Author’s response to reviews

Title: Morphological characteristics of the posterior malleolar fragment according to ankle fracture patterns: a computed tomography-based study

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Author’s response to reviews:

Dear Reviewers

We appreciate for your comments and review of this study.

We agreed with your comment and sincerely tried to revise the manuscript.

Reviewer Comments:

Reviewer 1

Question and comment:

Dear Editor, here are the comments and reviews for the paper entitled "Morphological characteristics of the posterior malleolar fragment according to ankle fracture patterns: a computed tomography-based study". The Authors assessed the morphological characteristics of posterior malleolar fragment (PMF) in trimalleolar ankle fractures. The study is well conducted and well written. The paper adds some new informations about trimalleolar ankle fractures. However, the biggest bias relies on the purpose of the study itself. Morphological characteristics can be assessed pre-operatively by surgeons with CT examination and they cannot predict the
Clinical outcomes. The quality of the reduction of the PMF is one of the most important factors for the outcome. Therefore, knowing parameters such as cross angle, fragment length ratio, fragment area ratio, sagittal angle and fragment height cannot help surgeons to predict potential complications and prognosis. It would be useful to assess the quality of the reduction of PMF related to morphological characteristics.

Answer:

We are really sorry that our expression regarding the purpose of the study in background section may cause your misinterpretation. We have described the background section more clearly in revised manuscript.

Clinical studies have shown that the presence of a posterior malleolar fragment (PMF) is important as a prognostic factor or functional outcome in the treatment of ankle fracture. Although fixation is recommended for fragments involving 25–30% of articular surface based on the articular involvement in all overall trimalleolar fracture, technical treatment strategies such as indication or method for fixation of PMF remains controversial. To understand the pathoanatomy or morphology of the PMF, two classification systems of assess the PMF morphology of ankle fractures have been addressed through CT-based studies. But, neither classification described the morphological characteristics of the PMF according to the ankle fracture pattern or injury mechanism. Therefore, a better understanding of morphological characteristics of the PMF depending on the mechanism of the injury could be useful to surgeon on planning to fixation of PMF and may provide a basis for prognosis.

The most commonly used classification systems of ankle fractures are the Lauge-Hansen, Dannis-Weber/ AO classification systems. The Dannis-Weber/ AO classification system is simple to understand due to coordinating role of the fibula and syndesmosis of the ankle joint. On the other hand, the Lauge-Hansen classification system is complex and cumbersome due to understanding the different stages of pathological damage in addition to the fracture pattern depending on injury mechanism. For these reasons, Dannis-Weber/ AO classification system has more reliability and reproducibility compared to Lauge-Hansen classification system. Despite these shortcomings, the Lauge-Hansen system provided the most clinically relevant information, because the ankle fractures are categorized as basis for injury mechanism using a combination of foot position and direction force.

Therefore, the aim of the present study was to evaluate the morphological characteristics of the posterior malleolar fragment (PMF) according to the ankle fracture pattern described in the Lauge-Hansen classification on the basis of a comprehensive CT.

Thus, the previous sentences were replaced with the following sentences in background section.
Ankle fractures commonly occur with an overall age- and sex-adjusted incidence rate of 187 per 100,000 person-years [1]. Trimalleolar fracture with the posterior malleolar fragment (PMF) accounted for 7% of ankle fracture [2]. Clinical studies have shown that the presence of a posterior malleolar fragment (PMF) is important as a prognostic factor or functional outcome in the treatment of ankle fracture [3-6]. Although fixation is recommended for fragments involving 25–30% of articular surface based on the articular involvement in all overall trimalleolar fracture, technical treatment strategies such as indication or method for fixation of PMF remains controversial [7-10].

To understand the pathoanatomy or morphology of the PMF, some studies have been undertaken using plain radiographs [11-13], computed tomography (CT) cross-section[14-16], and 3-D reconstruction CT [17, 18]. However, most studies had proven that using plain radiographs are inadequate to properly understand the pathoanatomy of this PMF. In a few studies that examined PMF using CT, the authors concluded that PMFs resulted from ankle and pilon fractures. To date, two classification systems [14, 17] of assess the PMF morphology of ankle fractures have been addressed through CT-based studies. Despite the fact that these two classification systems [14, 17] were able to describe the pathoanatomy or morphology of PMF in ankle fracture, neither classification described the morphological characteristics of the PMF according to the ankle fracture pattern or injury mechanism. Therefore, a better understanding of morphological characteristics of the PMF depending on the mechanism of the injury could be useful to surgeon on planning to fixation of PMF and may provide a basis for prognosis.

