID in the submission letter. Please note that the Journal may not use the suggestions, but suggestions are appreciated and may help facilitate the peer review process.

23. Authorship principles
These guidelines describe authorship principles and good authorship practices to which prospective authors should adhere to.

**Authorship clarified**
The Journal and Publisher assume all authors agreed with the content and that all gave explicit consent to submit and that they obtained consent from the responsible authorities at the institute/organization where the work has been carried out, before the work is submitted.
The Publisher does not prescribe the kinds of contributions that warrant authorship. It is recommended that authors adhere to the guidelines for authorship that are applicable in their specific research field. In absence of specific guidelines, it is recommended to adhere to the following guidelines*:
All authors whose names appear on the submission
1) made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work;
2) drafted the work or revised it critically for important intellectual content;
3) approved the version to be published; and
4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

* Based on/adapted from:
**ICMJE, Defining the Role of Authors and Contributors. Transparency in authors’ contributions and responsibilities to promote integrity in scientific publication, McNutt at all, PNAS February 27, 2018**

### 24. Disclosures and declarations

All authors are requested to include information regarding sources of funding, financial or non-financial interests, study-specific approval by the appropriate ethics committee for research involving humans and/or animals, informed consent if the research involved human participants, and a statement on welfare of animals if the research involved animals (as appropriate).

The decision whether such information should be included is not only dependent on the scope of the journal, but also the scope of the article. Work submitted for publication may have implications for public health or general welfare and in those cases it is the responsibility of all authors to include the appropriate disclosures and declarations.

### 25. Data transparency

All authors are requested to make sure that all data and materials as well as software application or custom code support their published claims and comply with field standards. Please note that journals may have individual policies on (sharing) research data in concordance with disciplinary norms and expectations.

### 26. Role of the Corresponding Author

**One author** is assigned as Corresponding Author and acts on behalf of all co-authors and ensures that questions related to the accuracy or integrity of any part of the work are appropriately addressed.

The Corresponding Author is responsible for the following requirements:
ensuring that all listed authors have approved the manuscript before submission, including the names and order of authors;
managing all communication between the Journal and all co-authors, before and after publication; *providing transparency on re-use of material and mention any unpublished material (for example manuscripts in press) included in the manuscript in a cover letter to the Editor; making sure disclosures, declarations and transparency on data statements from all authors are included in the manuscript as appropriate (see above).

* The requirement of managing all communication between the journal and all co-authors during submission and proofing may be delegated to a Contact or Submitting Author. In this case, please make sure the Corresponding Author is clearly indicated in the manuscript.
Author contributions
In absence of specific instructions and in research fields where it is possible to describe discrete efforts, the Publisher recommends authors to include contribution statements in the work that specifies the contribution of every author in order to promote transparency. These contributions should be listed at the separate title page.
• Conceptualization: [full name], …; Methodology: [full name], …; Formal analysis and investigation: [full name], …; Writing - original draft preparation: [full name], …; Writing - review and editing: [full name], …; Funding acquisition: [full name], …; Resources: [full name], …; Supervision: [full name],….
For review articles where discrete statements are less applicable a statement should be included who had the idea for the article, who performed the literature search and data analysis, and who drafted and/or critically revised the work.
For articles that are based primarily on the student’s dissertation or thesis, it is recommended that the student is usually listed as principal author:

Affiliation
The primary affiliation for each author should be the institution where the majority of their work was done. If an author has subsequently moved, the current address may additionally be stated. Addresses will not be updated or changed after publication of the article.

Changes to authorship
Authors are strongly advised to ensure the correct author group, the Corresponding Author, and the order of authors at submission. Changes of authorship by adding or deleting authors, and/or changes in Corresponding Author, and/or changes in the sequence of authors are not accepted after acceptance of a manuscript.

Please note that author names will be published exactly as they appear on the accepted submission!
Please make sure that the names of all authors are present and correctly spelled, and that addresses and affiliations are current.
Adding and/or deleting authors at revision stage are generally not permitted, but in some cases it may be warranted. Reasons for these changes in authorship should be explained. Approval of the change during revision is at the discretion of the Editor-in-Chief. Please note that journals may have individual policies on adding and/or deleting authors during revision stage.

Author identification
Authors are recommended to use their ORCID ID when submitting an article for consideration or acquire an ORCID ID via the submission process.

Deceased or incapacitated authors
For cases in which a co-author dies or is incapacitated during the writing, submission, or peer-review process, and the co-authors feel it is appropriate to include the author, co-authors should obtain approval from a (legal) representative which could be a direct relative.

Authorship issues or disputes
In the case of an authorship dispute during peer review or after acceptance and publication, the Journal will not be in a position to investigate or adjudicate. Authors will be asked to resolve the dispute themselves. If they are unable the Journal reserves the right to withdraw a manuscript from the editorial process or in case of a published paper raise the issue with the authors’ institution(s) and abide by its guidelines.

