

# Total Ankle/Total Talus Replacement – Retrospective Comparison of Surgeon Decision Relative to Three-Dimensional Joint Health Assessment

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**Disclosures:** Grayson Talaski (N), Ben Wesorick (restor3d), Albert Anastasio (consulting, QPIX), Cesar de Cesar Netto (Paragon28, Zimmer Biomet, Medartis); Samuel Adams (consulting - Stryker, EXACTECH, Trilliant Surgical, Medshape, Sanara Medtech); Ken Gall (restor3d)

**INTRODUCTION:** In recent years, there has been a gradual rise in the utilization of personalized patient-specific metallic implants within the realm of foot and ankle orthopedics. An example of this trend is the total ankle/total ankle replacement (TATTR) procedure. In the efficient creation of personalized implants, the patient selection and design expertise of surgeons remains imperative to ensure favorable patient outcomes. A critical decision made by surgeons in conjunction with the TATTR procedure involves the potential arthrodesis of the subtalar joint through custom screw holes and underside porous material on the talar prosthesis. This decision hinges upon numerous factors encompassing the surgeon's preference, radiographic assessment of joint health, and other clinical evaluations. To date, no studies have compared surgeon decision for fusion to the joint health measured by three-dimensional analysis. Although one might anticipate that surgeons would opt for subtalar joint fusion in instances of increased joint instability or collapse, no study has been able to assess this relationship from three-dimensional (3D) imaging data. Therefore, this study includes a retrospective analysis of a relatively large TATTR cohort, with the primary aim to determine if the decisions made by surgeons correlated with the joint health status of patients measured by 3D imaging. Our hypothesis is that arthrodesis of the subtalar joint with the TATTR procedure correlates with measures of sinus tarsi impingement or reduced joint space evident on 3D imaging. These signs align with clinical observations of patient discomfort during inversion and eversion movements.

**METHODS:** We analyzed two groups of cases in our study: 27 TATTR with subtalar fusion and 19 TATTR without subtalar fusion. These numbers were chosen to reflect the proportion of fused to unfused cases in the entire dataset. Each patient underwent a bilateral computed tomography (CT) scan, which was then segmented prior to surgery. An experienced segmentation researcher evaluated each segmentation to ensure the clarity of the talus and subtalar joint, forming our final working groups. Cases involving significant revisions or extensive anatomical damage were excluded from the analysis. To assess joint health using 3D imaging data, we used a semi-automated MATLAB program. A single reader manually selected the articulating surfaces of the subtalar joint. This included the posterior and middle/anterior talocalcaneal facets on the talus, and the anterior facet, middle facet, posterior facet, and sinus tarsi on the calcaneus. We conducted distance mapping on these articulations by projecting a vector perpendicular from one triangulation until it intersected with its opposing triangulation. We calculated the average distance for each region of the subtalar joint. For better analysis, the sinus tarsi was divided into four sectors and the calcaneus posterior facet into nine sectors. Statistical analysis involved calculating the difference in means between the fused and unfused cases. We used Welch's t-test to test the significance of these differences. For visual analysis, we ranked and plotted the joint space distances for each case to determine if there was a clear distinction in measured joint spacing between subtalar joints surgeons opted to fuse or keep intact.

**RESULTS SECTION:** A total of 46 TATTR cases were included. No significance was found between groups for the four large regions (sinus tarsi, anterior, middle, and posterior facet), but when analyzing by specific regions, significance was found on the lateral portion of the posterior sinus tarsi as well as at both the medial portion of the anterior and middle sections of the posterior facet. When analyzing on rank plots for the posterior facet (anterior/medial), a clear cutoff was found around 2mm of joint space width (JSW) (Figure 2). Table 1 summarizes these results, and figure 1, 2, and 3 demonstrate our findings visually.

**DISCUSSION:** In this study, we compared the decision of surgeons to arthrodesis the subtalar joint along with a TATTR procedure to 3D imaging data of the pre-operative joint. Our findings indicate that in patients who underwent fusion in addition to TATTR as prescribed by a surgeon expert, there is a noticeable anterior/medial downward shift of the talus. Moreover, our initial assumption regarding sinus tarsi impingement in fused cases was validated, as there was a significant reduction in sinus tarsi JSW. Future following of individualized surgeon decision could begin to establish trends in surgeon decision-making to improve pre-operative planning. Utilizing this assessment tool prior to surgery in conjunction with the surgeon's clinical decision-making process could potentially enhance patient outcomes. This approach would also facilitate a comprehensive evaluation of the subtalar/peritalar structures before undertaking a TATTR procedure in the future.

**SIGNIFICANCE/CLINICAL RELEVANCE:** This analysis is of clinical interest as it assesses surgeon decision-making while also providing insight into how and where the joint deteriorates in three dimensions for patients that require a fusion in conjunction with a TATTR procedure.

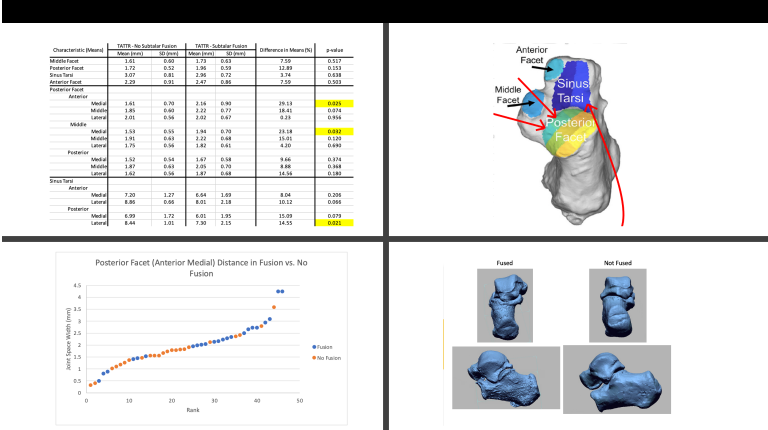


Figure: Table 1 (top left) summarizes statistical results, Figure 1 (top right) shows significant regions overlaid on anatomical model, Figure 2 (bottom left) shows rank plot for one specific region, and Figure 3 (bottom right) demonstrates general trend of fused vs. unfused.