The Effect of Modular Neck System on Prevention for Prosthetic Impingement

Methods: ANCA-Fit system (Wright Medical, Arlington, TN, USA) includes a modern ceramic on ceramic bearing with a modular neck system. This system provided 11 neck options, including straight (St), 8 degrees anteversion (A8), 8 degrees anteversion (R8), 15 degrees anteversion (A15), 15 degrees anteversion (R15), 8 degrees varus (Vr), 8 degrees valgus (Vl), 4.5 degrees anteversion + 6 degrees varus (AVr), 4.5 degrees anteversion + 6 degrees varus (AVf), 4.5 degrees retroversion + 6 degrees varus (RVf), 4.5 degrees retroversion + 6 degrees valgus (RVl).

We built 8 implant CAD models of ANCA-Fit system (Fig. 1). A implant model was consisted of a 48mm Cup with a Liner, a 28mm size-M head and a size-12 Stem with one of 8 size-S neck options (St, A8, R8, A15, R15, Vr, AVr and RVr). These were selected because of high frequency in clinical use. In each model, we made subsets with different implant orientations. Stem was set in 5 degrees flexion and adduction, and stem anteversion was within 0-60 degrees (by each 5 degrees) to simulate wide variation of femoral version. Cup radiographic inclination and anteversion were within 35-50 and 0-45 degrees (by each 5 degrees) to reproduce possible cup situations. Collision between the liner and neck models was mathematically detected in directions of flexion, extension, external rotation, and internal rotation at 90 degrees. When those angles up to collision were more than 130, 40, 40 and 40 degrees, respectively, the subset was defined as having no impingement [7-9].

Results: The results of collision detection were shown in Table 1. It showed that even if cup orientation was appropriate, in use of only straight neck, the THA could not provide enough ROM in the case with more than 40 degrees femoral anteversion. On the other hand, modular neck system could provide the cases with 0-60 degrees femoral anteversion enough ROM.

Discussion: Developmental displasia of the hip (DDH) is a major cause of secondary osteoarthritis. It was reported that the incidence of excessively anteverted femora was very high in femora with DDH compared with in the normal femora. 94% of femora with DDH had 0-50 degrees anteversion, although 93% of normal femora had 0-40 degrees anteversion [10].

The present study showed that it might be difficult to indicate the prosthesis with only straight neck for the cases with more than 40 degrees anteverted femur as regards prevention for prosthetic impingement. On the other hand, the modular neck system may be useful for most of the hips with even excessively anteverted femur, although another procedure might be necessary for rare cases with more than 60 degrees anteversion.

The present study revealed that the modular neck system had good potential to prevent the hips with even excessively anteverted femora from prosthetic impingement.

References
9 Sugano N et al. 49th Annual Meeting of the ORS 28: #0155 2003

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Implant CAD Models

Subsets in each model

Collision Detection

Fig. 1: This shows implant CAD models and their subsets with different implant orientations. Each subset was tested by an algorithm for collision detection whether it had enough ROM to avoid prosthetic impingement or not.

Table 1: The results of collision detection