Curved intertrochanteric varus osteotomy versus total hip arthroplasty for osteonecrosis of the femoral head in patients under 50 years old

[1] List of abbreviations

[1] CVO, Curved intertrochanteric varus osteotomy; HHS, Harris hip score; JHEQ, Japanese Orthopaedic Association Hip-Disease Evaluation Questionnaire; MCS, Mental Component Summary; OHS, Oxford hip score; ONFH, Osteonecrosis of the femoral head; PCS, Physical Component Summary; PRO, Patient-reported outcomes; RCS, Role/Social Component Summary; ROM, Range of motion; THA, Total hip arthroplasty

Abstract

Background: Given recent advances in total hip arthroplasty (THA), curved intertrochanteric varus osteotomy (CVO) is not indicated as a treatment for osteonecrosis of the femoral head (ONFH), unless maintaining long-term hip function and patient satisfaction. We aimed to compare the clinical outcomes of CVO with those of THA for treatment of ONFH in young adults <50 years old.

Methods: This comparative study included 105 ONFH patients: 59 patients, 67 hips who underwent CVO and 46 patients, 56 hips who underwent THA. Assessment tools included the Harris hip score (HHS), patient-reported outcomes of the Short Form 36 (SF-36), Oxford hip score (OHS), Japanese Orthopaedic Association Hip-Disease Evaluation Questionnaire (JHEQ), University of California Los Angeles (UCLA) score, together with complication and survival rates.

Results: Preoperative HHS was significantly higher in the CVO group than the THA group. ($p<0.01$) No between-group differences were noted in HHS or the following patient-reported outcomes at last follow-up: all domains of JHEQ scores, OHS, and SF-36. UCLA scores and complication rates were comparable: 3% for the CVO and 7% for the THA group. The 10-year survival rate with surgery for any reason as the endpoint was comparable, at 91.8% for the CVO and 97.7% for the THA group.

Conclusion: Functional outcomes, survival rate, and sporting activities for patients <50 years old undergoing CVO or THA for ONFH were comparable at a mean follow-up of 10 years. Strict indications for CVO can help maintain hip function and patient satisfaction equivalent to that for THA, in the long term.

Keywords: osteonecrosis of the femoral head, curved intertrochanteric varus osteotomy, total hip arthroplasty, comparative study

Introduction

Osteonecrosis of the femoral head (ONFH) is defined as collapse of the femoral head, with secondary osteoarthritis leading to severe hip pain and restriction in daily activities [1, 2]. ONFH often occurs in young adults and requires early intervention, which makes treatment choice difficult [3]. Although total hip arthroplasty (THA) is the most widely used surgical procedure for the treatment of ONFH [4], high rates of revision surgery and of complications have been reported for this operation [5]. Therefore, joint preservation surgery might be preferred for ONFH patients aged <50 years.

Curved intertrochanteric varus osteotomy (CVO) was developed as a treatment for osteoarthritis secondary to acetabular dysplasia, and several studies have reported favorable clinical outcomes for its use in ONFH [6-8]. CVO was indicated in patients who could obtain coverage of more than one-third of the weight-bearing area with an intact articular surface, based on preoperative anteroposterior radiographs of the hip in maximum abduction [6, 8, 9]. CVO is a relatively simple surgical procedure; it prevents weakening of the gluteus medius and minimus muscles as well as leg-length discrepancy, which are disadvantages of conventional varus wedge osteotomy [7].

The choice of treatment for ONFH in young adults is controversial. While there have been recent advances in THA, leading to good postoperative outcomes, it is not clear whether this is the case for adults aged <50 years. It is important to prioritize procedures, including joint preservation surgery, that allow long-term maintenance of hip function and patient satisfaction. Thus, this study aimed to compare the clinical outcomes of CVO and THA for ONFH patients aged <50 years.

Patients and Methods

Design

This study was based on a retrospective chart review and was approved by our Institutional Review Board. All patients provided their written informed consent to participate. The study included 216 patients who consecutively underwent CVO (96 patients) or THA (110 patients) for non-traumatic ONFH between January 1999 and May 2014. Seventy-two patients aged >50 years were excluded. Of the remaining 143 patients, 31 who underwent different operations for each hip and eight who could not be observed for more than five years were also excluded. Therefore, the CVO group finally consisted of 59 patients (36 men and 23 women; 65 hips; mean age, 37.7 (range, 18–49) years), while the THA group comprised 46 patients (28 men and 18 women; 56 hips; mean age, 39.2 (range, 17-49) years) (Figure 1). The patients in each group were followed for a mean duration of 11.5 (range, 5-18) years and 10.7 (range, 5-18) years, respectively. Six patients (10%) in the CVO group and 10 patients (22%) in the THA group had bilateral CVO or THA. The stage and type of ONFH were classified as described by the Japanese Investigation Committee of the Ministry of Health, Labour and Welfare [10]. In the CVO group, 19 hips were stage 2 (sclerosis without femoral head collapse), 29 were stage 3A (femoral head collapse of <3 mm), and 17 were stage 3B (femoral head collapse of >3 mm). In the THA group, stage 3B comprised 15 hips and stage 4, 41 hips. Seven hips were type B, 44 type C1, and 14 type C2 in the CVO group; while five hips were type B, 19 type C1 and 32 type C2 in the THA group. No significant differences in sex, age, body mass index or follow-up duration, except for stage and type classification, were found between the groups (Table 1).

