DISTAL RADIUS FIXATION AND OSTEOARTHRITIS: A FINITE ELEMENT MODELING STUDY

1. INTRODUCTION

Distal radius fractures account for 20% of all fractures and represent therefore the most common injury seen in orthopaedics. These fractures are usually caused by a fall on an outstretched arm, and concern mostly older women. These fractures can be treated by internal fixation with a titanium plate (Fig1). For optimal fixation, it is advised to implant the fixation plate as distal as possible. Unfortunately, post-traumatic osteoarthritis at the wrist joint is a common complication, concerning up to 40-65% of the patients (Knirk). Many studies have shown that cartilage degenerates when loaded abnormally.

The purpose of this study is to investigate the influence of the placement of the fixation plate on the stress pattern in the distal radius and the joint cartilage using the finite element method (FE). Time permitting, in a second step, the computer simulation will be validated by performing experimental in vitro mechanical testing.

This investigation should improve our understanding of the influence of the fixation location, finally allowing clinical recommendation on optimal position of the fixation plate.

Figure: Titanium volar distal radius plate (Synthes®)

2. PROJECT TASKS

1. Review of the literature.
2. Become familiar with requisite commercial finite element software.
3. Development of the FE model of the radius, cartilage, plate and screws.
4. Test influence of positioning of the plate.
5. Experimental validation of the simulation through in vitro mechanical testing of the fixations.
6. Submission of a final report.

3. RELEVANT LITERATURE

1. Anderson DD, Deshpande BR, Daniel TE, Baratz ME (2005). “A three-dimensional finite element model of the radiocarpal joint: distal radius fracture step-off and stress
transfer”. Iowa Orthop J 25:108-17.

2. Blecha LD, Zambelli PY, Ramaniraka NA, Bourban PE, Månson JA, Pioletti DP (2005). “How plate positioning impacts the biomechanics of the open wedge tibial osteotomy; a finite element analysis.” Comput Methods Biomech Biomed Engin. 8(5):307-13. Figure: Titanium volar distal radius plate (Synthes®)

3. Cheng HY, Lin CL, Lin YH, Chen AC (2007). „Biomechanical evaluation of the modified double-plating fixation for the distal radius fracture”. Clin Biomech 22(5):510-7

4. Goreham-Voss CM, McKinley TO, Brown TD (2007).” A finite element exploration of cartilage stress near an articular incongruity during unstable motion.” J Biomech 40(15):3438-47.

5. Knirk JL, Jupiter JB (1986). ”Intra-articular fractures of the distal end of the radius in young adults”. J Bone Joint Surg 68A: 647-59.

6. Lin CL, Lin YH, Chen AC (2006). “Buttressing angle of the double-plating fixation of a distal radius fracture: a finite element study.” Med Biol Eng Comput 44(8):665-73.