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ORIGINAL PAPER

Comparative retrospective study of the direct anterior and transgluteal approaches for primary total hip arthroplasty

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Abstract
Purpose The presented retrospective study compares clinical outcomes five years after total hip arthroplasty performed through a minimally invasive direct anterior approach and a direct transgluteal lateral approach.
Methods A total of 171 arthroplasties in 167 patients were evaluated utilizing the Harris hip score (HHS), the SF-36, a daily activity questionnaire, and the UCLA activity score.
Results The average HHS showed no significant difference equalling 91.4 points in the anterior group and 92.4 in the lateral group ($p=0.952$). The SF-36 physical component scores were 50.7 (anterior) and 50.0 (lateral) while the psychometric properties added up to 48.6 (anterior) and 50.3 (lateral) with no significant differences evident ($p=0.782$, $p=0.071$). Daily activity was found to result in 4,855 (anterior) and 5,016 (lateral) cycles, respectively ($p=0.364$). No difference regarding pain sensation was determined ($p=0.859$). A significant difference was found for the UCLA score, which was calculated to be 5.9 in the anterior and 6.4 in the lateral approach group ($p=0.008$).
Conclusion In summary, our mid-term results show comparable outcomes for both approaches regarding functionality, pain, quality of life and daily activity.

Keywords Total hip arthroplasty · Direct anterior approach · Transgluteal approach · Outcome · Mid-term

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Introduction

Total hip arthroplasty (THA) represents one the most successfully applied surgical procedures as relief of pain and restoration of mobility greatly improve patients' quality of life. Currently, about 150,000 THAs are performed annually in Germany and the portion of minimally invasive surgeries (MIS) is continuously rising. The improvement of surgical instruments and an incremental understanding of hip anatomy contribute to the rise of minimally invasive techniques. Most commonly, the direct anterior, the anterolateral and the posterior approach to the hip are used in MIS.

Certain approaches have been reported to be associated with a decreased intra-operative blood loss [1], and our own group could report on lower peri-operative pain levels and shorter recovery time frames [2, 3] with the direct anterior approach. However, there is still uncertainty concerning the mid- and long-term advantages and disadvantages of these minimally invasive over hitherto standard approaches.

Therefore, we retrospectively compared the functional mid-term outcome after THA performed through a minimally invasive, single-incision direct anterior approach and a direct transgluteal lateral approach.

Materials and methods

The present retrospective single-center clinical study was approved by the institutional review board and compares two different surgical techniques, the minimally invasive direct anterior approach as described by Rachbauer [4] and the lateral transgluteal approach according to Bauer [5].

The study involves 171 hips in 167 consecutive patients who underwent unilateral total hip arthroplasty between May 2005 and May 2008.

In total, a number of 85 arthroplasties were preformed through the minimally invasive anterior approach and 86 arthroplasties through the transgluteal lateral approach. The surgeries were performed by four fellowship-trained surgeons with extensive experience in both techniques (Table 1).

Patient selection followed a set of defined inclusion and exclusion criteria. All patients examined required cemented or non-cemented arthroplasty for primary osteoarthritis. The subjects enrolled received Trilogy cups (Trilogy® Acetabular Hip System, Zimmer) combined with a non-cemented stem (M/L-Taper, Zweymüller® Alloclassic®, Mayo®, all Zimmer) or cemented M. E. Müller straight stems (Zimmer). Overall, the anterior group included 36 cemented stems, the lateral group 45. All devices used are commercially available and were implanted according to approved labelling.

Standardized pre-operative and postoperative treatment protocols, including multimodal pain management and rapid rehabilitation, were utilized for all subjects.

On average, study subjects were evaluated 3.7 years (range 3.3–4.3, anterior) and 5.5 years (4.5–6.7, lateral) postoperatively by a qualified physician.

The primary end point represented the ability to climb stairs normally and walk unlimited distances at the time of evaluation. Secondary end points included the Harris hip score (HHS) [6], the medical outcome survey short-form 36 (SF-36) questionnaire scores [7], the scores obtained in the daily activity questionnaire (DAQ) [8], and the University of California, Los Angeles activity score (UCLA) [9].

Conventional antero-posterior pelvis and cross-table lateral radiographic projections (Lauenstein) were obtained to assess skeletal fixation, cup orientations, such as the angles of inclination, and stem orientation (graded as valgus, neutral or varus) [10].

At the time of follow-up, clinical examination was performed for 68 (anterior) and 65 (lateral) patients, respectively; the remaining patients were subject to phone interviews performed by a qualified physician.