27. Confidentiality
Authors should treat all communication with the Journal as confidential which includes correspondence with direct representatives from the Journal such as Editors-in-Chief and/or Handling Editors and reviewers’ reports unless explicit consent has been received to share information.

28. After Acceptance

Upon acceptance, your article will be exported to Production to undergo typesetting. Once typesetting is complete, you will receive a link asking you to confirm your affiliation, choose the publishing model for your article as well as arrange rights and payment of any associated publication cost.
4. REVIEWERS’ COMMENTS

Manuscript Number: EJOS-D-21-00701
Article Title: Radiographic Union Score for Tibia (RUST) scoring system in adult diaphyseal femoral fractures treated with intramedullary nailing: an assessment of interobserver and intraobserver reliability.
European Journal of Orthopaedic Surgery & Traumatology

Dear Dr Panchoo,

Reviewers have now commented on your paper. You will see that they are advising that you revise your manuscript. If you are prepared to undertake the work required, I would be pleased to reconsider my decision.

For your guidance, reviewers’ comments are appended below.

If you decide to revise the work, please submit a list of changes or a rebuttal against each point which is being raised when you submit the revised manuscript.

Your revision is due by 16 Oct 2021.

"Please make sure to submit your editable source files (i.e. Word, TeX)."

To submit a revision, go to https://www.editorialmanager.com/ejos/ and log in as an Author. You will see a menu item call Submission Needing Revision. You will find your submission record there.

Best regards,

Cyril Mauffrey
Editor-in-Chief
European Journal of Orthopaedic Surgery & Traumatology

COMMENTS TO THE AUTHOR:

Reviewer's Responses to Questions

Content of manuscript
Purpose

Reviewer #1:
*Clear

Originality

Reviewer #1:
*Acceptable

Importance of the subject
Reviewer #1:
*Acceptable

Integration of the most recent data
Reviewer #1:
*Complete

Scientific writing/structure
Reviewer #1:
*Outstanding

Content of manuscript
Reviewer #1: Adequate

Materials
Reviewer #1:
*Appropriate

Materials
Reviewer #1: Adequate

Methods
Reviewer #1:
*Correctly presented

Methods
Reviewer #1: Adequate

References The number of references
Reviewer #1:
*Outstanding literature review/citations

References
Reviewer #1: Adequate
Iconography and charts

Iconography

Reviewer #1:
*Satisfactory/need explanation

Charts

Reviewer #1:
*Incorrect/inadequate/inappropriate legends

Iconography and charts: Reviewer’s comments/suggestions

Reviewer #1: Line 25 of page 5: Interobserver and intraobserver agreement of previous studies involving the RUST and our current study is found in Table 3 not Table 1.

Reviewer #1: Please revise Line 25 of Page 5: Interobserver and intraobserver agreement of previous studies involving the RUST and current study is found in Table 3 not Table 1

Please note that this journal is a Transformative Journal (TJ). Authors may publish their research with us through the traditional subscription access route or make their paper immediately open access through payment of an article-processing charge (APC). Authors will not be required to make a final decision about access to their article until it has been accepted.

Authors may need to take specific actions to achieve compliance with funder and institutional open access mandates. If your research is supported by a funder that requires immediate open access (e.g. according to Plan S principles) then you should select the gold OA route, and we will direct you to the compliant route where possible. For authors selecting the subscription publication route our standard licensing terms will need to be accepted, including our self-archiving policies. Those standard licensing terms will supersede any other terms that the author or any third party may assert apply to any version of the manuscript.
5. REBUTTAL DOCUMENT

To
Cyril Mauffrey
Editor-in-Chief
European Journal of Orthopaedic Surgery & Traumatology.

Thank you for the review of the Manuscript Number: EJOS-D-21-00701 entitled Radiographic Union Score for Tibia (RUST) scoring system in adult diaphyseal femoral fractures treated with intramedullary nailing: an assessment of interobserver and intraobserver reliability. I really appreciate the quick response from the journal. All the comments are very encouraging for which I am grateful to the reviewers. Only three comments needed amendments to be made in the text and charts.

Please find below changes made regarding the comments.

1. Iconography and charts
*Satisfactory/need explanation.
Thank you for the comment. Explanation has been added to the charts and tables.

2. Charts
*Incorrect/inadequate/inappropriate legends
Thank you for the comment. Legends revised.

3. Iconography and charts: Reviewer’s comments/suggestions

Reviewer #1: Line 25 of page 5: Interobserver and intraobserver agreement of previous studies involving the RUST and our current study is found in Table 3 not Table 1.
Thank you for the comment and I apologize for the mistake. The text has been corrected.

