• The design of the total knee prosthesis changed the intra-operative joint gap

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ABSTRACT INTRODUCTION:

Soft-tissue balancing of the knee is fundamental to the success of total knee arthroplasty (TKA). Preparing equal and rectangular extension and flexion joint gaps is the most important goal in TKA because this facilitates functional restoration of the knee. However, joint gap might be influenced by the design of articulating surface of total knee prosthesis. It has been difficult to assess intra-operative joint gap under the condition of trial components reduction. The purpose of this study was to compare the intra-operative joint gap of two posterior stabilized (PS) prostheses that had different shapes of articulating surface (fixed-bearing PS prosthesis and mobile-bearing PS prosthesis), using a unique tensor device (Figure 1).

METHODS:

We measured the intra-operative joint gap in 30 knees undergoing posterior-stabilized TKA. First, the femoral and patellar trial components of a fixed-bearing prosthesis were inserted. Joint gap was measured using a tensor device, which had completely the same shape as the fixed-bearing polyethylene insert (FB-PS gap). The center width and asymmetry (tilting) under 120N of distracting force were measured at 0, 30, 60, 90, 120, 145 degrees flexion of the knee with the patellofemoral joint reduced and the quadriceps tendon sutured (Figure 2). Second, the femoral and patellar trial components were changed to a mobile-bearing prosthesis, which had the same shape of chamfer but had the different articulating surface. Joint gap was measured using a tensor device, which had completely the same shape as the mobile-bearing polyethylene insert (MB-PS gap) (Figure 1).

RESULTS SECTION:

From 30 to 120 degrees flexion of the knee, MB-PS gap tended to be smaller than FB-PS gap. At 30 degrees flexion, MB-PS gap was significantly smaller than FB-PS gap (p=0.007) (Figure 3). Although the difference between the groups did not reach to statistically significance, the tilt of MB-PS gap tended to be more stable than that of PS gap through full range of motion (Figure 4).

Figure 1: The tensor device and femoral component trial of a fixed-bearing PS prosthesis (left) and a mobile-bearing PS prosthesis (right) were shown. Note that the mobile-bearing prosthesis had larger contact area both in femorotibial and cam-post articulating surface. Insert trial of fixed-bearing PS prosthesis was fixed on tensor device (left), but that of mobile-bearing PS prosthesis can rotate on the tensor device (right).

Figure 2: (A) The femoral and patellar trial components and the tensor device were inserted. Joint gap was measured using a tensor device, which had completely the same shape as polyethylene insert. (B) The center width and asymmetry (tilting) under 120N of distracting force were measured.

Figure 3: The joint gap of fixed-bearing PS prosthesis and mobile-bearing PS prosthesis was shown. At 30 degree flexion, MB-PS gap was significantly smaller than FB-PS gap (p=0.007)

Figure 4: The joint gap tilt of fixed-bearing PS prosthesis and mobile-bearing PS prosthesis was shown.

DISCUSSION:

To our knowledge, this is the first report which compared the intra-operative joint gap between two different shapes of articulating surface. This study showed that the joint gap became largest at 30 degrees flexion of the knee in both PS prostheses. This might results in mid-flexion instability of PS prostheses. However, the joint gap at 30 degrees flexion of MB-PS prosthesis was significantly less than that of FB-PS prosthesis. Our results suggested that the design of the total knee prosthesis changed the intra-operative joint gap and could reduce the mid-flexion instability.

SIGNIFICANCE:

Intra-operative joint gap of two different TKA prostheses were measured. Mid-flexion instability was significantly reduced in a mobile-bearing prosthesis comparing to a fixed-bearing prosthesis.

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