The Journal of Arthroplasty xxx (2016) 1–5

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Original Article

Total Hip Arthroplasty After Periacetabular and Intertrochanteric Valgus Osteotomy

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ARTICLE INFO

Article history:
Received 13 April 2016
Received in revised form
28 July 2016
Accepted 18 August 2016
Available online xxx

Keywords:
periacetabular osteotomy
rotational acetabular osteotomy
eccentric rotational acetabular osteotomy
intertrochanteric valgus osteotomy
total hip arthroplasty
quality of life

ABSTRACT

Background: We performed periacetabular osteotomy (PAO) combined with intertrochanteric valgus osteotomy (TVO) to obtain better congruity for patients with acetabular dysplasia and nonspherical femoral head. These patients with PAO-combined TVO demonstrate long-term progression of osteoarthritis, thereby, needing conversion to total hip arthroplasty (THA) and is difficult due to morphological changes. The objective of the present study was to investigate outcomes of patients who underwent THA after PAO-combined TVO.

Methods: We performed 3 groups' case-control study. The participants were 20 patients (20 hips) who underwent THA after PAO-combined TVO (PAO-TVO group); these patients had a mean age at surgery of 56.3 years and underwent postoperative follow-up for a mean period of 6.8 years. For the control group, we included 53 patients (57 joints) who underwent THA after PAO and 76 patients (80 joints) who underwent primary THA for hip dysplasia matching age, sex, and time of surgery.

Results: Harris hip score at the last follow-up was significantly poorer in PAO-TVO group compare with PAO group and primary group. Short Form-36 of Physical Component Summary was significantly poorer in PAO-TVO group compared with primary group. The socket position in the PAO-TVO group was significantly superior and lateral compared with that in the primary THA group. Considering socket placement in Lewinnek's safe zone and stem malalignment, there were no significant differences in the 3 groups.

Conclusion: Harris hip score and Short Form-36—Physical Component Summary for THA after PAO-combined TVO were significantly poorer compared to those of primary THA.

Various types of periacetabular osteotomy (PAO) are considered to prevent the progression of osteoarthritis in young patients with acetabular dysplasia [1-4]. We previously developed a type of PAO, known as eccentric rotational acetabular osteotomy (ERAO) [4], as an improved version of rotational acetabular osteotomy (RAO) [2] and reported favorable long-term outcomes in patients with pre-osteoarthritis and early osteoarthritis [5]. For patients with a nonspherical femoral head and poor congruity in maximum hip abduction, we reported significantly poor results of ERAO combined with intertrochanteric valgus osteotomy (TVO) [5,6]. Some patients who undergo PAO combined with TVO demonstrate long-term progression of osteoarthritis and eventually require total hip arthroplasty (THA). When THA is performed after failed osteotomy, morphological changes are reported to complicate the surgical technique [7-11]. Therefore, we hypothesized that THA after PAO combined with TVO is a difficult surgery with poor clinical outcomes and quality of life (QOL).

From the above perspectives, we conducted the present study to determine the clinical outcomes, QOL, and radiographic findings for patients who underwent THA after PAO combined with TVO, THA after PAO alone, and primary THA.

Patients and Methods

This study was based on a retrospective chart review and was approved by the institutional review board. All patients provided

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to http://dx.doi.org/10.1016/j.arth.2016.08.023.

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http://dx.doi.org/10.1016/j.arth.2016.08.023
0883-5403/

written informed consent to participate. The study included 21 patients (21 hips) who consecutively underwent THA between April 1990 and April 2015 because of the progression of osteoarthritis after PAO combined with TVO (PAO-TVO group). One patient (1 hip) who died during the follow-up period because of causes not related to surgery was excluded. Thus, the PAO-TVO group finally comprised 20 patients (20 hips). The types of PAO included ERAO [4] performed for 12 hips at our institution and RAO [2] performed for 8 hips at other hospitals. There was 1 man (1 hip) and 19 women (19 hips) with a mean age of 56.3 years (range, 41-80 years) at the time of THA. All patients were followed up for a mean duration of 6.8 years (range, 1-22 years; Table 1). The mean age at the time of PAO combined with TVO was 45.8 years. The mean interval between PAO combined with TVO and THA was 13.6 years (range, 1-23 years).

We also scanned the hospital records to identify patients who underwent THA after PAO alone (PAO group) and formed a control group of 54 patients (58 hips). One patient (1 hip) could not be followed up. Thus, PAO group finally comprised 53 patients (57 hips). Another control group (primary THA group) of patients who underwent primary THA was formed in a similar manner. Patients were matched by age (±2 years), sex, and the time of PAO-TVO surgery (±1 year). We searched the hospital records to identify 76 patients (80 hips) with no history of osteotomy who underwent primary THA for Crowe type I/II hip dysplasia. Thus, we designed a case-control study involving 3 groups. All THA procedures were performed by a single senior surgeon or by junior surgeons under the guidance of a senior surgeon.

