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Reliable anatomical landmarks for minimizing leg-length discrepancy during hip arthroplasty using the lateral transgluteal approach for femoral neck fracture

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ABSTRACT

Background: The purpose of this study was to describe our experience of a preoperative templating technique, and to investigate the most reliable anatomical reference to minimize leg length discrepancy (LLD) during hip arthroplasty using the lateral transgluteal approach for femoral neck fractures. We hypothesized that the medial fracture tip and greater trochanter would be viable alternative anatomical References

Methods: A total of 156 hip arthroplasty cases were enrolled in the present study (103 women, 114 hemiarthroplasties, 42 total hip arthroplasties). Preoperative acetate overlay templating was conducted based on pelvic anteroposterior radiographs. Three different anatomical references were used to determine the bony resection level, including the uppermost point of the lesser trochanter, uppermost point of the greater trochanter, and medial fracture tip. The accuracy of preoperative templating and the reliability of each anatomical reference for minimizing LLD were assessed.

Results: Significant differences in postoperative LLD after hip arthroplasty between the three groups were identified. Post-hoc analysis showed that postoperative LLD in group A was significantly larger than that in groups B or C in hip arthroplasty.

Conclusion: The results of this study suggest that the use of the lesser trochanter as an anatomical reference to determine the level of femoral neck osteotomy should be discouraged, and that the medial fracture tip and greater trochanter may be better alternatives when using the lateral transgluteal approach.

Introduction

Preoperative templating is essential to allow orthopedic surgeons to evaluate many preoperative surgical factors related to hip arthroplasty. The process enables the surgeon to assess the need for non-standard implant sizes, avoid potential size mismatches, and anticipate appropriate instruments and implants required intraoperatively [1–3]. Templating has been shown to reduce the likelihood of femoral shaft fractures, and prevents unidentified anatomical variations leading to intra-operative problems. In particular, preoperative templating helps to minimize leg-length discrepancy (LLD) by determining the bony resection level on the femoral neck and achieving an appropriate offset [1,3,4].

The lateral transgluteal approach is one of the preferred standard approaches for hip arthroplasty because it is easy to learn, provides an excellent intraoperative view, can be extended if needed, and carries a low risk of fracture [5–8]. Although the lateral transgluteal approach has some disadvantages, including the risk of neuromuscular damage to the gluteus muscles leading to subsequent abductor weakness, a lower incidence of postoperative dislocation is a major advantage [6,7]. Nevertheless, it can be difficult to perform exact femoral neck osteotomy at the level planned during preoperative templating because the lesser trochanter, an important anatomical reference for minimizing LLD, is located posteriorly during femoral neck osteotomy. This makes it difficult to use as an anatomical reference during the surgery.

Although many reports concerning preoperative templating for hip arthroplasty have been published, none have addressed the

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aforementioned problem. In addition, no study has investigated the most reliable anatomical reference for planning the bony resection level at the femoral neck during the lateral transgluteal approach. With the above in mind, the purpose of this study was to describe our experience of the preoperative templating technique, and determine the most reliable anatomical reference for minimizing LLD during hip arthroplasty using the lateral transgluteal approach for femoral neck fractures. In the present study, we hypothesized that the medial fracture tip and greater trochanter might represent good alternative anatomical References

Materials and methods

Study population and definition

This study followed the guidelines of the Declaration of Helsinki and the KGCP guidelines, and institutional review board approval was obtained. The study design was a retrospective comparative study based on consecutively collected data from a data base. Between March 2010 and December 2015, 287 hip arthroplasties were performed at our hospital for displaced femoral neck fractures. The inclusion criteria for the present study were as follows: (1) cementless hip arthroplasty performed for acute displaced femoral neck fractures, (2) use of the lateral transgluteal approach, (3) adequate pre-operative anteroposterior (AP) radiograph of the pelvis, (4) evidence of pre-operative on-screen templating by the operator, (4) adequate post-operative AP radiographs of the pelvis sufficient to assess postoperative LLD. The exclusion criteria were as follows: (1) incomplete medical records, (2) inadequate preoperative templating due to deformity, previous surgery of the contralateral hip or pathologic fracture (3) insufficient quality of post-operative AP radiographs of the pelvis to assess postoperative LLD. Total hip arthroplasty was performed in relatively healthy patients with no functional or cognitive limitations. Bipolar hemiarthroplasty was peformed when patients had low activity levels, cognitive dysfunction, neuromuscular disorders, or were aged ≥80 years [9,10].