The most commonly used classification systems of ankle fractures are the Lauge-Hansen, Dannis-Weber/ AO classification systems. The Dannis-Weber/ AO classification system is simple to understand due to coordinating role of the fibula and syndesmosis of the ankle joint. On the other hand, the Lauge-Hansen classification system is complex and cumbersome due to understanding the different stages of pathological damage in addition to the fracture pattern depending on injury mechanism. For these reasons, Dannis-Weber/ AO classification system has more reliability and reproducibility compared to Lauge-Hansen classification system [19]. Despite these shortcomings, the Lauge-Hansen system provided the most clinically relevant information, because the ankle fractures are categorized as basis for injury mechanism using a combination of foot position and direction force [1].

The aim of the present study was to evaluate the morphological characteristics of the posterior malleolar fragment (PMF) according to the ankle fracture pattern described in the Lauge-Hansen classification on the basis of a comprehensive CT.”

Specific comments:

1- The number of patients included in the SER group (76) is more than double of the PER group (31). Please clarify this limitation.
In this study, we retrospectively analyzed CT data of 107 patients (107 ankles) who underwent surgery for trimalleolar fracture including PMF from January 2012 to December 2014. 107 patients were divided the patients into the following groups: 76 ankles in the supination-external rotation (SER) stage IV group and 31 ankles in the pronation-external rotation (PER) stage IV group. In the literature review, supination external rotation is the most common mechanism of fracture, accounting for 40%–70% of all ankle fractures. (Michelson J, Solocoff D, Waldman B, Kendall K, Ahn U. Ankle fractures: the Lauge-Hansen classification revisited. Clin Orthop Relat Res 1997;(345): 198–205.) For this reason, it is presumed that the difference in the number of patients was shown in two groups. On the other hands, as statistically, a compromise power analysis could be performed to determine the appropriate sample size for this study. The control group showed a power (1-β err prob) of 0.845 for detecting a noncentrality parameter δ of 2.03 at a critical t level of 1.019. So this study has a statistically meaningless difference in the number of samples between the two groups, but this difference could be lead confusion to readers.

Thus, we added following sentence at the “limitation” section.

“The number of patients in the SER group was more than double of the PER groups. Supination external rotation type has been reported as most common mechanism of fracture, accounting for 40%–70% of all ankle fractures [26]. For this reason, it is presumed that the difference in the number of patients was shown in two groups. On the other hands, as statistically, a compromise power analysis could be performed to determine the appropriate sample size for this study. The control group showed a power (1-β err prob) of 0.845 for detecting a noncentrality parameter δ of 2.03 at a critical t level of 1.019. So this study has a statistically meaningless difference in the number of samples between the two groups, but this difference could be lead confusion to readers.”

2- The Lauge-Hansen classification system is a comprehensive yet cumbersome system. A previous study reported low inter- and intraobserver kappa values (Yin MC, Yuan XF, Ma JM, et al Evaluating the Reliability and Reproducibility of the AO and Lauge-Hansen Classification Systems for Ankle Injuries. Orthopedics. 2015 Jul 1;38(7):e626-30). Why the authors choose this classification instead of a more reliable one (e.g. AO classification system)?

Answer:

We think there are two important points to choice of classification for this study. First, ‘could the classification explain ankle injury mechanism?’ and the second is ‘which classifications have been used in previous posterior malleolar fracture studies.’ The answer to this comment is included answer to above comment about background section. Thus, we added following sentence at the “background” section.
“The most commonly used classification systems of ankle fractures are the Lauge-Hansen, Dannis-Weber/ AO classification systems. The Dannis-Weber/ AO classification system is simple to understand due to coordinating role of the fibula and syndesmosis of the ankle joint. On the other hand, the Lauge-Hansen classification system is complex and cumbersome due to understanding the different stages of pathological damage in addition to the fracture pattern depending on injury mechanism. For these reasons, Dannis-Weber/ AO classification system has more reliability and reproducibility compared to Lauge-Hansen classification system [19]. Despite these shortcomings, the Lauge-Hansen system provided the most clinically relevant information, because the ankle fractures are categorized as basis for injury mechanism using a combination of foot position and direction force [1]. “

3- Please provide some informations about the orthopedic surgeons involved in the reliability assessment (years of experience, field of expertise, etc.)

