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ORIGINAL ARTICLE

Functional Outcome following Revision Hip Arthroplasty with Complex Femoral Reconstruction. A self-reported outcome analysis

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ABSTRACT

Purpose: There is not enough information in the literature regarding the functional outcome after major hip revision surgeries. This study presents a self-reported outcome analysis of 37 patients following a complex hip revision arthroplasty performed with an extended trochanteric osteotomy (ETO).

Materials and Methods: Pre- and post-operative data were collected from an electronic database with a 2-year minimum follow-up. For this purpose, standardized questionnaires with emphasis on physical function, patient satisfaction and expectations, were used. Statistical analysis was performed to compare pre- and post-operative scores and to assess any relationship between score changes and certain factors.

Results: Self-reported outcome analysis revealed a significant improvement ($p<0.001$) in total Harris Hip Score (76.34 versus 48.03), and Western Ontario & McMaster Universities Osteoarthritis Index scores (pain: 2.27 versus 10.00, function: 15.58 versus 30.96, summary: 20.27 versus 44.58) post-operatively. Six out of eight subcategories of 36-Item Short-Form Health Survey demonstrated a significant upgrade postoperatively. Univariate analysis revealed that Charnley class B & C patients improved significantly less in five out of eight SF-36 items; whereas age, gender, BMI, number of previous revisions, degree of femoral bone loss and stem design had no influence on score improvement in any of the outcome measures ($p>0.05$). Satisfaction rate was high (92%).

Conclusions: Complex hip revisions provide good mid-term functional results and good satisfaction rates. However, patients should be advised not to have unrealistic expectations regarding their post-operative activity level. Further high-quality prospective studies are needed to establish the long-term functional outcome of hip revisions using ETO.

KEY WORDS: hip revision arthroplasty; extended trochanteric osteotomy; ETO; functional outcome; outcome analysis

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Introduction

The number of patients requiring revision total hip arthroplasty (THA) is constantly rising [1]. Such revision procedures can be quite complex and technically demanding. In order to perform a successful revision THA a surgeon needs a pre-operative plan for adequate operative exposure, removal of the implanted prosthesis and final reconstruction. Extended Trochanteric Osteotomy (ETO) is a well-established technique that facilitates removal of both cemented and uncemented prostheses [2].

The advantages of ETO are well known; it is a safe and reliable surgical technique that allows for excellent exposure of the femoral canal with preservation of soft-tissue attachments to the trochanteric bone and easy access to the femoral component, whilst causing minimal damage to the femoral bone stock, and also decreasing the operative time and facilitating exposure of the acetabulum [3,4]. The ETO also has predictable healing when used with extensively porous-coated implants and has shown decreased non-union rates as compared to previous trochanteric osteotomy techniques [2,5-8].

Total hip revisions are usually indicated in elderly patients and therefore one can wonder if the benefit/risk ratio for this aging population, with several comorbidities, can justify such an extensive hip surgery. Functional outcome following primary total hip replacement has been extensively reviewed in several older and more recent studies; there has been reported a significant improvement in most outcome measures regarding pain, physical function in daily activities and patient satisfaction [9-12]. In contrast, it is generally accepted that major hip revisions are accompanied with higher complication rates and therefore functional outcome is expected to be inferior to that after a primary hip arthroplasty [13-15]. To the best of our knowledge, there are no published studies presenting the functional results following complex hip revision arthroplasties, performed through a femoral reconstruction by means of an ETO.

The purpose of this study was to assess the functional outcome after a total hip revision arthroplasty with complex femoral reconstruction, using a self-reported outcome analysis with standardized questionnaires emphasizing on physical function and patient satisfaction and expectations.

TABLE 1.

Characteristics of participants

Characteristics	**Patients**
Patients, n	37
Age, y (mean)	69.1 +/- 9.8
Gender	12 male : 25 female
Charnley Functional Classification	Charnley Function Class A: 11 (30%) Charnley Function Class B or C: 26 (70%)
Previous ipsilateral hip revision (> 1)	Yes: 15(40%) No: 22 (60%)
Mallory classification	**Mallory type I: 7** **Mallory type II: 14** **Mallory type IIIA-B: 16 (43%)**
Revision of femoral component only	11 (30%)
Revision of both components	26 (70%)
Stem used	Modular uncemented: 20 (54%) Monoblock uncemented: 17 (46)%

