Joint sounds, how do they arise?

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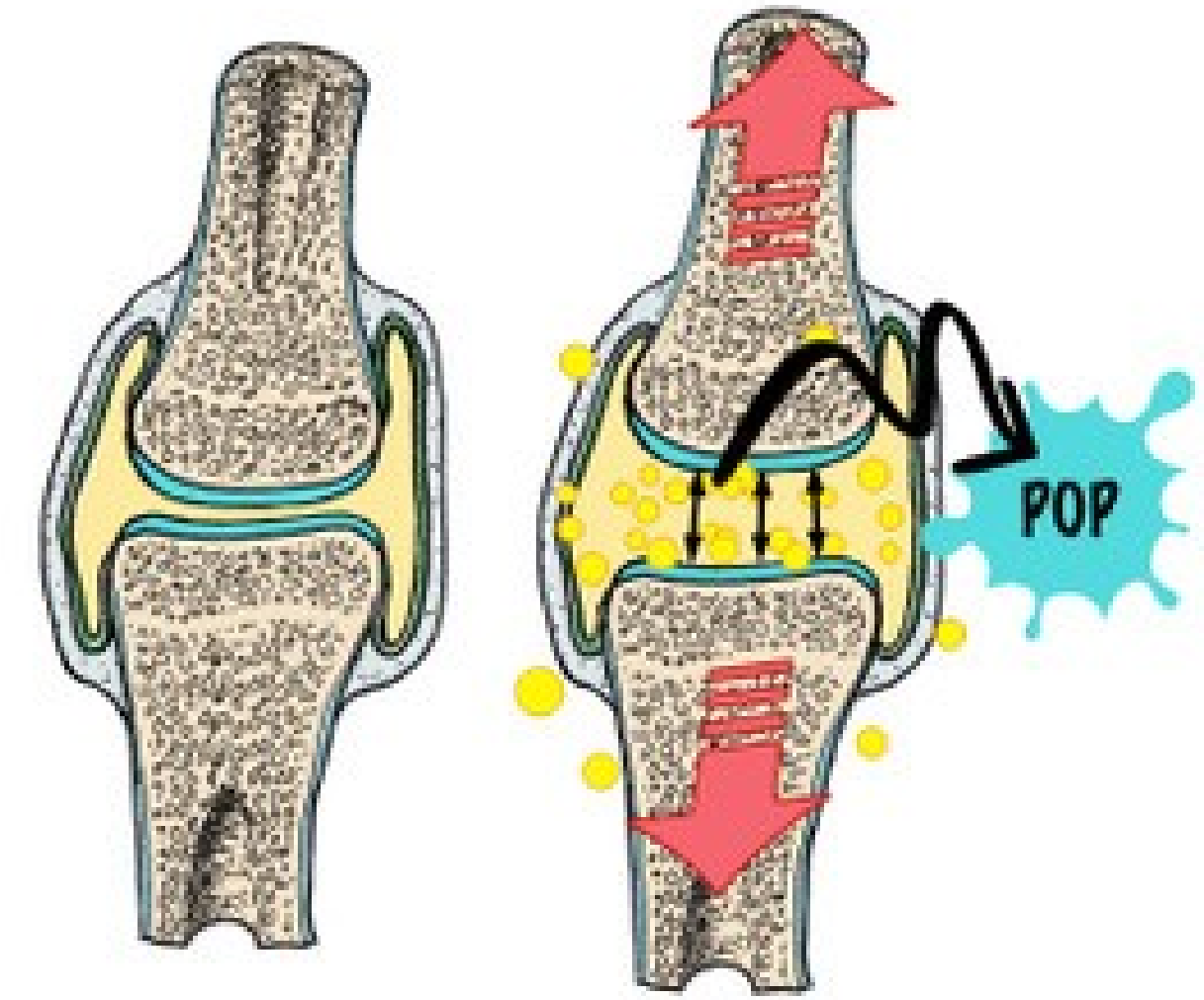

Figure 1 (Created by Dr. Valerie Weiss)

A key aspect of joint manipulation is the audible sounds that may occur during manipulation, which are believed to result from a phenomenon known as tribonucleation. Dr Rob Sillevis from Florida Gulf Coast University discusses his research on the clinical significance of these sounds

Joint manipulation is a widely applied manual therapy technique that enhances joint motion, alleviates discomfort, and restores optimal musculoskeletal function. This intervention involves applying precise, controlled forces to a joint. The historical origins of joint manipulation are deeply rooted in ancient medical traditions. Archaeological and written records from civilizations such as those in ancient Egypt, China, and Greece suggest that forms of manual therapy were practiced as far back as 3000 BCE.