Surgical indication and technique

In general, joint preservation surgery is indicated for patients under 50 years old. CVO was performed in patients who could obtain coverage of more than one-third of the weight-bearing area with an intact articular surface, based on preoperative anteroposterior radiographs of the hip in maximum abduction. If there was no other indication for CVO and there was an intact articulating circumference exceeding one-third of the entire circumference in Lauenstein's view, we selected transtrochanteric rotational osteotomy [11]. THA was selected for patients in whom there was no indication for, or who did not wish to undergo, joint preservation surgery, and also for cases with stage 4 ONFH.

The operative technique of CVO has been described previously [6, 9]. Briefly, an osteotomy guide is attached to a line from the top of the greater trochanter to a point 2–3 mm above the middle of the lesser trochanter. After performing the curved osteotomy, the femoral head is rotated into a varus position by displacing the femoral neck in the cranial direction. The femoral head is then stabilized using two or three screws, or compression hip screws. Patients are allowed to walk with 10-kg partial weight bearing, using two crutches, from the first day after surgery. Full-weight bearing is allowed at 10–12 weeks post-surgery.

THA was performed in all patients using a standard posterior approach, with the patient in the lateral decubitus position. The type of implant in the THA group was the Super Secur-Fit stem in 36 hips, the Secur-Fit stem in 14, the Omnifit C stem in six, the Trident HA cup in 40, the TriAD HA cup in 11 and the Secur-Fit AD cup in five (all implants were Stryker Orthopedics, Mahwah, NJ). Generally, walking practice with full-weight bearing was allowed. All CVO and THA procedures were performed or supervised by a single senior surgeon.

Measurements

We evaluated hip function using the Harris Hip Score (HHS) and range of motion (ROM) preoperatively and at the final follow-up. Patient-reported outcomes (PRO) were evaluated using the Japanese version of the Short Form-36 (SF-36) [12, 13]. Oxford Hip Score (OHS) [14], and Japanese Orthopaedic Association Hip-Disease Evaluation Questionnaire (JHEQ) [15] for health status. Scores for the Physical Component Summary (PCS), Mental Component Summary (MCS), and Role/Social Component Summary (RCS) domains of the SF-36 were evaluated. The OHS is scored in a range from 0 (worst) to 48 (best), as reported by Murray et al. [16] The JHEQ consists of three components: pain, movement, and mental health. Each component is scored in a range from 0 (worst) to 28 (best). The total score therefore ranges between 0 (worst) and 84 (best). In addition, assessment by the University of California, Los Angeles (UCLA) score was performed to assess patient sports activity [17]. When the assessment questionnaires were sent to the patients after the last follow-up, the response rate was 86% (51/59) for the CVO group and 91% (42/46) for the THA group. The overall response rate was 89% (93/105).

Statistical analysis

Statistical analysis was performed with SPSS version 21 (IBM Corp., Armonk, NY, USA). The analyses consisted of Student's t-test for continuous variables, the Mann-Whitney U test for non-continuous variables, and Fisher's exact test for categorical variables. Survival rates were examined using the Kaplan–Meier method with any reason due to revision surgery as the endpoints. The groups were compared

using a log-rank analysis. P-values less than 0.05 were considered statistically significant.

Results

Our findings indicated a significant difference in preoperative HHS, when comparing the CVO (70.2 ± 9.6) and THA groups (59.6 ± 5.8) ($p < 0.01$). However, the HHS at final follow-up showed no such difference (CVO 88.2 ± 9.1 and THA 91.6 ± 7.4). However, pain score of HHS tended to be poorer in the CVO group than in the THA group. With regard to the range of motion (ROM), preoperatively all ROMs expect for adduction, were significantly greater in the CVO than the THA group (all $p < 0.01$). Postoperatively, the ROM in abduction was significantly greater in the THA than the CVO group ($p < 0.01$; Table 2). No between-group differences were noted at the last follow-up, with regard to any domain of the SF-36, OHS, and JHEQ scores. Pain score of JHEQ tended to be poorer in the CVO group than in the THA group. In addition, the UCLA score at the last follow-up showed no significant differences between the CVO (4.9 ± 1.8) and THA groups (5.1 ± 1.9) (Table 3).

No between-group difference in the rate of complication was found. There were two cases of peri-implant fracture in the CVO group, and one case of infection and periprosthetic fracture plus two cases of dislocation in the THA group. Conversion operations to THA due to secondary osteoarthritis were performed in five patients in the CVO group, and revision surgery was required in two cases in the THA group (one case of periprosthetic fracture and one case of aseptic loosening). The 10-year survival rate with reoperation as an endpoint (Figure 2) was 91.8% for the CVO group and 97.7% for the THA group at 10 years ($p = 0.532$).