n=number of patients, y = years

Materials and Methods

Between 2013 and 2017, 37 consecutive patients underwent a revision THA with complex femoral reconstruction for a failed hip arthroplasty using an ETO [2,3]. All hips were operated by the senior surgeon at one institution. The characteristics of the participants are summarised in Table 1 (Table 1). There were 12 male and 25 female patients, with a mean age at the time of index operation of 69.1 (SD: 9.8) years. Regarding the functional status as per Charnley Functional classification [16,17], 11 patients (30%) were Charnley Function Class A, and 26 patients (70%) Charnley Function Class B or C. The mean follow-up was 41 months (range: 24-73 months). No patient was lost to follow-up. Fifteen of the patients (40%) had undergone more than one previous ipsilateral hip revisions. The Mallory classification was used to assess and grade pre-operative femoral bone loss [18]. Seven hips (19%) were

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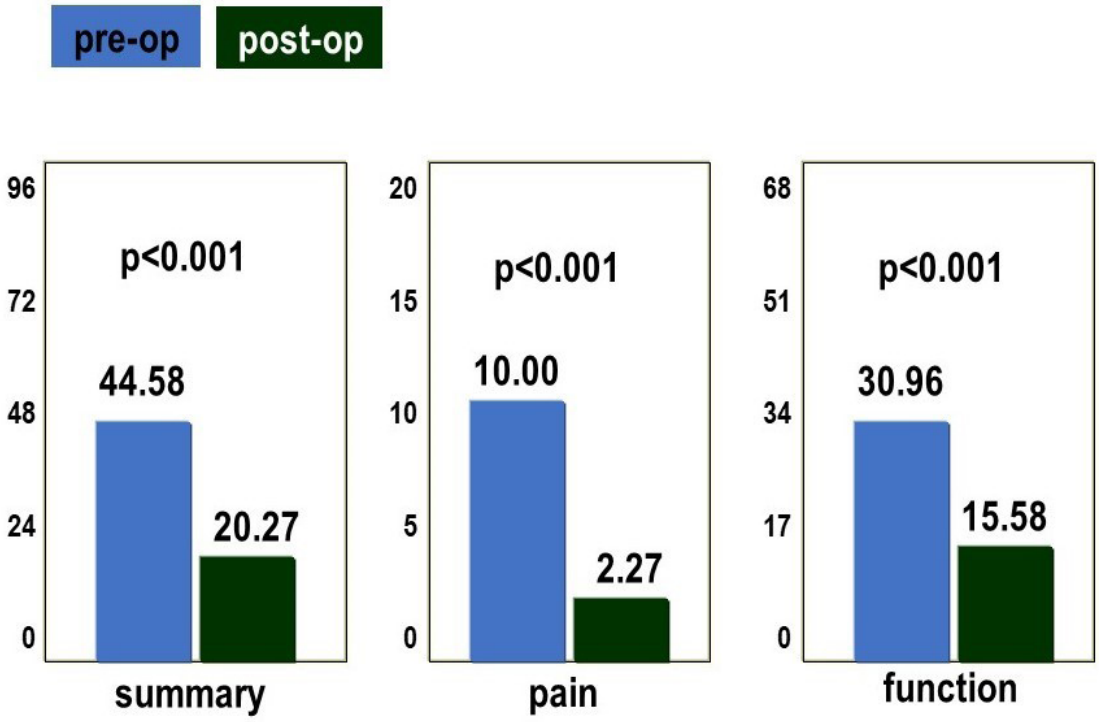

Figure 1

graded as Mallory type I, 14 hips (38%) as type II; and 16 hips (43%) as type IIIA-B. Eleven hips (30%) had loosening and revision of the femoral component only, and 26 hips (70%) had loosening and revision of both components. A combined anterior and posterior approach was used in all cases. An uncemented long revision stem was used in all cases. Twenty patients (54%) received a long modular stem (ARCOS Modular Femoral Revision System, Zimmer Biomet), and in the remaining 17 femurs (46%) a monoblock stem was implanted (ARCOS One-Piece Femoral Revision System, Zimmer Biomet).

