ABSTRACT

Purpose. To measure preoperative hip flexion under general anaesthesia in patients with developmental dysplasia of the hip and analyse its correlation with leg-length change.

Methods. 79 women and 6 men aged 27 to 82 (mean, 59) years underwent 92 total hip arthroplasties for severe developmental dysplasia of the hip of Crowe types II (n=60), III (n=17), and IV (n=15). All such patients had severe pain and/or considerable difficulty in walking and performing daily activities. 16 of the hips were treated with transverse subtrochanteric shortening osteotomy, whereas the remaining 76 had no femoral osteotomy. Preoperative passive hip flexion was measured under general anaesthesia with a goniometer by a single investigator. Its mean value in patients with Crowe type-III deformity was 60.3º. Therefore, >60º of flexion was defined as high. Postoperative leg-length change was measured radiographically. The distraction of the greater trochanter was equal to the leg-length change in patients treated with femoral osteotomy, whereas leg-length change was calculated by subtracting the amount of resection of the femur from the distraction of the greater trochanter in patients treated with femoral osteotomy.

Results. Of the 16 hips treated with a transverse subtrochanteric shortening femoral osteotomy, 2, 2, and 12 were Crowe types II, III, and IV, respectively. In these 16 hips, hip flexion was high in 10 (mean, 86º) and low in 6 (mean, 36º). Leg-length change was significantly greater in the high than low flexion groups (31 vs. 13 mm, p<0.01). In the 76 hips without osteotomy, hip flexion was high in 54 (mean, 85º) and low in 22 (mean, 40º). Leg-length change was significantly greater in the high than low flexion groups (25 vs. 19 mm, p=0.016). Preoperative hip flexion under general anaesthesia correlated with leg-length change in hips with osteotomy (r=0.850, p=0.0002) and without osteotomy (r=0.267, p=0.019).

Conclusion. Preoperative hip flexion measured under general anaesthesia may predict leg-length change after THA.

Key words: anesthesia, general; arthroplasty, replacement, hip; classification; leg length inequality; range of motion, articular
INTRODUCTION

The Crowe classification of developmental dysplasia of the hip is based on the magnitude of subluxation of the femoral head. Total hip arthroplasty (THA) for patients with severe developmental dysplasia of the hip (Crowe types III or IV [75% to 100% subluxation]) is technically demanding. Leg-length equalisation and femoral offset restoration are important for good function and patient satisfaction. Predicting the exact amount of leg-length change is difficult for patients with severe acetabular dysplasia. Preoperative planning is thus needed to determine the optimum position of the acetabular component, the level of the femoral neck resection, and the need for a simultaneous subtrochanteric shortening osteotomy or greater trochanteric osteotomy. We measured preoperative hip flexion under general anaesthesia in patients with developmental dysplasia of the hip and analysed its correlation with leg-length change.

MATERIALS AND METHODS

Between April 2008 and March 2009, 503 primary THAs were performed at our institution. Among these, 92 (18%) were for 79 women and 6 men aged 27 to 82 (mean, 59) years who had severe developmental dysplasia of the hip of Crowe types II (n=60), III (n=17), and IV (n=15). All such patients had severe pain and/or considerable difficulty in walking and performing daily activities.

Under general anaesthesia, the patients were placed in the lateral position and operated on through a posterolateral approach. 60 (65%) of the hips received structural autologous femoral head bone grafts, whereas 32 (35%) received morcellised autografts behind the acetabular component. 16 of the hips had a transverse subtrochanteric shortening osteotomy using the straight S-ROM femoral prosthesis (DePuy Orthopedics, Warsaw [IN], USA) as an intramedullary fixation device, whereas the remaining 76 hips had no femoral osteotomy. The length of possible elongation at the moment of the trial reduction was checked, and the amount of overlapping femoral shaft was resected.

Preoperative passive hip flexion motion was measured under general anaesthesia with a goniometer by a single investigator (to minimise inter-observer variability). Its mean value in patients with Crowe type-III deformity was 60.3°. Therefore, >60° of flexion was defined as high.

Postoperative leg-length change was measured radiographically. The distraction of the greater trochanter was calculated by subtracting the distance from the most proximal point of the greater trochanter to the interteardrop line as a horizontal reference on the postoperative radiograph in the supine position from the same distance on the preoperative radiograph (Fig. 1). The distraction of the greater trochanter was equal to the leg-length change in patients treated without femoral osteotomy, whereas leg-length change was calculated by subtracting the amount of resection of the femur from the distraction of the greater trochanter in patients treated with a femoral osteotomy.

The Kruskal-Wallis test was used to compare the preoperative flexion or the distraction of the greater trochanter among patients with Crowe types II, III and IV hips. The Mann-Whitney U test was used to compare the preoperative flexion, the distraction of the greater trochanter, or the leg-length change in the high and low flexion groups, and to compare the preoperative flexion or leg-length change in patients with and without an osteotomy. Correlation between hip flexion and leg-length change was evaluated using the Pearson’s correlation coefficient. A p value of <0.05 was considered statistically significant.