Statistical analysis was carried out with a two-tailed Mann–Whitney U test (SPSS 19.0, SPSS Inc.), and p-values < 0.05 were considered significant.

Table 1 Characteristics of the patient collective

Characteristic	Anterior	Lateral
Number of patients	85	86
Age in years	68.1	64.4
Female	56.5 %	44.2 %
Body mass index (BMI)	27.5	29.2
Time of surgery	09/2007–05/2008	10/2005–07/2006
Follow-up in years (range)	3.7 (3.3–4.7)	5.4 (4.5–6.7)
Surgeons	4	4

Results

The average HHS scores reflected excellent clinical outcomes with no significant difference between the two surgical approaches equalling 91.4 points (standard deviation ±10.8) in the anterior group and 92.4 in the lateral group (±8.5, p=0.952). Compared to preoperative scores (52.81±8.5 and 49.7±8.5), a significant increase was seen postoperatively (p<0.01) (Fig. 1 and Table 2). No significant differences were determined for the different domains covered by the HHS, which include pain, function, absence of deformity, and range of motion.

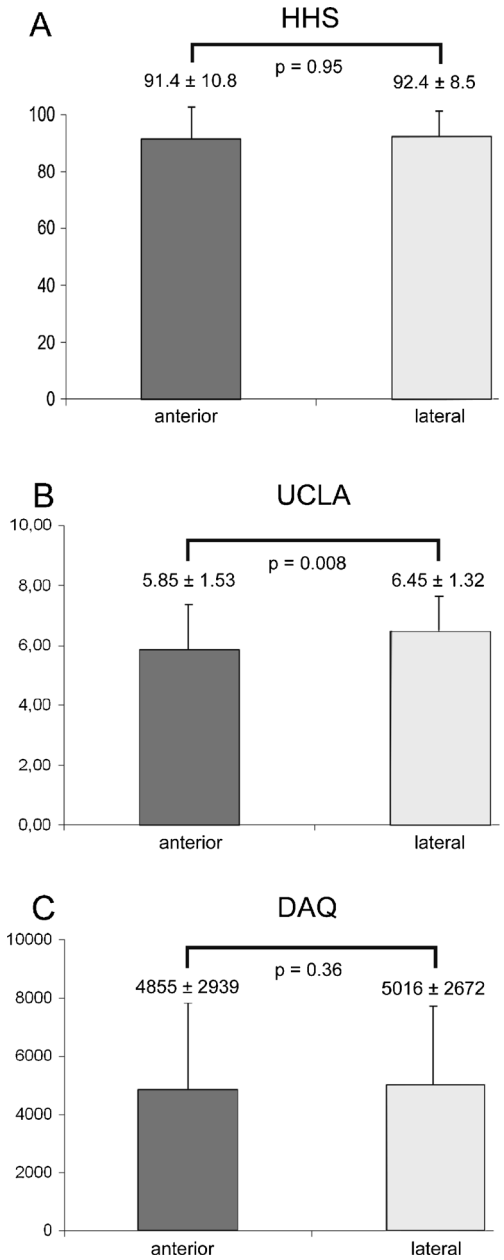

Fig. 1 Study results obtained for the Harris hip score (HHS), the University of California, Los Angeles activity score (UCLA) and daily activity questionnaire (DAQ). Values are presented as mean ± standard deviation

Table 2 Summary of study outcomes regarding functionality, daily activity, pain, and quality of life

Measurement method	Anterior	Lateral	Significance, *p*
HHS	91.4	92.4	0.95 n.s.
Flexion	111°	112°	0.21 n.s.
Trendelenburg	0	1	
Load cycles (DAQ)	4855	5016	0.36 n.s.
UCLA	5.9	6.4	0.008 n.s.
SF-36 f	50.7	50.0	0.78 n.s.
SF-36 m	48.6	50.3	0.007 n.s.
Pain (VAS)	1.24	1.21	0.86 n.s.

HHS Harris hip score, *UCLA* University of California, Los Angeles activity score, *DAQ* daily activity questionnaire

The average scores obtained in the physical component of the SF-36 were calculated to be 50.7±7.8 (anterior) and 50.0±8.0 (lateral) points while the psychometric properties summed up to a score of 48.6±6.3 (anterior) and 50.3±3.8 (lateral), respectively. Again, no statistically significant differences were evident (p=0.782 and p=0.071) (Fig. 2 and Table 2). With the lateral approach 97.7 % of study subjects (84 patients) compared to 95.3 % (anterior approach, 81 patients) reported to feel better or even much better regarding the operated hip in comparison to the pre-operative state.