Pre- and post-operative data were derived from an electronic database (Patient Analysis & Tracking System – PATS version 2.06, AXIS Clinical Software, Inc, Portland OR) with a 2-year minimum follow-up. Outcome measures were standardised health questionnaires with emphasis on physical function, patient satisfaction and expectations and these were:

- Harris Hip Score (HHS) [19]: used as measure of functional outcome specific to the hip. It has ten items covering four domains: pain (0-44 points), function (0-47 points), absence of deformity (0-4 points), and range of motion (0-5 points). The best score is 100.
- Western Ontario & McMaster Universities Osteoarthritis Index (WOMAC) [20]: used to evaluate the condition of patients with osteoarthritis (OA) of the knee and hip. It evaluates pain, stiffness and physical functioning of the joints with 24 questions. Five questions for pain (0-20 points), 7 for stiffness (0-8 points) and 17 for functional limitation/disability (0-68 points). The best score is 0 and the worst score is 96.
- 36-Item Short-Form Health Survey (SF-36) [21]: used as measurement of general health status. It is a 36-item questionnaire that generates scores for 8 dimensions/subcategories that evaluate mental health and physiological and social functioning: physical function, role limitation due to physical problems, role limitation due to emotional problems, social functioning, mental health, vitality, bodily pain, general health perception. The best score is 100.

Radiographic follow-up included recording of

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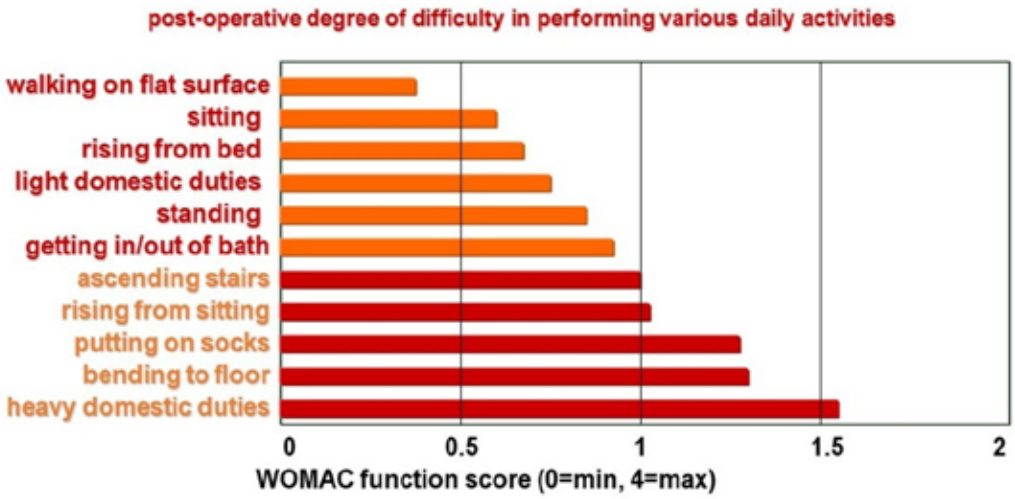

Figure 2

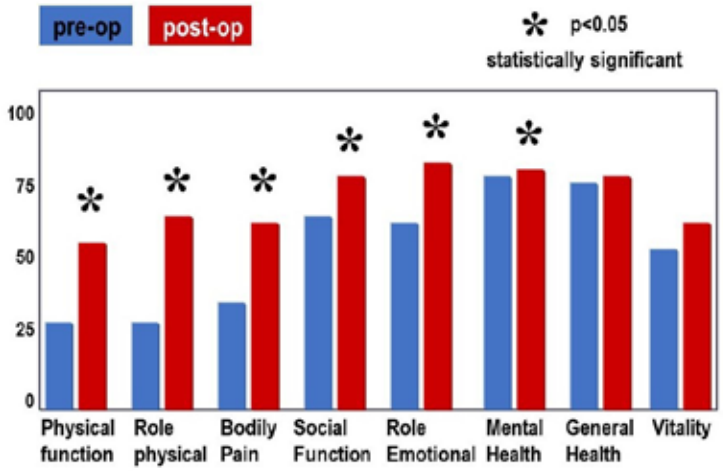

Figure 3

the following parameters: time to radiographic union, incorporation of the strut allograft used for the femoral reconstruction and presence of superior trochanteric migration >2mm. Complications were also recorded including femoral component loosening, instability, infection, intraoperative fracture and re-operations.

