Hip-arthroplasty - a geometric study of the primary fixation of lord prostheses

Hip arthroplasty

A geometric study of the primary fixation of Lord prostheses

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In an effort to gain some insight into the primary fixation of uncemented total hip replacements, Lord prostheses were implanted postmortem in both hips and cut into sections in a reproducible manner. The contact areas between prosthesis and bone, in the femoral as well as in the acetabular component, were studied and measured.

Primary fixation of the femoral component proved to be based mainly on incarceration of the stem of the prosthesis in the diaphysis resulting from narrowing and antecurvation of the femur. The cortical bone/prosthesis contact was limited here: at best 25 percent of the stem circumference in a few sections, but at most levels considerably less.

The contact configuration of the screwed acetabular component showed that a major part of the thread had no or only marginal contact with the acetabulum. The two acetabular rings were incarcerated between the anterior/cranial and posterior/caudal aspects of the acetabulum.

Although only two total hip replacements were studied, the results are important in view of the lack of geometric studies of uncemented fixation in the literature and in view of the emphasis placed on postoperative bone/prosthesis contact with uncemented hip replacements. In addition, the results obtained may serve as a basis of tension analyses using the finite elements method. The method of investigation used may also be employed in studying other uncemented prostheses.

Radiographic interpretation of cement-bone interlock in the femur

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Recent modifications of the technique of cementing arthroplasties – bone lavage, use of low-viscosity cement, retrograde cement injection, and pressurization – aim at improving primary fixation of the implant. Available knowledge about the cement-bone interface is still insufficient, as is the knowledge required for proper interpretation of the interface on standard radiographs. The value of conventional diagnostic radiography for assessment of the actual cement-bone interface was studied. For this purpose, seven femurs cemented in vitro and two cemented in vivo were cut into sections of 1.5-mm thickness. The cement-bone interface as depicted radiographically was compared with the macroscopic features in cross section.

Findings: 1) Due to superimposition of cancellous structures, the proximal view of the cement-bone interface on radiographs was often obscured. 2) On the radiographs, discrimination between air, blood, soft-tissue debris, and intact cancellous bone was impossible. 3) Fractured interposed trabeculae and intact cancellous bone with adequate cement contact produced similar radiographic features. 4) Porosity and coarse lamellation of the cement were not radiographically visible. All of these phenomena, which were difficult to differentiate radiographically, were quite distinct macroscopically.

Conclusion: Immediate postoperative radiographs supply virtually no information on the quality of cement-bone interlock and on important structural properties of the cement. The practical consequence is that assessment of any interface development and loosening is possible only by comparing timed series of radiographs.

A modular femur prosthesis

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Malignant tumors of the distal femur often necessitate an operation. In a joint project of the Groningen University Hospital and Twente University, work is in progress to develop a modular prosthesis system to replace the resected bone. Because the unaffected contralateral leg continues to grow, the prosthesis system should comprise a component that can be adjusted for length. The system also comprises a hip and a knee component and bone-prosthesis joints to be connected to a universal joint.

The lengthening component was first designed. The major criterion was that it should permit noninvasive phaseless lengthening up to a maximum of 72 mm. This was achieved by using an external magnetic field, which causes an internal magnet to rotate; via a screw transmission, this magnet can move two telescope parts apart.

Animal experiments have shown that the prosthesis functioned well, although moisture entered the telescope part and the prosthesis was prematurely overgrown with bone.

The next design concerned a universal joint derived from a dovetail joint.