Reviewer #1: Please revise Line 25 of Page 5: Interobserver and intraobserver agreement of previous studies involving the RUST and current study is found in Table 3 not Table 1.
Thank you for the comment. Line 25 of page 5 has been revised.
I remain at your disposal for any further queries.
Regards
Pravesh Panchoo.
6. ACCEPTANCE LETTER

Ref.: Ms. No. EJOS-D-21-00701R1
Radiographic Union Score for Tibia (RUST) scoring system in adult diaphyseal femoral fractures treated with intramedullary nailing: an assessment of interobserver and intraobserver reliability.
European Journal of Orthopaedic Surgery & Traumatology

Dear Dr Panchoo,

We would like to confirm acceptance of the above-mentioned manuscript for publication in our journal European Journal of Orthopaedic Surgery & Traumatology.

As the next step, you will receive proofs of your article. Please check them carefully and send them back to the address indicated.

Thank you for submitting your work to this journal.

Sincerely yours,

Cyril Mauffrey
Editor-in-Chief
European Journal of Orthopaedic Surgery & Traumatology

7. CONFIRMATION OF PUBLICATION

Dear Author,

We are pleased to inform you that your article has just been published:

**Title**
Radiographic union score for tibia (RUST) scoring system in adult diaphyseal femoral fractures treated with intramedullary nailing: an assessment of interobserver and intraobserver reliability

**Journal**
European Journal of Orthopaedic Surgery & Traumatology, (), 1-5

**DOI**
10.1007/s00590-021-03134-6
Your article is available as 'Online First':

We're committed to making your article as accessible and discoverable as possible:

- Your article is fully accessible to all users at libraries and institutions that have purchased access to SpringerLink.
- SharedIt: Springer Nature's innovative content-sharing initiative means that research articles can also be posted anywhere.
- Open access: If your article is published open access, it will be freely accessible to any user, immediately, with no access fees. Open access also allows for unrestricted re-use.

Announce your publication
We encourage you to forward this email to your co-authors. Additionally, we recommend you mention your article’s publication and its DOI on your website or your social media profiles.
Use the buttons below to share your article on social media.

Citation Information
Your article can be cited by its DOI 10.1007/s00590-021-03134-6 in the following form:

    Author, Journal Title, Year, DOI

We will notify you once your article completed production and is assigned to a specific journal issue. After that any additional (printed) offprints or posters you might have ordered will be shipped to you.

Author services to amplify your research
From video abstracts to article metrics to research data support, find out about the author services and how these could benefit you and your research.

Thank you again for publishing with Springer. We look forward to your future contributions!

Best regards,

Alison Mitchell
Managing Director Journals
8. Department of research committee approval

UNIVERSITY OF CAPE TOWN

Department of Surgery
Departmental Research Committee
Dr Timothy Pennel
D24 Office, Groote Schuur Hospital
Observatory 7925
South Africa
Tel (021) 404 3430
Email: tim.pennel@uct.ac.za
17 Mar 2020

Doctor P Panchoo
Department of Surgery
University of Cape Town
Dear Doctor Panchoo
RE: Project 2020/033

PROJECT TITLE: Validation Of Rust Scoring System For Diaphyseal Femur Fractures Treated With Intramedullary Nailing: Inter Observer And Intra Observer Reliability.

The above protocol has been reviewed by the Department of Surgery Research Committee. I am pleased to inform you that the committee approved the scientific merit of the study, and endorse the protocol for submission to the relevant ethics committee.

Although this letter serves as confirmation that the above protocol has successfully passed through the surgical DRC, respective ethics committees still require DRC chair signature before submission.

Please use the above project number in all future correspondence,

Yours sincerely

[Signature]

DR TIMOTHY PENNEL
CHAIR: SURGICAL DRC

DR MARITZ LAUBSCHER
CHAIR: PROTOCOL REVIEW COMMITTEE

“OUR MISSION is to be an outstanding teaching and research university, educating for life and addressing the challenges facing our society.”

Document 3: DRC approval letter
9. Copy of Ethics approval for HOST study

Document 4: copy of ethics
10. Turnitin submission receipt

Document 5: Copy of the Turnitin submission
11. Turnitin report

Please note that Turnitin has detected my own article already published by EJOST as 93% plagiarism. My original article can be accessed on the link below:
12. Plagiarism Declaration

1. I know that plagiarism is wrong. Plagiarism is to use another’s work and pretend that it is one’s own.

2. I have used the EJOST style for citation and referencing on Mendeley. Each contribution to, and quotation in this essay/report/project from the work(s) of other people has been attributed, and has been cited and referenced.

3. This essay/report/project is my own work.

4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

“This thesis/dissertation has been submitted to the Turnitin module (or equivalent similarity and originality checking software) and I confirm that my supervisor has seen my report and any concerns revealed by such have been resolved with my supervisor.”

Name: Pravesh Panchoo

Student number: PNCPR001

Signature:

Date: 2021/12/06

Document 7: Plagiarism declaration