Ankle Dustraction Arthroplasty: How Much is Enough?

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What was the question?
Distraction arthroplasty is an appealing alternative to fusion for ankle arthritis. This procedure relies on external fixation and distraction to unload the ankle articular cartilage. This unloading is thought to promote cartilage regeneration. The minimum distraction required to adequately unload the joint is desirable. We asked, what is the joint space needed on a standing x–ray to complete unload of the articular cartilage during ambulation?

How did you answer the question?
We mounted SBI RAD frames on 9 cadaver ankles using three tension wires in the hind foot and two half–pins in the tibia. We fitted the talotibial joint with a pressure sensitive film. Then we applied three axial loads to undistracted ankles: 0N (no weight), 350N (half body weight / bipedal x–ray), 700N (full body weight / walking). At each applied load joint contact was assessed via the pressure sensing film and a joint space measurement was made from a lateral x–ray. We then distracted the ankles repeating the three applied loads and joint space measurements at 5 mm, 7 mm and then every 3rd mm of distraction thereafter. We continued this until the pressure sensitive film showed no contact between the articular surfaces at 700N of applied load. We considered this the minimum adequate distraction.

What are the results?
At the minimum adequate distraction we measured a mean additional joint space at 350N of 5.1 mm (4.2–7.0) and of 6.1 mm (4.3–9.4) at 0N.

What are your conclusions?
The minimum adequate distraction is that at which no load is transferred across the articular cartilage despite application walking load (700N). As this biomechanical goal cannot be measured *in vivo* we translate it to clinical practice using the minimum additional joint space. The minimum additional joint space is the measured x–ray joint space, above that present on an undistracted film, at the minimum adequate distraction under 0N (non–weight–bearing) or 350N (bipedal standing film) of applied load. The minimum additional joint space required to unload the taliotibial joint is 6.1 mm on a non–weight–bearing film and 5.1 mm on standard bipedal film. We believe this numbers give insight into the least morbid distraction that will achieve the therapeutic goals of distraction arthroplasty.