

ADVANCED FINITE ELEMENT ANALYSIS TO PREDICT IMPACT DAMAGE BEHAVIOUR OF FRACTURED HIP

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Introduction

“Quality of compassionate care for older people that protects their dignity and independence, is one of the most sacred duties of any civilised society”. Bone fracture is a common serious injury that occurs mainly in older people. For many previously fit patients it means loss of prior full mobility; for some frailer patients the permanent loss of the ability to live at home. For the frailest of all it may bring pain, confusion and disruption to complicate an already distressing illness (SIGN – NHS, June 2009). Bone is a complex material, with a heterogeneous and anisotropic microstructure. The processes of fracture and healing can only be understood in terms of the fundamental bone structure and its mechanical function. Bone fracture analysis attempts to forecast the failure of musculoskeletal structures by several possible mechanisms under different loading conditions.

Methods

An accurate finite element (FE) method will assist scientists and researchers to predict the impact damage response of cracked bone structures. In this paper, the effect of low velocity impact on the hip fracture in aging people will be investigated. The cortical bone is modelled based on Belytschko-Lin-Tsay quadrilateral shell elements which is a combined co-rotational and velocity strain. At macroscopic continuum level, bone exhibits orthotropic behaviour with inhomogeneous material properties. In this regard, the Chang-Chang failure criterion which is the modification of the Hashin’s failure criterion is chosen for assessing damage failure in hip structure. The contact between the rigid plate and the specimens is modelled using a *nodes impacting surface* to avoid lateral movements. To prevent the penetration of the boundary by its own nodes, a *single surface* contact algorithm without friction is used (see Figure 1).

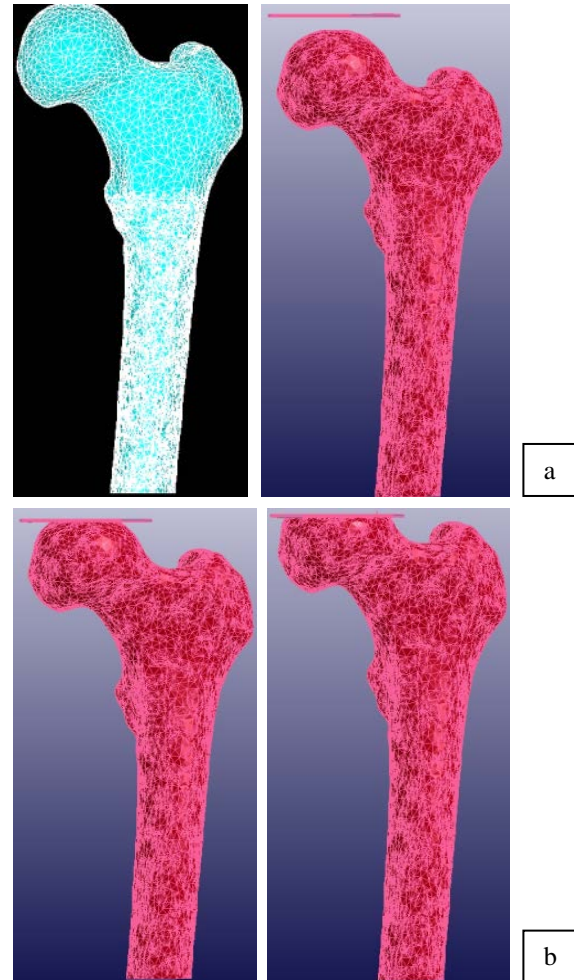


Figure 1: Finite Element Model of hip a) Pre-processing in ANSYS and b) Post-processing in LSDYNA

Conclusion

The critical impulse loading of different cracked hip will enable designers to improve the design of safety instruments and consequently wellbeing of elderly people.

Reference

Care for older people is top priority, SIGN – NHS, Available at:
www.scotland.gov.uk/news/ June 2009.