Statistical analysis

Statistical analysis was performed using SAS software (Statistical Analysis System, Version 5). Paired t-tests were used to compare pre-operative and post-operative scores. One-sample t-test was used to assess any relationship between score changes and each one of the following factors: (i) Age, (ii) Gender, (iii) BMI, (iv) Associated co-morbidities, (v) Number of previous revisions, (vi) Follow-up duration, (vii) Grade of femoral bone defects, (viii) Stem design, (ix) Proximal migration of cut segment. A p value < 0.05 was considered statistically significant.

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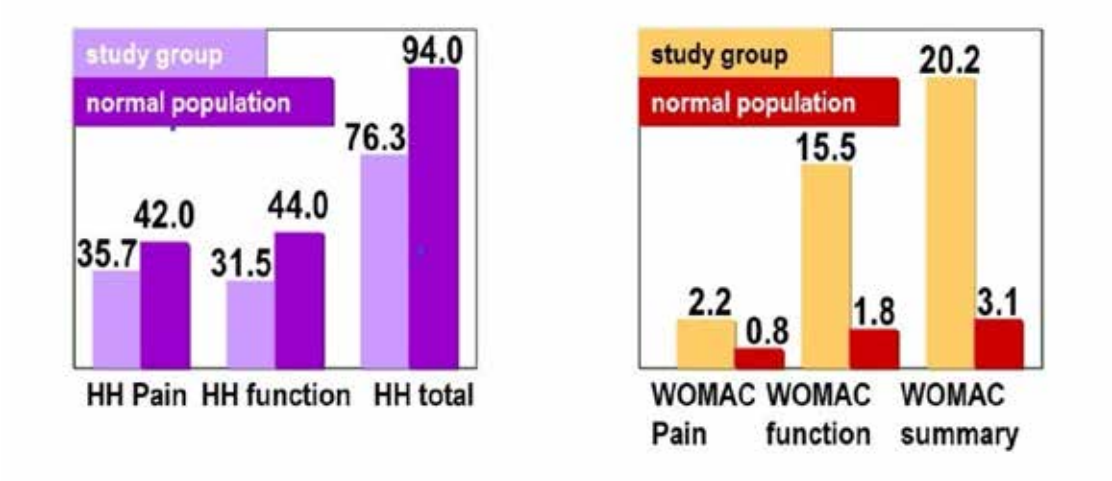

Figure 4

Results

Functional results - Self-reported outcome analysis

Total HHS: The post-operative HHS (mean:76.34, SD:17.54) was significantly improved (p<0.001) as compared to the pre-operative HHS (mean:48.03, SD:16.36).

WOMAC score: Fig. 1 shows the pre- and post-operative values for WOMAC score overall, but also especially for pain and function. The post-operative WOMAC score overall (mean:20.27, SD:17.95) was significantly improved (p<0.003) as compared to the pre-operative score (mean:44.58, SD:16.37). Analysing further the WOMAC score, post-operatively the WOMAC pain score (mean:2.27, SD:3.78) and the WOMAC function score (mean:15.58, SD:14.13) were also significantly improved (p<0.001) as compared to the pre-operative scores for pain (mean:10.00, SD:4.44) and function (mean:30.96, SD:12.08) respectively.

Regarding the post-operative activity level, it was easier for the patients to perform some daily activities like walking on a flat surface, sitting, rising from bed or doing light domestic duties. Most patients, though, continued to experience difficulty during various daily activities such as putting on socks, bending to floor or performing heavy domestic duties. This is demonstrated in Fig. 2.

SF-36: The mean scores of six out of the eight dimensions of the SF-36 Health Survey were significantly improved (p<0.05) post-operatively as compared with the pre-operative respective scores: physical function, role physical, bodily pain, social functioning, role emotional, mental health (Fig. 3). The mean scores for the rest two dimensions (general health, vitality) were also improved post-operatively but there was no statistical difference (Fig. 3). Univariate analysis revealed that Charnley class B & C patients improved significantly less in five out of eight SF-36 dimensions: role physical (p=0.03), bodily pain (p=0.007), vitality (p=0.003), social functioning (p=0.007), role emotional (p=0.03). With regards to the relationship between score changes and certain factors: age, gender, BMI, number of previous revisions, degree of femoral bone loss, stem design and proximal trochanteric displacement > 2mm had no influence on score improvement in any of the outcome measures (p>0.05).