Answer:

We have provided informations about the orthopedic surgeons involved in the reliability assessment.

Thus, the previous sentences were replaced with the following sentences in method section.

“Two orthopedic surgeons (JC; orthopedic surgeons, foot and ankle expert, 9 years of experience and SHL; orthopedic resident, trauma semi-expert, 3 years of experience)”

4- In the introduction section, please try to better justify the need of this study. In the discussion section, please try to describe the benefits obtained with the results of this study..

Answer:

We think the answer to this comment is included answer to above comment about background section. We have described the background section more clearly in revised manuscript.

Thus, the previous sentences were replaced with the following sentences in background section.

“Ankle fractures commonly occur with an overall age- and sex-adjusted incidence rate of 187 per 100,000 person-years [1]. Trimalleolar fracture with the posterior malleolar fragment (PMF) accounted for 7% of ankle fracture [2]. Clinical studies have shown that the presence of a posterior malleolar fragment (PMF) is important as a prognostic factor or functional outcome in the treatment of ankle fracture [3-6]. Although fixation is recommended for fragments involving 25–30% of articular surface based on the articular involvement in all overall trimalleolar fracture, technical treatment strategies such as indication or method for fixation of PMF remains controversial [7-10].
To understand the pathoanatomy or morphology of the PMF, some studies have been undertaken using plain radiographs [11-13], computed tomography (CT) cross-section[14-16], and 3-D reconstruction CT [17, 18]. However, most studies had proven that using plain radiographs are inadequate to properly understand the pathoanatomy of this PMF. In a few studies that examined PMF using CT, the authors concluded that PMFs resulted from ankle and pilon fractures. To date, two classification systems [14, 17] of assess the PMF morphology of ankle fractures have been addressed through CT-based studies. Despite the fact that these two classification systems [14, 17] were able to describe the pathoanatomy or morphology of PMF in ankle fracture, neither classification described the morphological characteristics of the PMF according to the ankle fracture pattern or injury mechanism. Therefore, a better understanding of morphological characteristics of the PMF depending on the mechanism of the injury could be useful to surgeon on planning to fixation of PMF and may provide a basis for prognosis.

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The aim of the present study was to evaluate the morphological characteristics of the posterior malleolar fragment (PMF) according to the ankle fracture pattern described in the Lauge-Hansen classification on the basis of a comprehensive CT.”

And then, we agree with your comment regarding need of clarifying the benefits obtained with the results of this study. Thus, we have described treatment strategy related to our results of this study. Thus, we added following sentence after "Therefore, the differences of morphological characteristics of the PMF by direction force may be clinically relevant to the different methods for fixation of PMF”.

“The treatment strategy proposed by the authors is that smaller fragment due to the rotational force is enough to positioning screw, while larger fragment due to a combination of rotational and axial forces require direct open reduction and internal fixation.”

Reviewer 2

Question and comment:

Thank you for conducting this interesting study.
Although the role of the posterior malleolar Fragment is already well understood, your work contributes interesting aspects of different morphology of the Fragment depending on the mechanism of the injury.

Basically, the manuscript is well written. However, some minor errors in language and grammar have to be erased. The methods including statistics seem to be appropriate.

The results including tables and legends are clearly represented.

However, in the discussion section, the clinical relevance of your study should be further clarified. You only wrote "Therefore, the differences of morphological characteristics of the PMF by direction force may be clinically relevant to the different methods for fixation of PMF". Which different methods of Fixations would you use in PMF associated with PER compared with those associated with PER. Do all types of fractures require fixation or do you decide on the Basis of your measurements whether to fix or not to fix the PMF? It is interesting to know that different mechanisms of injury lead to different morphologies of the PMF but how does that relate to your Treatment strategy. Maybe you can further illustrate that issue. Otherwise, I do not have any major complaints.

Thank you again for that interesting work.

Answer:

We agree with your comment regarding need of clarifying treatment strategy related to our results of this study. Thus, we added following sentence after "Therefore, the differences of morphological characteristics of the PMF by direction force may be clinically relevant to the different methods for fixation of PMF".

“The treatment strategy proposed by the authors is that smaller fragment due to the rotational force is enough to positioning screw, while larger fragment due to a combination of rotational and axial forces require direct open reduction and internal fixation.”