Real-Time Visualization of Joint Cavitation

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Gregory N. Kawchuk, Jerome Fryer, Jacob L. Jaremko, Hongbo Zeng, Lindsay Rowe, Richard Thompson
The primary author is from the Department of Physical Therapy, Faculty of Rehabilitation Medicine, University of Alberta, CAN.

KEY POINTS FROM THIS ARTICLE:

1) The objective of this study was to characterize the events associated with joint cracking within the joint itself using real-time cine-magnetic resonance imaging (cine-MRI). The evidence shows that the mechanism of joint cracking is related to cavity [gas shadow] formation.

2) Mechanically, when "surfaces are distracted, viscous adhesion or tension between the surfaces resist their separation. As distraction forces overcome the adhesive forces, the surfaces separate rapidly creating a negative pressure. This negative pressure, combined with the speed with which the surfaces separate, can create a vapor cavity."

3) This article presents direct evidence from real-time magnetic resonance imaging that the mechanism of the sound obtained is from joint cavitation. The authors applied a slowly increasing long-axis traction manually to 10 metacarpal-phalangeal joints while imaging the joints with rapid cine-magnetic resonance images at a rate of 3.2 frames per second until the cracking event occurred.

4) The first published scientific study describing the origins of joint cracking was in 1947, and the authors used x-rays.

5) This cine-MRI study, in agreement with prior x-ray studies, showed that joint cracking following joint distraction followed this sequence of events:

- The process begins with the resting phase where joint surfaces are in close contact.

- "As traction forces increased, real-time cine magnetic resonance imaging demonstrated rapid cavity inception at the time of joint separation and sound production after which the resulting cavity remained visible."

6) "Our results offer direct experimental evidence that joint cracking is associated with cavity inception."

7) "Cracking" sounds require time to pass before they can be repeated despite ongoing joint motion. This is called the *refractory* period.

8) "A light distraction force will barely separate the joint surfaces. With a greater distraction force, the surfaces resist separation until a critical point after which they separate rapidly. It is during this rapid separation phase that the characteristic cracking sound is produced. Following cracking, the joint is in a refractory phase where no further cracking can occur until time has passed (approximately 20 minutes)."

9) "Post-cracking distraction also reveals the presence of a 'clear space'." This cavity "has been thought to form as distraction forces decrease pressure within the synovial fluid to the point were dissolved gas comes out of solution."

10) "Cine-MRI demonstrated minimal joint surface separation in the resting phase prior to joint cracking followed by rapid joint separation during the crack itself."

11) "Cine-MRI revealed rapid cavity inception associated with concurrent sound production and joint separation."

12) "Dark signal intensities in the joint immediately following cracking support the presence of an air region."

13) "Our results offer direct experimental evidence that joint cracking is the result of cavity inception within synovial fluid."

14) During joint separation, the drop in synovial pressure allows dissolved gas to come out of solution and creates a gas bubble within the joint. This gas bubble persists after the point of sound production.

15) Distraction force must be applied to overcome tension within the synovial fluid before cracking can occur.

16) Rapid joint separation with cavity formation does not occur at the same traction force in each finger. **[Important]**

17) These authors note: "Habitual knuckle cracking has not been shown to increase joint degeneration." **[Important]**

COMMENTS FROM DAN MURPHY

Adhesion disruption and fibrotic tissue remodeling are dependent upon increased motion. Slowly applied motion causes the muscle to contract as a consequence of spinal reflexes, which is counterproductive for achieving adhesion disruption and fibrotic tissue remodeling. However "quick" motion beats these motion limiting spinal reflexes. This study clearly demonstrates, with the best evidence to date, that joint cavitation during a traditional chiropractic adjustment rapidly separates the joints, "beating" the motion limiting reflexes, enhancing adhesion degradation and tissue remodeling; and it all done without any injury to tissues.