RESULTS

Of the 16 hips treated with a transverse subtrochanteric shortening femoral osteotomy, 2, 2, and 12 were Crowe types II, III, and IV, respectively.

Figure 1 Pre- and post-operative anteroposterior radiographs showing the distance from the most proximal point of the greater trochanter to the interteardrop line (A and B), the extent of distraction of the greater trochanter (C) and subtrochanteric shortening transverse osteotomy (arrow).
The overall mean distraction of the greater trochanter was 28 (range, -2 to 83) mm. It was 48 mm in patients with Crowe type-IV hips, which was significantly greater than those with Crowe type-II (22 mm) or -III (30 mm) hips (p<0.01). The mean leg-length change was not significantly different among patients with Crowe type-II, -III, and -IV hips (21 vs. 28 vs. 24 mm, respectively) [p=0.08, Kruskal Wallis test]. In patients with osteotomy, the mean distraction of the greater trochanter was 49 (range, 21–85) mm, whereas the mean intercalary femoral resection was 25 (range, 15–40) mm. Thus, the mean leg-length change was 24 mm. In patients without osteotomy, the mean distraction of the greater trochanter was 23 (range, -2 to 46) mm, which was equal to the leg-length change. The leg-length change was not significantly different in patients with and without an osteotomy (p=0.57).

The overall mean preoperative flexion under general anaesthesia was 70° (range, 5°–125°). It was 60.3° in patients with Crowe type-III hips, which was significantly lower than those with Crowe type-II (72°) or -IV (69°) hips (p<0.01, Kruskal-Wallis test). In the 16 hips with osteotomy, hip flexion was high in 10 (mean, 86°) and low in 6 (mean, 36°). The distraction of the greater trochanter was significantly greater in the high than low flexion groups (57 vs. 37 mm, p<0.01). Leg-length change was significantly greater in the high than low flexion groups (31 vs. 13 mm, p<0.01). Preoperative hip flexion under general anaesthesia correlated with leg-length change in hips with osteotomy (r=0.850, p=0.0002, Fig. 2) and without osteotomy (r=0.267, p=0.019).

No postoperative neurological injury or infection was encountered in any patient. Dislocation occurred once in a single patient.

DISCUSSION

In patients with severe developmental dysplasia of the hip (Crowe type IV), careful preoperative planning is needed to determine the optimum position of the acetabular component and the level of femoral neck resection, and whether a subtrochanteric shortening osteotomy is needed to achieve leg-length equality.6–8 In our study, 80% of patients with Crowe type-IV deformity were treated with femoral osteotomy, whereas 95% of patients with Crowe type-II and -III deformities were not. Patients with Crowe type-IV deformity should be treated with femoral osteotomy in order to place the socket to the level of the true acetabulum for mechanical and anatomic reasons. Even patients with lower Crowe type deformities may require THA with femoral osteotomy when the deformity and/or the soft tissue contracture is severe.

In a study measuring the anatomic range of hip motion during THA using a navigation system, the operation could significantly increase hip motion, and hip motion after implantation correlated with that before implantation, although the diagnosis, stage of OA, and Crowe classification were not related. We also measured preoperative hip flexion under general anaesthesia and hypothesised that preoperative hip flexion could affect soft-tissue contractures. Leg-length change was significantly greater in the high than low flexion groups. The soft tissues surrounding the hip joint with low flexion could be more contracted, and leg-length change might be affected by preoperative range of hip motion.

In a study evaluating leg-length change in THA with subtrochanteric femoral shortening osteotomy for Crowe type-IV developmental hip dysplasia, the mean lengthening in patients without iliofemoral OA was about 20 mm greater than that in patients with iliofemoral OA. In our study, the mean leg-length change in patients with a femoral shortening osteotomy was 17 mm greater in the high flexion group. Correlation between preoperative hip flexion under anaesthesia and leg-length change in patients without osteotomy was low, whereas it was high in patients with an osteotomy. Thus, preoperative hip flexion under general anaesthesia may predict leg-length change after THA.
There were several limitations in our study. First, positioning of the pelvis relative to the plane of the radiograph and centring of the X-ray beam may have varied. This may have ensued despite anteroposterior radiographs being standardised with controlled pelvic rotation, so that the vertical line from the symphysis to the interteardrop line and the vertical line from the middle of the coccyx to the interteardrop line were aligned. Second, the osteotomy group was relatively small (accounting for <0.3% of all THAs at our institution). Third, leg-length change could have been affected by many other factors such as age, gender, body mass index, radiographic articular features, pain, and stiffness.

REFERENCES