

EFFECT OF STEM DESIGN ON STEM-END PAIN IN REVISION TKR

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INTRODUCTION

Recently, hybrid fixation, which represents cemented tray and press-fit stem, has emerged due to the advantages of press-fit fixation such as a low incidence of loosening, reducing stress shielding area and simplicity in removing the component in the case of revision surgery. However, it has been reported that a press-fit stem in revision TKR could induce the stem-end pain [1]. The relationship between the stem-end pain and stem design is not clearly defined. We followed the clinical hypothesis that the stem-end pain would be related to the local contact pressure and stress distribution around the stem-end [2]. The purpose of this study was to investigate the effect of stem-end design on contact pressure and stress distribution in revision TKR and to associate the stem-end pain with them.

METHODS

A finite element model of a tibia was created from Imm-CT scan images and implanted with a commercial tibial prosthesis(Wright Medical Technologies, U.S.A.) by using commercial pre/post processor FEMAP®(V8.2, EDS Corp., U.S.A). Applied load to the tibia was 2000N [3]. The distal end of tibia was fixed in all directions, representing a rigid boundary condition. Cemented tray and press-fit stem, which represented the hybrid fixation, were applied. The finite element analysis were carried out using ABAQUS™(Standard 6.5, ABAQUS Inc., U.S.A).

Various 3D CAD models were developed and four design parameters which were length, diameter, slot and press-fit were applied in the pre-op. planning (Table 1). The stem design and contact clearances of the press-fit stem were varied and compared with the base model.

Table 1. Pre-op. planning with four stem design parameters

	length (mm)	Diameter (mm)	Slot	Press-fit (μm)
Base model	115	10	solid	0
Case1	90	10	solid	0
	70	10	solid	0
Case2	115	12	solid	0
Case3	115	10	slot	0
Case4	115	10	solid	5
	115	10	solid	10

RESULTS

The result of the contact pressure and the Von-Mises stress according to the stem lengths, diameters, slot and press-fit were presented in Fig. 1. When the stem length and diameter decreased, the peak contact pressure and stress also decreased. The increment of the stem diameter induced the small increase of the peak contact pressure and stress. There was no difference for the stress

between the solid stem and the slot stem but in the case of the slot stem, the peak contact pressure decreased. For the press-fit stem, the small increment of the clearance raised the peak contact pressure and stress significantly.

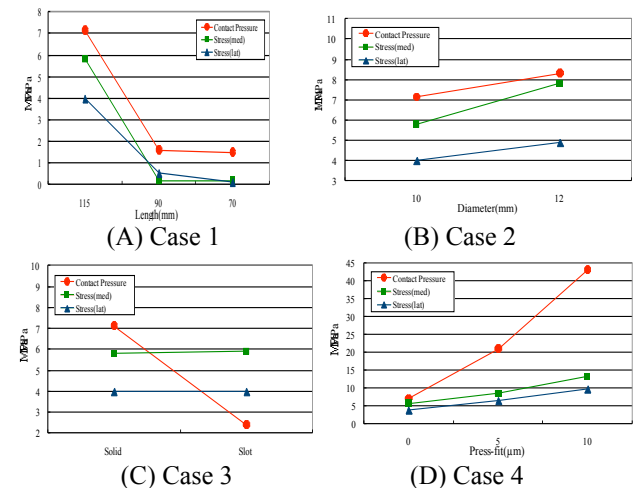


Fig. 1 Peak contact pressure and Von-Mises stress in the adjacent bone to the stem-end

DISCUSSION

Compared with those clinical reports, the results of this study were coincident with the above hypothesis. Therefore, the results of this study demonstrated that the shorter stem length, smaller stem diameter was planned, the smaller peak contact pressure and stress were induced in the bone adjacent to the stem-end and could reduce the stem-end pain. Furthermore, the use of slotted implant in revision TKR could be appropriate and reduce the stem-end pain by reducing the peak contact pressure significantly. When a press-fit stem was planned, the peak contact pressure and stress increased drastically and it was represented that large clearance press-fit could induce the stem-end pain.

The result of this study could be useful information in the pre-operative planning of revision TKR. By combining the clinical and functional planning, which could reduce the stem-end pain and improve the stability of the artificial knee joint, the optimal revision TKR would be accomplished.

REFERENCES

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ACKNOWLEDGEMENT

This work was financially supported by MOCIE through EIRC program.