5.3 Modular neck and ceramic on ceramic coupling in revision total hip arthroplasty

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Introduction

Being able to change the geometry of the prosthesis enables the surgeon to choose intraoperatively the best configuration for the articular morphology of the patient: leg length, offset, ante-retroversion. Besides the head and the cup, the prosthetic neck may also be modular, therefore extending the range of choice for different clinical situations, in both primary and revision total hip arthroplasty. The use of a modular femoral neck and head system is one method of achieving predetermined anteversion and adjusting offset and abductor lever arm.

Besides choosing a modular implant, also the choice of material for the coupling is fundamental. Although the metal-polyethylene coupling, introduced by Charnley [5] in 1961, is currently the most commonly used, and has been performed on large number of patients with a mean follow-up of over 15 years, it has a big disadvantage: the production of polythene wear debris, which has long been known to cause loosening of the implant itself in the long term [7,8]. In an attempt to reduce the problem of wear, since the end of the 70’s research has been aimed at alternative materials such as bioceramics, which are inert, biocompatible materials, characterized by hardness and strength, which have made the problem of wear negligible. However, ceramic as a coupling material has been criticized for its fragility; the risk of breakage is increased markedly if a ceramic head is inserted on a used Morse taper. Being able to change the prosthesis neck enables the ceramic-ceramic coupling to be maintained in partial revision.

The authors tested the reliability and practicality of modular necks and ceramic-ceramic couplings in hip revision arthroplasty.

Patients

Between 1990 and 2005, we performed 785 hip revision arthroplasties; 324 complete revisions, 290 acetabular revisions, 141 stem revisions, and 30 inlay replacements. The prostheses used were AnCA-Fit (Cremascoli Ortho, Italia) with a cementless titanium anatomical stem and Profemur with a tapered revision titanium stem. Both stems have a modular neck inserted by Morse taper and a hemispheric press-fit cup. There are 2 lengths of modular neck and 5 different types: straight, varus-valgus of 8°, lateral-medial, anteversion-retroversion of 8° or 15°. The ceramic head (Biolox® Forte, CeramTec, Stuttgart, Germany) has a diameter of 28 mm and is available in three lengths: short (–3.5 mm), medium (0 mm), and long (+3.5 mm). A non-straight neck was used in 61% of cases.

No neck fractures were observed. We did not see any radiographic signs of ceramic wear. No breakage occurred in the ceramic heads and none of the modular components (head-neck, neck-stem) became disassembled. Analysis of retrieved necks confirmed the absence of corrosion.
Conclusions

Modular implants were designed because the surgeon needed to adapt the prosthesis to the anatomical characteristics of the patient, [10] both in primary and revision arthroplasty, where the joint anatomy and biomechanics can be severely affected by previous implant failure. The versatility of modular implants is helpful to the orthopedic surgeon performing revision surgery in patients with bone or soft tissue defects that can jeopardize implant stability. The higher dislocation rates of revision total hip arthroplasty are related directly to soft tissue defects and have been a major stimulus for the development of systems that provide intraoperative choices to achieve hip kinematic restoration. Being able to modify femoral anteversion, abductor lever arm and femoral offset gives the surgeon the choice of the most reliable combination and reduces the risk of joint impingement and prosthesis instability, especially in partial revisions that are more often accompanied by dislocation [3] compared with total revision.

However, doubts concerning mechanical strength and mobile neck wear are legitimate. Laboratory studies have been performed to test the fatigue strength of the modular neck. The fatigue tests performed on the Morse taper did not cause breakage at up to 20 million cycles. Also “fretting”, i.e. wear produced between two surfaces caused by micromovement, was tested in the laboratory. These tests showed a negligible production of wear particles under 1 mg. per year [4]. The special oblong and conical shape of the coupling obviates micromovement between the modular stem and neck and minimizes “fretting corrosion”[2].

In partial revision removing the mobile neck enables better exposure for revising the cup, and when the stem is stable a ceramic-ceramic coupling can be maintained without increasing the risk of breaking the head [1] (Fig. 1,2,3).

Figure 1a, b:
Cup loosening and dislocation in a 73 year-old patient.