Discussion

Treatment selection for ONFH in patients <50 years old, especially in younger adults, is controversial. Previous reports demonstrated poor clinical outcomes of THA for ONFH because ONFH patients were relatively young, and highly active [4]. With the recent progress in THA, favorable long-term results in ONFH patients <50 years old have been reported [18, 19]. However, recent reports showed that the rate of revision surgery is higher in ONFH than in osteoarthritis [20]. In addition, the Norwegian registry demonstrated poor clinical results of THA for younger adults, and the possibility of multiple future revision operations should be considered [21]. The use of osteotomy for ONFH has been declining in recent years [22] because it does not always provide good long-term results [23]. However, favorable clinical outcomes for CVO, mainly in Japan, have been reported [6-8]. In this study, the joint survival rate in the CVO group was 91%, with reoperation as the endpoint, and we believe that this procedure may have played a significant role in joint preservation (Figure 3).

Previous reports demonstrated that poor clinical outcomes when postoperative coverage is less than 33.4-40% [6-8]. Therefore, in general, CVO is indicated in patients who could obtain coverage of more than one-third of the weight-bearing area with an intact articular surface, based on preoperative anteroposterior radiographs of the hip in maximum abduction. In our previous study, the 10-year survival rate of 47% with Type C2 ONFH as the endpoint of radiographic failure was poor [7], so only Type B and C1 ONFH, who could obtain coverage of more than one-third of the weight-bearing area with an intact articular surface, are currently indicated for this method. As other risk factors, Okura et al. reported poor treatment outcomes for dysplaitic hips with a CE

angle of less than 25 degree [7]. Kubo et al. reported that the presence of anterior necrotic lesion was a risk factor for osteoarthritis changes [24]. Careful consideration should be given to the indication of CVO to prevent future progression of osteoarthritis.

There have been few reports on PRO of osteotomy for ONFH. Seki et al. reported no significant difference in SF-36 results between THA and osteotomy for ONFH in a cross-sectional study [25]. Kubo et al. evaluated trochanteric rotational osteotomy and THA and reported no significant difference in postoperative PRO at 1 year [26]. In our study, there was almost no difference in patient-reported hip function, nor in satisfaction between the two groups. We believe that favorable hip function can be maintained in the long term if the CVO indication is strictly selected. However, the CVO group showed slightly poor outcomes with regard to pain score of JHEQ as well as pain score of HHS, which we considered possibly due to secondary osteoarthritis; although the difference was not statistically significant.

Previous studies demonstrated that 64%-74% of patients who underwent THA participated in sports [27, 28] and the postoperative UCLA score after THA was 6.6-6.9 [29, 30]. In the present study, UCLA score after THA (5.1) was poor compared to reported UCLA scores in previous studies. In contrast, almost no study has reported on the sporting activities of ONFH patients post-osteotomy. According to our results, the UCLA score of the CVO group was almost equivalent to the THA group. However, outcomes related to sporting activities were not good in either group. We believe that the scores may have been affected by the characteristics of ONFH patients with alcoholic backgrounds, and by primary pathology caused by steroid use. It is also possible that sporting activities were voluntarily restricted due to concerns regarding the risk of reoperation and complications. Therefore, patient guidance was considered

necessary to obtain greater patient satisfaction after hip surgery for ONFH.

There are several limitations to this study. First, the number of patients in this study were small and a greater number of patients would have been preferable to increase the statistical power. However, ONFH is a rare disease, and its annual incidence in Japan has been reported to be an average of 2.51 cases per 100000 persons [31], it is difficult to collect many patients. Second, there may be a significant difference in preoperative HHS because of differences in disease stage and ONFH classification between the groups. However, previous reports demonstrated the postoperative outcomes of THA due to differences in stage, were similar except for ROM [32]; therefore, we believe the final outcome was not significantly affected. Furthermore, preoperative PRO could not be evaluated in this study; a previous study reported that PRO was significantly poorer in the more severe stages [3] but preoperative PRO was poorer in the THA than the CVO group.

Recent advances in THA have resulted in many favorable long-term outcomes for ONFH [18, 19, 33], while registries have poor THA outcomes in younger adults, and the risk of multiple future revisions must be considered [21]. Therefore, we consider joint preservation surgery to be the first choice for ONFH in adults less than 50 years old. However, revision THA after CVO is technically difficult due to anatomical deformity [34], and recovery of muscle strength and ROM is inferior to that after primary THA, due to contracture following reoperation [35]. Consequently, operative indications should be strictly followed when performing CVO, and if osteoarthritis develops after CVO, careful attention paid to the timing of conversion to THA.

In conclusion, the clinical results of CVO and THA for ONFH in patients less than 50 years old were almost equivalent. Strict operative indications for CVO can ensure

maintenance of hip function and patient satisfaction equivalent to THA in the long term.

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