A total of 156 hip arthroplasty cases met the above criteria (103 women; 114 hemiarthroplasties, 42 total hip arthroplasties). The mean age was 74.6 years (range, 50–96 years). A single surgeon performed all surgeries at the same institution. The acetabular component consisted of a Trilogy (n = 35) or Continuum (n = 7) cup (Zimmer, Warsaw, IN, USA) implanted using a press-fit technique. The acetabular component sizes available were 40–72 mm in diameter (at 2 mm increments). In cases of bipolar hemiarthroplasty, a Multipolar (n = 114) cup (Zimmer, Warsaw, IN, USA) was implanted. The bipolar cup sizes available were 39–60 mm in diameter (at 1 mm increments). A Cementless ML taper (n = 156) femoral stem (Zimmer, Warsaw, IN, USA) was implanted using a press-fit technique in all patients. The stem sizes available were 5–22.5 (12 different sizes), with each stem size offering a standard or extended-offset option. Actual range of acetabular component sizes, bipolar cup sizes, and femoral stem sizes used in the present study were 46–60 mm, 40–54 mm, and 5–17.5 mm, respectively.

Preoperative templating

Preoperative acetate templating on digital images was conducted using AP radiographs of the pelvis. The preoperative AP

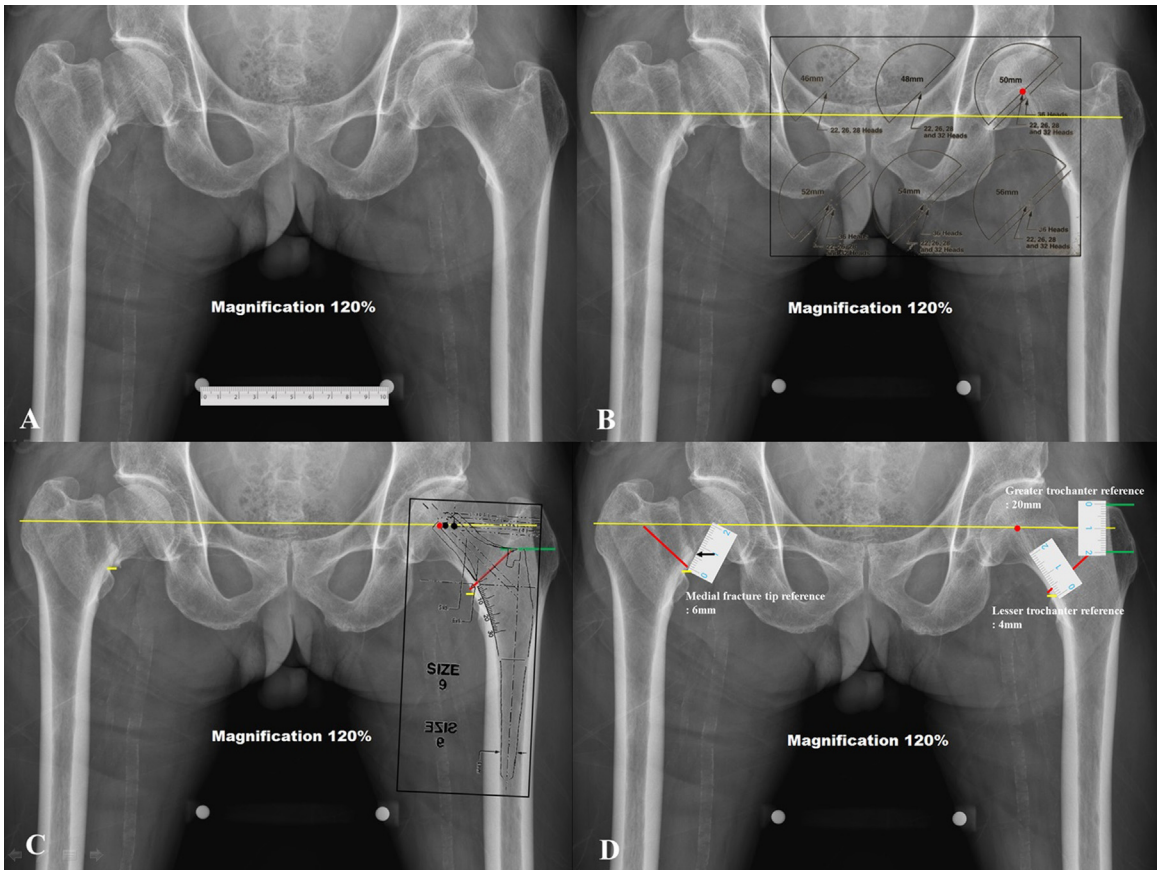

Fig. 1. Steps for preoperative templating. (A) The anteroposterior radiographs of the pelvis were magnified until the 10 cm magnification marker on the digital image measured 10 cm using the magnified ruled line. (B) Overlay acetate templates of the acetabular cup were placed on the digital images to select an appropriate implant size. (C) Overlay acetate templates of the femoral stem were placed in the same way. (D) Bony resection level was determined using three different anatomical References.

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