CONTACT PRESSURE ANALYSIS OF THE PARTS OF TOTAL HIP JOINT ENDOPROSTHESIS WITH SHAPE DEVIATIONS OF THE CONTACT AREAS

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INTRODUCTION

The reliability is the most important behaviour of the bioimplants [1]. In the Czech Republic some time ago occured the problems with the reliability of the implants. The first case was the *in vivo* destructions of the ceramics head of the total hip joint endoprosthesis The second case was *in vivo* the release of the cups of the hip joint endoprosthesis from the pelvic bone. The reason of these orthopaedic problems is the shape deviations of the contact areas of the hip joint endoprosthesis [2, 3]. Therefore the computational modelling of the influence of the shape deviations of the cone and sphere contact areas were realised.

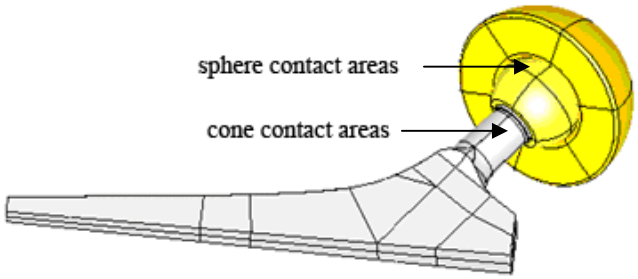

Figure 1: Location of the assumed shape deviations.

COMPUATIONAL MODELLING

The model of analysed system (pelvic bone, polyethylene cup, ceramic head and the steel stem) was created in the FEM system ANSYS. The macro and micro shape deviations were implemented into the both contact areas. The macro shape deviations (different taper of the head's and stem's cones and different radius of the head's and the cup's sphere – Figure 1) and micro shape deviations of the contact areas were measured using the IMS-UMPIRE measuring equipment. The Figure 2 shows the micro shape deviations of the stem's cone. The macro shape deviation of the cone taper was about 6' [2]. The measured difference between the inner cup's radius and head's radius was changed from -0.15 mm (the cup's sphere radius was smaller than head's radius) to 0.25 mm [3]. The loading of the system simulates the physiological loading for the configuration - standing on one extremity (assumed man weigh is 80 kg).

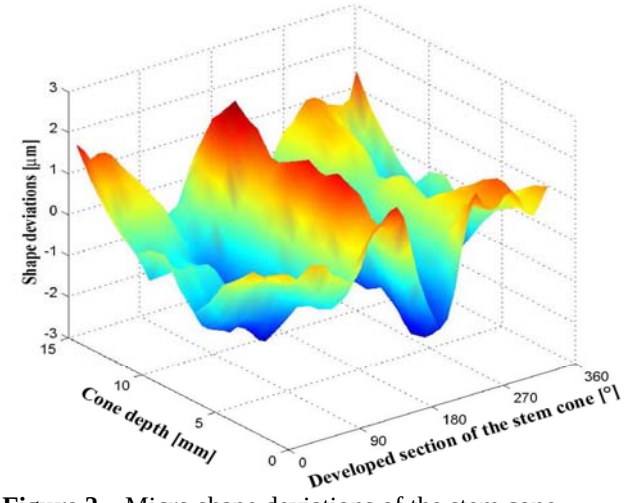

Figure 2: Micro shape deviations of the stem cone.

RESULTS

The value of the friction moment and iso-surface of the contact pressure on the head's sphere are shown in Figure 3 for different inner radius of the cup - the head's radius is the same (16 mm). The maximum value of the friction moment on the cup is for the smallest cup's diameter (cup's sphere is smaller than the head's sphere) which was the *in vivo* case and therefore the release of the cups were happened to.

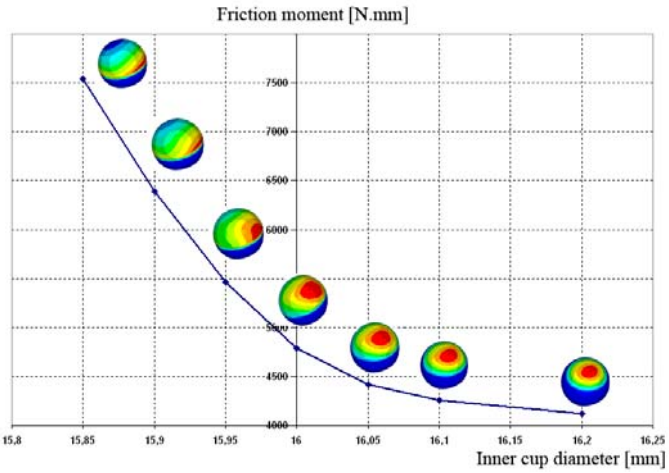

Figure 3: Friction moment on the inner cup diameter.

The micro shape deviations of the cone areas is the cause of double the value of the tensile stress in the ceramics head which highly reduce its reliability (based on the Weibull weakest link theory).

CONCLUSIONS

By the computational modelling it has been proved that the character and the size of shape deflections of the contact areas have a pronounced influence on the character and the value of the contact stress in the system and, hence, on the reliability of the complete implants.

ACKNOWLEDGEMENTS

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