Patient satisfaction and expectations: In the Harris rating scale, 17 patients (46%) rated the result excellent or good (HSS > 80) based on their post-op score, whereas 20 patients (54%) fair or poor (HSS < 80). Thirty-two patients (86%) felt much better as compared to how they felt before surgery and thirty-four (92%) were very satisfied or satisfied with the result of the hip revision surgery. With regards to patients' expectations, 46% expected to be better.

Radiographic results

The average time to union was 9.2 months (range:

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3-24 months). All 7 strut allografts used for the femoral reconstruction incorporated well. Superior trochanteric migration > 2 mm was observed in 13 cases (35%). Finally, 3 stems (8%) were radiographically loose at 3, 15 and 22 months.

Complications

In total there were seven complications (19%) in the 37 operated hips. Three (8%) had femoral component loosening, two (5%) had instability, one (2.7%) had a superficial infection, and one (2.7%) developed painful trochanteric bursitis. There was no intra-operative fracture or cortical perforation. Six patients (16%) had to be re-operated. Three had a repeated femoral revision, one had acetabular revision for recurrent instability and two had to remove cerclage wires.

Discussion

ETO is a useful technique in order to safely remove a non-loose femoral stem in difficult hip revision arthroplasties. To our knowledge there is lack of information in the literature regarding the functional outcome after major hip revision surgeries, especially when performed with a complex femoral reconstruction. With the current study we attempted to assess the functional outcome after such complex hip revision arthroplasties, using a self-reported outcome analysis through standardised questionnaires.

Our study reports mid-term functional results in a series of patients undergoing a complex hip revision surgery performed by a single surgeon. The results reported by this "difficult" patient group indicated that even in low-demand elderly patients with impaired walking ability and associated musculoskeletal co-morbidities, surgical treatment with complex femoral reconstruction has led to a dramatic improvement in all outcome measure categories and a high satisfaction rate (>90%). Nevertheless, most patients continued to experience difficulty during various daily activities such as putting on socks, bending to floor or performing heavy domestic duties. Moreover, mean post-operative Harris Hip Scores (pain/function/overall) and WOMAC scores (pain/function/summary) were considerably below the normal population reference values [22]; this is clearly shown in the diagrams in Fig. 4. These scores mean that many of these patients who undergo a major hip revision will possibly continue to experience considerable functional limitations after surgery. Therefore, patients who are candidates for such a complex hip revision should always be advised not to have unrealistic expectations, as associated co-morbidities can seriously affect physical fitness and overall quality of life.

Although ETO is considered to be a safe and reliable surgical technique for major hip revisions, with most published series reporting favourable results [2-4,6,7], it does not come without complications. The pre-operative functional status and comorbidities seem to predict the post-operative risk for complications and post-operative outcomes [23]. Nevertheless, the majority of the patients requiring a hip revision have associated co-morbidities that affect their physical function and the risk for perioperative and post-operative complications. The overall complication rate has been reported up to 24% [2-4,6,7,24,25]. Such reported complications include nonunion (0-3%), malunion (0-1%), fractures (1-16%), instability/dislocation (0.8-15%), proximal migration of the fragment osteotomized for ETO (0-7%), infection (1-3%), sciatic nerve injury (0-2%), stem subsidence (0-1%), haematoma (1-3.5%), trochanteric bursitis, and femoral component loosening. Adequate reduction and fixation of the fragment osteotomized for the ETO and preservation of its blood supply are very important to minimize complications and have good results [2,6]. Although complications were not the focus of this study, we reported the complications in our patients and our rates were below the reported rates in other series.

The study has its own limitations. The main limitation is the retrospective nature of data collection, but also the relatively short-term length of follow-up, and the small patient population. However, to our knowledge, it is the first study to focus and report on functional outcome and patient satisfaction and expectations after major hip revision surgeries.

The results of this study support the use of ETO

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in complex femoral revisions when indicated. Even if technically demanding, ETO is a safe and effective surgical technique to facilitate stem removal in such complex revisions, that confers good functional results and good satisfaction rates. However, patients undergoing such complex hip revisions should be advised not to have unrealistic expectations regarding their post-operative activity level. In most of these patients, associated musculoskeletal co-morbidities represent the most important factor that dramatically affects physical fitness and overall quality of life. Further high-quality prospective studies are needed to establish the long-term functional outcomes of complex hip revisions using the ETO.

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