INTRODUCTION

Distraction arthroplasty has gained popularity as an alternative to arthrodesis or traditional arthroplasty for tibiotalar arthritis. This procedure uses external fixation to apply traction (distraction) across the ankle joint thereby expanding the narrowed joint space. Unloading is believed to create favorable conditions for cartilage repair and/or regeneration. Additionally, the resultant stress shielding of the subchondral bone allows for regression of arthritic changes that bone resorption. The desire for optimal unloading must be balanced against the need to protect neurovascular structures and avoid sacrificing ankle range of motion by increasing tension on the ankle ligaments.

This presents an obvious question: what is the minimum, and thus morbidity minimizing, distraction necessary to fully unload the articular surface during full weight bearing? Good clinical results have been reported using 5 mm of additional joint space as measured on a weight bearing x-ray of the ankle. However, this suggested distraction has not been studied in and of itself. The purpose of this study was to rigorously measure this minimum critical joint distraction using a cadaveric model.

RESULTS

The average joint space at which articular surfaces did not contact despite 700N of applied load was 2.4 (SD: 0.8; range: 1.6-4.0) mm. The average critical joint distraction was 4.4 (SD: 0.7; range: 3.5-5.8) mm at 200N of load and 4.9 (SD: 0.7; range: 3.7-7.0) mm at 0N of load (Figure 8).

DISCUSSION AND CONCLUSIONS

The goal of distraction arthroplasty is to apply the minimum joint distraction at which no load is transferred across the articular cartilage despite full weight bearing loads. As this goal cannot be directly measured in routine clinical practice, we use a minimum additional joint space target on biplanar radiographs. This target, or critical joint distraction, is the additional joint space needed above the joint space present on an undistracted film, to unload the articular surfaces despite application of 700N of axial load.

The additional joint space required depends on the load under which the radiographs are made. If biplanar films are used, the critical distraction is 4.4 mm. If nonweightbearing films are used, the critical distraction is 4.9 mm. If clinical radiographs were made standing on one leg, 2.4 mm of additional joint space would be required. Although much of the joint surface is unloaded at a minute increase in joint space under these conditions, the additional 2.4 mm are required to ensure the whole irregular surface of the joint is unloaded.

We believe these numbers give insight into the least morbidity distraction that will achieve the therapeutic goals of distraction arthroplasty. In order to ensure all patients have an opportunity for maximum response, our therapeutic target will be 6mm on biplanar radiographs moving forward. This would provide adequate additional joint space to fully unload the articular surface of even the most difficult to distract subject (maximum critical joint distraction was 5.8 mm) based on these data.