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Plenary Lecture

COMPUTATIONAL BIOMECHANICS FOR CLINICAL DECISION MAKING. HAVE WE REACHED IT?

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Summary: Computational models are widely used in medical sciences to study disease aetiology and progression. Finite element analysis is one specific computational modeling technique, widely used for the mechanical evaluation and characterization of objects and with applications across all length scales. Since its first application to biological tissues 50 years ago [1], its use has increased tremendously. Whereas initial analyses dealt with concepts, and with improving devices such as total hip replacements, the tremendous increase in computational power has brought more detail and more physiological accuracy into the models, thus allowing patient-specific/specimen-specific analyses. These analysis have demonstrated that accurate estimates of stiffness, strength and deformation behavior of biological tissues such as bones and bone-implant structures can be obtained; i.e., many studies have appeared in which finite element modelling has been used to quantify mechanical performance, and how these properties change with specific treatment. Though implementation of this technique in a clinical context seems a logical and straight-forward step, this has seen only very few actual realizations. Why? What are the hurdles? In this presentation I will address these questions. As an example I will show that finite element analysis can provide a biomechanics-based evaluation of the risk for bone fracture in patients with bone tumors, before and after treatment. These data can support clinicians in the decision process. At the same time it remains a challenge to include additional factors related to patients health status and well-being and to weigh the impact of treatment.

References

[1] Brekelmans, Poort, and Slooff (1972), Acta *Orthop*. Scand. 43: 301-317