Custom made femoral component for total hip replacement: a clinical and technical challenge in nine cases

MERLOZ P, EID A, TONETTI J, RUATTI S

Department of Orthopaedic Surgery, CHU Albert Michallon, Grenoble, France

PMerloz@chu-grenoble.fr

Introduction: Some hip diseases observed in children, adolescents or young adults create important functional deficits and unusual deformation of the upper part of the femur due to the pathology and repeated surgical procedures. These cases may be treated by using a Total Hip Replacement (THR) with a custom made femoral stem in order to fit exactly to the shape and the anatomy of the proximal femur. Custom made femoral component appeared in the early 90's when the CT scan data has been used in the process of designing and manufacturing computer-aided technology. We report a short clinical experience of nine surgical procedures.

Methods: Seven patients (nine hips) have been operated on between 2001 and 2007 by using a custom made femoral component (ISIS ® program, Tornier, Montbonnot, France). The average age of the patients (4 men and 3 women) was 38 (ranging from 14 to 49). The aetiologies were highly variable: sequelae of osteoarthritis (three hips), trauma (osteonecrosis: two hips), idiopathic coxa vara (one hip), and Developmental Dysplasia of the Hip [DDH] (three hips). A computer-assisted system (CT based) was used to create a 3D model of the proximal part of the femur. The creation of the individual femoral component used a Computer Assisted Design – Computer Assisted Manufacturing (CAD/CAM) prototyping technology. Femoral stems were uncemented stems in all cases and the acetabular component was a standard one. Clinical evaluation, using the Harris Hip Score (HHS) and conventional radiological assessment were done at the last follow-up (4 to 10 years after THR).

Results: Taking into account the severity of preoperative functional score (average HHS = 25) the clinical results after surgery were considered as excellent (average HHS = 85) at follow-up. Most of the patients were satisfied. However two cases were regarded as good (and not excellent) because of residual leg length discrepancy (3 and 4.5 cm). One case of post-operative dislocation was observed two days after surgery. The patient was re-operated on by using a dual mobility acetabular component. At follow-up no femoral and/or pelvic osteolysis and no femoral component migration were observed. There were no septic and/or deep veinous thrombosis (DVP) complications.

Discussion & Conclusion: In general, custom made implants are familiar and readily accepted tools in orthopaedic surgery. The only missing information is the exact relationship between the bone, the surgical planning, and the tool guides. This system is also called "semi-active" as opposed to "active" systems (robots). For these cases precise knowledge of the three-dimensional femoral shape is essential to the design and selection of adapted implants. Fit can be achieved by designing a custom-made stem adapted to the femur modified anatomy to provide optimal stress transfer. In these cases the anatomy of the hip was often modified and CT-scan studies with osteoarthritis following DDH, coxa vara and osteonecrosis showed a great individual variability with a reduced mediolateral and anteroposterior dimensions of the intramedullary femoral canal. The custom-made femoral components can be accommodated in the abnormal proximal femur and the femoral stem is ready to be implanted in a specific patient. Three criteria were used for the indication for surgery (THR): high level of chronic pain, no other possibilities of conservative surgery and major disruption in the workplace or school. We deliberately opted for cementless custom made femoral stems for the following reasons: preservation of bone stock and better adaptation to the bone morphology (all pre-operative hips were already multi operated joints with an average of four previous surgical procedures [osteotomies of the proximal femur, debridements]).