Finite element modeling of retro-acetabular pathology

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PhD Project

Total hip arthroplasty (THA) has developed over the last 4 decades such that modern implants provide a reliable means of eliminating pain and restoring function in those afflicted by disease affecting the hip joint. The major reason for revision THA remains aseptic loosening for which there are several causes. While particulate wear related disease remains a major cause, the evidence for mechanical related bone remodeling is increasing.

Several authors have focused on implant related changes to pelvic stress and strain and finite element studies of stress transmission in the pelvis have been conducted. The pelvis behaves as a sandwich material, meaning that stress is transmitted via the high-modulus, inner and outer cortical bone plates supported by the low-modulus cancellous bone between. There is however little in the literature on the biomechanics associated with acetabular pathology, especially the ramifications of advancing osteolytic disease.

The focus of this thesis is to improve knowledge of the biomechanical environment created by retro-acetabular bone remodeling, especially in advanced osteolytic disease. The first step is to create a pelvis specific finite element model validated against an experimental model containing a retro-acetabular cyst. Once an accurate model has been established, the method will be applied to specific patients with CT data to examine trends in stress transmission based on bone architecture and density. The model will also be applied to the method of cortical windowing and bone graft.

It is hoped that the results of this research can be used to provide surgeons with an enhanced ability to decide which patients with retroacetabular bone loss require surgery.