Biomechanical characteristics of equine metacarpophalangeal joint. A review article.

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Abstract

The metacarpophalangeal joint (MCPJ) is a high-motion joint subjected to substantial loads and elastic work during locomotion. Elastic strain energy is stored in the flexor tendons and suspensory apparatus during joint hyperextension and released during the push-off phase. These complex biomechanical characteristics predispose the joint structures to injuries such as subchondral bone injury, progressive osteoarthritis, and fractures, often linked to chronic fatigue from repetitive loading at the third metacarpal bone and proximal phalanx articulation. In horses, the MCPJ is commonly affected by osteoarthritis (OA). Several studies have focused on researching MCPJ mechanics and its relationship with OA. This review discusses leading advancements in the field of MCPJ biomechanics, emphasizing their clinical relevance in understanding osteoarthritis pathophysiology. Joint biomechanics evaluation includes kinematics and kinetics analysis. Kinematics are analyzed through the recorded trajectory of reflective markers attached to the distal limb, registered by a motion capture system. The trajectory data are then analyzed by the software for subsequent kinetic analysis. To calculate joint reaction forces, detailed activity of the muscles and ligaments directly impacting the MCPJ has been evaluated. As a high-motion joint with elastic properties during locomotion, the MCPJ experiences significant loads that create substantial pressure on articular cartilage and stress on surrounding bones. This review provides insights into the most recent concepts of stress distribution across bones and articular cartilage proposed to explain and enhance the understanding of injuries to joint structures.

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