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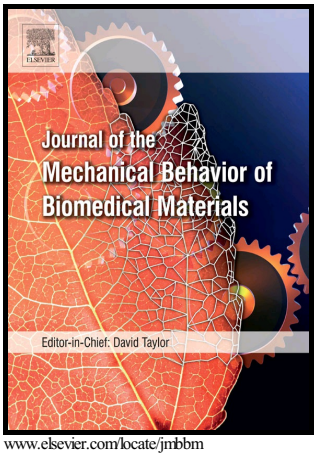

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A novel fracture mechanics model explaining the axial penetration of bone-like porous, compressible solids by various orthopaedic implant tips

Sloan A. Kulper[1], KY Sze[2], Christian X. Fang[1*], Xiaodan Ren[3], Margaret Guo[4], Kerstin Schneider[5], Frankie Leung[1], William Lu[1], Alfonso Ngan[2]

[1]Department of Orthopaedics & Traumatology, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Hong Kong, China

[2]Department of Mechanical Engineering, Faculty of Engineering, The University of Hong Kong, Hong Kong, China

[3]School of Civil Engineering, Tongji University, Shanghai, China

[4]Stanford University School of Medicine, Stanford, USA

[5]Schulthess Clinic Zurich, Zurich, Switzerland.

[*]**Corresponding Author**: Dr. Christian Fang, FRCS, Clinical Assistant Professor, Department of Orthopaedics and Traumatology, Queen Mary Hospital, The University of Hong Kong, Tel.: +(852) 22554581, fax: +(852) 28174392, cfang@hku.hk

Abstract:

Many features of orthopaedic implants have been previously examined regarding their influence on migration in trabecular bone under axial loading, with screw thread design being one of the most prominent examples. There has been comparatively little investigation, however, of the influence that implant tip design has on migration under axial loads. We present a novel fracture mechanics model that explains how differences in tip design affect the force required for axial penetration of porous, compressible solids similar to trabecular bone. Three tip designs were considered based on typical 5 mm diameter orthopaedic locking screws: flat and conical tip designs, as well as a novel elastomeric tip.

Ten axial penetration trials were conducted for each tip design. In order to isolate the effect of tip design on axial migration from that of the threads, smooth steel rods were used. Tip designs were inserted into polyurethane foam commonly used to represent osteoporotic trabecular bone tissue (ASTM Type 10, 0.16 g/cc) to a depth of 10 mm at a rate of 2 mm/min,