Does PSI in total ankle arthroplasty affect joint line levels and functional outcomes?

Cesare Faldini¹, Alberto Arceri, Simone Ottavio Zielli, Federico Sgubbi, Laura Langone, Gianmarco Di Paola, Antonio Mazzotti¹

¹Istituto Ortopedico Rizzoli INTRODUCTION:

Total Ankle Arthroplasty (TAA) is a well-established solution for the treatment of severe end-stage ankle osteoarthritis (AO). While results are generally satisfactory in terms of pain relief, functional outcomes are still somewhat limited, particularly regarding range of motion (ROM). This may be due to the challenge of restoring the correct centre of rotation and joint line height, which are not systematically considered in planning with current prosthetic models and available instrumentation.

Existing literature suggests that ankles affected by end-stage OA are almost post-traumatic and often exhibit reduced bone stock, or an elevated joint line due to bony erosion. This elevation tends to persist after TAA as the degenerated joint line is used as a reference during bone cutting. In support of this speculation, recent studies have demonstrated that an elevated joint line is associated with reduced postoperative ROM and poorer functional scores.

The native joint line restoration was already proved being crucial in other anatomical site, as reported in the knee arthroplasty literature.

The application of Person-Specific Instruments (PSI) should theoretically improve accuracy in bone resection and implant positioning, then also optimise restoring the native joint lines.

The aim of this study is to compare joint line height, ROM, and functional clinical outcomes between standard TAA and TAA using PSI.

METHODS:

After institutional review board approval, a retrospective analysis was conducted on a consecutive cohort of patients who underwent standard TAA and TAA with PSI between January 2020 and December 2022.

Radiographic assessments, including joint line height and ROM, were performed.

A recent radiographic measurement method, known as the Joint Line Height Ratio (JLHR), has been used to assess joint line height on weight-bearing anteroposterior ankle radiographs before and after surgery. Elevated JLHR values indicate a higher joint line height. Postoperative ankle ROM, including maximum dorsiflexion, maximum plantarflexion and total ROM, was assessed using established methods with Cobb angle measured between lines on the tibial component baseplate and talar component lateral radiographs.

The clinical outcome was assessed using the Forgotten Joint Score, a patient-reported outcome measure developed to assess joint awareness following joint replacement surgery.

The correlation between joint line height, postoperative ROM, and clinical scores was investigated using Pearson correlation and multiple linear regression models.

RESULTS:

Fifty-one patients underwent standard TAA, while 22 received TAA with PSI. The mean JLHR preoperatively was 1.51 ± 0.24 and postoperatively was 1.56 ± 0.23 in the standard TAA group (p = .056). Conversely, the mean JLHR of PSI TAA group passed from 1.56 ± 0.19 to 1.43 ± 0.19 after TAA (p < .05). A lowered joint line was observed in 24 of 51 patients (47.1%) in the standard TAA group and in 18 of 22 patients (81.8%) in the PSI TAA group.

Although the postoperative joint line level was significantly lower in the TAA with PSI group, no significant correlation between JLHR with ROM or clinical outcome scores were observed both in the two groups at the mean 1-year follow-up.

Regression analysis showed no association between post-TAA ROM and postoperative JLHR, which was instead associated with TLS and OA onset (defined as the time elapsed between the onset of functionally limiting ankle symptoms and TAA surgery).

DISCUSSION AND CONCLUSION:

The joint height of an arthritic ankle tends to be higher than the healthy contralateral ankle. In this context, lowering the joint line without adequate instrumentation or planning to restore the native joint line is a challenging task.

This study suggests that while PSI may improve accuracy in implant positioning and joint line preservation, demonstrated by a significantly lowered joint line compared to standard TAA group. However, its effect on ROM and clinical outcomes is limited and not statistically significant.

A possible explanation for these results could lie in the conditions of the soft tissues. The arthritic process develops over years and the local tissues adapt to the evolving condition, often resulting in muscles, tendons, ligaments and capsules contractures that complicate any lengthening attempts, and contribute to postoperative stiffness and reduced ROM.

Even if the authors consider joint height restoration of fundamental importance in TAA, additional factors should be therefore considered. Not only soft tissue conditions, but also prosthetic implant design, presence of heterotopic calcifications, TAA tibial slope, and pre-operative ROM. Hence, there is a need for further investigation into these various variables.



