

# BIOMECHANICAL EFFECT OF THE COLLAR OF THE FEMORAL STEM ON TOTAL HIP ARTHROPLASTY

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## INTRODUCTION

Cementless hip joint prosthesis after THR (total hip replacement) is often subsided into the cancellous bone of femur under compressive loading arisen from body weight and gait. This phenomenon may occur additional damage to patients after THR.

To prevent this problem, a femoral stem with collar is invented and used as an alternative to the stem without collar (see Fig. 1) [1-3]. Because of the collar shape, it is easy to expect that the stem with the collar does not easily subside into the femur. However, the actual biomechanical effect of the small collar on THR is hard to estimate from the intuition based on the empirical background.

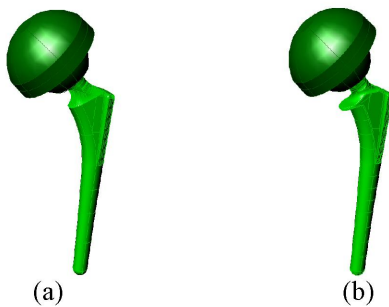


Fig. 1 Geometric models of the hip joint prosthesis (a) without and (b) with collar

## METHODS

To understand the biomechanical collar effect, two regular types of cementless implant without and with collar were selected and modelled using finite element meshes. For the FE (Finite Element) modelling of biological materials such as, sacrum, coxal bone and femur, X-ray CT images of a fifty four years old woman patient were used.

After practicing the virtual THR, which was done by Boolean operation between geometric models of femoral stems and cancellous bones, the FE models of both prosthesis as well as biological materials were constructed and finite element analysis for the whole structure around the implanted hip joint under compression was carried out (See Fig. 2).

## RESULTS AND DISCUSSION

From the comparison of the numerically obtained deformation behaviors between two analysis cases using collarless or collared stem, and stress fields of the femurs at which both prostheses are implanted, it is found that the collarless stem shows a possibility to subside into cancellous bone and the collar obviously prevents the subsidence of the stem but causes *the moment load* to the femur, which seriously increases the looseing at the interface between the

stem and the cancellous bone. Furthermore, it may produce *the varus deformation of the prosthesis*, which may lead *the femur fracture*.

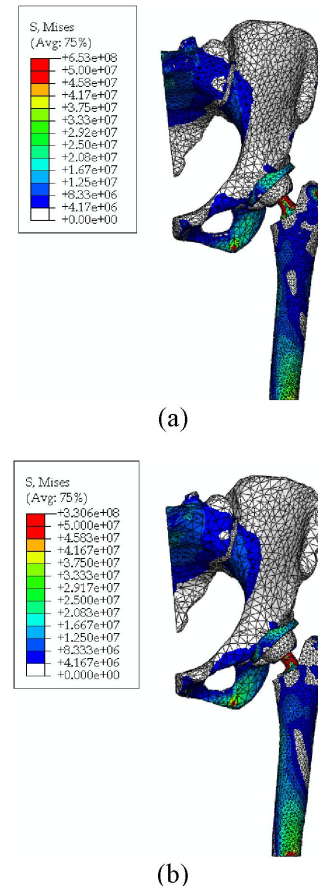


Fig.2 Mises stress field around the implanted hip joint prosthesis using (a) collarless and (b) collared stem

## CONCLUSIONS

From the results of this research, it is known that:

- Implanted stem without collar has a possibility to subside into the cancellous bone.
- The collar should prevent the subsidence of the implanted stem into the cancellous bone.
- The collar produces loosening between the stem and the cancellous bone.
- The collar may produce the varus deformation of the prosthesis.

## REFERENCES

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