As healthcare practices advanced, particularly in the late 20th century, joint manipulation gained scientific credibility through empirical research. Modern studies have consistently supported its clinical effectiveness for musculoskeletal conditions, including spinal pain, tension headaches, and functional joint impairments. Today, joint manipulation is integrated into various rehabilitative and musculoskeletal treatment frameworks, reflecting its historical significance and contemporary utility.

Audible sounds during joint manipulation

Audible sounds, commonly referred to as ‘cracks,’ ‘pops,’ or ‘clicks,’ are often produced during joint manipulation procedures. These acoustic phenomena have long been associated with successful manipulative outcomes in clinical practice and academic discourse. While the exact biomechanical and physiological source of the sound remains unclear, it is widely believed to result from the dynamics of synovial joints, particularly the interaction between the joint capsule, surrounding ligaments, and the synovial fluid (figure 1).

One prevailing hypothesis that seeks to explain the audible sound during joint manipulation is tribonucleation. This process involves the rapid separation of articular surfaces within a synovial joint, leading to a sudden drop in intra-articular pressure. When this negative synovial pressure surpasses a critical threshold, it causes the synovial fluid to ‘fracture,’ allowing dissolved gases within the fluid to come out of the solution and form gas bubbles. This rapid gas formation is believed to be the source of the characteristic audible pop associated with manipulation. While visually supported by imaging techniques such as MRI and ultrasound, the precise clinical significance of this biomechanical event remains under investigation.

Figure 2 (Created by Dr. Valerie Weiss)

Evaluating the clinical significance of audible joint manipulation

Dr Rob Sillevis of Florida Gulf Coast University has been investigating the clinical relevance of audible joint manipulation sounds since 2010. Through a series of original studies using electroencephalography (EEG), his research has explored cortical and autonomic responses to spinal manipulation. At the same time, findings show that the audible pop may coincide with changes in brainwave activity. However, no consistent or

clinically meaningful correlation has been established between the sound and outcomes such as pain reduction, joint mobility, or disability. These results suggest that the audible pop is a biomechanical phenomenon without proven therapeutic significance.

To complement these neurophysiological findings and better understand the mechanical underpinnings of the audible sound, Dr Sillevis and his research team extended their investigations to the structural level. Focusing on synovial joints, where audible pops exclusively occur, they employed musculoskeletal ultrasound (MSK US) to evaluate intra-articular responses to joint manipulation in the fingers and toes. This approach allowed for real-time, dynamic assessment of joint spacing and mechanics, providing valuable insights into the physical phenomena accompanying manipulation, independent of clinical outcomes.

Building on the biomechanical insights, the study results based on musculoskeletal ultrasound findings demonstrated that joint manipulations consistently increase joint space, whether accompanied by an audible pop or not. This finding aligns with previous research showing expanded synovial volume and capsular elongation observed through musculoskeletal ultrasound and real-time magnetic resonance imaging. Importantly, these results challenge the notion that cavitation, or gas bubble formation alone, is responsible for the audible sound during manipulation.

In both the audible sound and no audible sound groups, joint space increased similarly, suggesting that the presence of gas bubbles does not uniquely account for the pop. Instead, the data support tribonucleation as a more comprehensive theoretical framework to explain the synovial expansion and acoustic phenomena observed in clinical joint manipulation and self-induced joint cracking.

Based on current research evidence, clinicians and researchers should refrain from using the presence of an audible sound as an indicator of successful joint manipulation. The audible ‘pop’ is a biomechanical byproduct rather than a marker of clinical efficacy. Clinicians should educate patients that the effectiveness of joint manipulation is not determined by whether a sound occurs but rather by meaningful improvements in function, pain, and overall clinical outcomes. Moreover, the common public perception (figure 2) that an audible sound during manipulation signifies a more effective or beneficial treatment should be addressed and corrected to ensure realistic expectations and an informed understanding of care.

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