THA in all patients was performed using a standard posterior approach with the patient in the lateral decubitus position. To place the socket at a precise angle, we placed an Urushitani guide on the pelvis [12] at an inclination of 45° and anteversion of 20°.

With regard to the type of sockets used in the PAO-TVO group, cementless sockets were used in 19 patients and a cemented socket was used in 1. For preoperative planning, the socket was placed as close as possible to the anatomical hip center. Autologous bone grafting was performed from the femoral head for patients with a high hip center after PAO. Bone grafting was performed for 5/20 (25%) patients in the PAO-TVO group, 11/57 (19%) patients in the PAO group, and 10/80 (13%) patients in the primary THA group. The sockets comprised Trident HA (Stryker Orthopedics, Mahwah, NJ) for 10 hips, TriAD HA (Stryker Orthopedics) for 3 hips, Secur-Fit AD (Stryker Orthopedics) for 2 hips, dual geometry microstructured cups (Stryker Orthopedics) for 3 hips, and all-polyethylene acetabular cups (Stryker Orthopedics) for 2 hips.

With regard to the type of stems used in the PAO-TVO group, cementless stems were used as a rule for all patients (n = 19) except one with Dorr type C femoral bone with an expanded medullary cavity, who received a cemented stem. Super Secur-Fit (Stryker Orthopedics), Omnifit (Stryker Orthopedics), and Exeter (Stryker Orthopedics) stems were used for 16, 3, and 1 hip, respectively.

Table 1
Patients Demographics.

	PAO-TVO Group (n = 20)	PAO Group (n = 57)	Primary Group (n = 80)	*P* Value
Number of patients	20	53	76	—
Sex (male/female)	1/19	2/51	4/72	.924
BMI (kg/m^2)	23.5 ± 4.3	24.0 ± 4.1	24.1 ± 3.7	.616
Age at THA (y)	56.3 ± 8.5	56.4 ± 6.3	56.7 ± 9.7	.571
Duration PAO to THA (y)	13.6 ± 6.9	11.4 ± 6.8	—	—
Follow-up (y)	6.8 ± 6.4	5.7 ± 3.3	6.7 ± 6.4	.701

PAO, periacetabular osteotomy; THA, total hip arthroplasty; BMI, body mass index; TVO, intertrochanteric valgus osteotomy.

There were no significant differences in age, sex, the body mass index, or the follow-up duration among the 3 groups ($P = .924$, .616, .571, and .701) (Table 1).

Clinical Evaluation

We investigated the medical records of patients to determine the surgical duration, intraoperative blood loss, and postoperative complications such as infection, deep vein thrombosis, dislocation, and nerve palsy. Hip function was evaluated using the Harris hip score (HHS) and range of motion (ROM) before surgery and at the last follow-up. Both HHS and ROM were annually assessed by a single senior surgeon.

QOL Evaluation

QOL was evaluated using the Japanese version of the Short Form-36 (SF-36) questionnaire for health status [13,14]. Questionnaires were sent to all patients after the last follow-up. The response rate was 85% (17/20) for the PAO-TVO group, 84% (48/57) for the PAO group, and 90% (72/80) for the primary THA group. The overall response rate was 88% (138/157). We evaluated scores for the Physical Component Summary (PCS), Mental Component Summary (MCS), and Role/Social Component Summary domains of SF-36.

Radiographic Evaluation

For radiographic evaluation, we used anteroposterior images of the hip in a decubitus position that were obtained from a distance of 1.1 m, with the pubic symphysis at the center. Socket inclination, socket anteversion, and hip joint center, were measured using digital frontal images of the hip obtained from electronic medical records (NeoChart Hospital Information System; Fujitsu, Tokyo, Japan). Anteroposterior images of the hip were magnified (×300) to assess the above items. Socket anteversion was evaluated using Lewinnek's measurement method [15]. The socket position was evaluated by assessing the percentage of sockets positioned within Lewinnek's safe zone in each group [15]. The line connecting both teardrops was used as a reference for measuring the vertical and horizontal distances from the teardrop on the affected side to the hip joint center, in accordance with a report by Kiyama et al [16] (Fig. 1). These calculated values were corrected using the prosthetic femoral head size (as written in medical records) as a reference. Stem alignment was evaluated as a deviation of more than 2° from the longitudinal femoral axis, in accordance with a report by Breusch et al [17]. Image measurements were performed 3 times by 2 surgeons, and the median value was used. In order to assess the reliability of these measurements, 20 hips were randomly selected and assessed by 2 surgeons. Interrater reliability values for the measurement of socket inclination, socket anteversion, and vertical and horizontal distances to the hip joint center were 0.927, 0.787, 0.862, and 0.803, respectively.

Statistical Analysis

Statistical analyses of data for the 3 groups were performed using SPSS version 21 (IBM Corp, Armonk, NY). Data were analyzed using analysis of variance, Tukey's test, and Pearson's chi-square test as appropriate. The level of significance was set at 0.05.