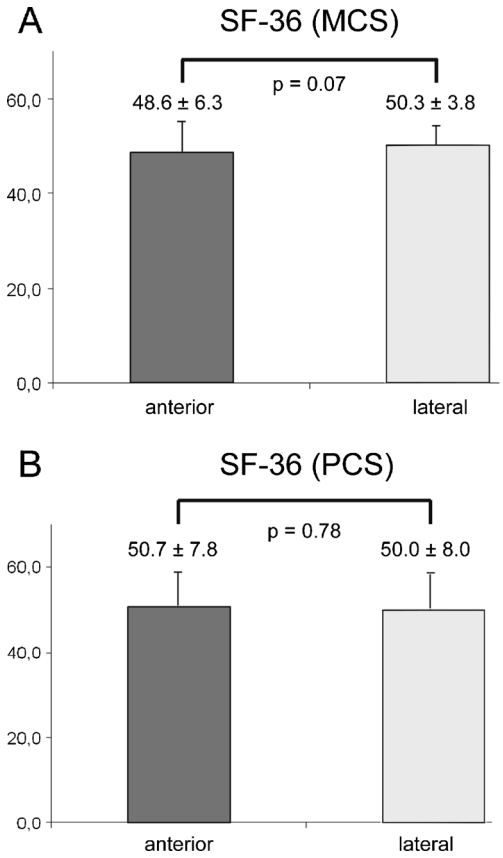

Fig. 2 Scores of the SF-36 mental component (MCS) and physical component summary (PCS). Values are presented as mean ± standard deviation

Daily activity as determined by the DAQ resulted in an average of 4,855±2,939 (anterior) and 5016±2672 (lateral) load cycles, respectively (p=0.364) (Fig. 1 and Table 2).

Notably, a significant difference was, however, found for the UCLA activity score, which was calculated to be 5.85± 1.53 in the anterior and 6.45±1.32 in the lateral approach group (p=0.008) (Fig. 1 and Table 2).

Pain intensity measurements as part of the HHS were determined to be of no significant difference (p=0.859) averaging 40.49 (anterior) and 41.42 (lateral) out of 44 possible points. In the anterior group, 56 out of 85 patients (65.9 %) reported to be free of any pain sensations compared to 53 out of 86 in the lateral approach group (61.6 %). Generally, postoperative pain reduction was assessed to be good to very good. In general, the observed outcomes were independent of the applied method of stem fixation.

The radiographic analysis revealed an average cup inclination of 37.6° in both groups ranging from 24.3 to 47.5° in the anterior group compared to 20.2 to 50.6° in the lateral approach group (Table 3). None of the cups in either group presented with evidence of migration.

Stem positioning was assessed to be neutral in 93 % (anterior) and 95 % (lateral) of all cases while 5 % (anterior) and 3 % (lateral) were graded varus. A valgus stem orientation was found in 2 % of cases in both groups (Table 3). No statistically significant differences were determined. In case of non-cemented implants, all acetabular and femoral components achieved radiographic evidence of osseointegration such as bone in- and bone on-growth, respectively, regardless of the approach used.

Peri- and postoperative complications associated with arthroplasty through the anterior approach included five cases of lateral femoral cutaneous nerve affections and one revision due to displacement of a non-cemented stem with following limb-length discrepancy. Furthermore, one singular subluxation one month postoperatively was observed with spontaneous reduction. In one patient an intermittent paresis of the

Table 3 Radiographic analysis of cup and stem placement; surgery-related complications

Measure	Anterior	Lateral
Inclination (°)	37.6 (24.3–47.5)	37.6 (20.2–50.6)
Stem positioning	Normal 79 Varus 5 Valgus 2	Normal 80 Varus 3 Valgus 5
Exchange of parts	1 (stem displacement)	1 (early infection)
Femoral nerve paresis	1 (full remission)	0
Ischiadic nerve paresis	0	1 (full remission)
Lateral femoral cutaneous nerve paraesthesia	5 (4.3 %)	0

femoral nerve occurred that showed full remission over time. In addition, one trochanteric bursitis occurred on the operative side, which resolved with conservative treatment.

Complications in the lateral group included one early infection (*Staphylococcus aureus*), which required singular surgical revision including synovectomy, exchange of all mobile parts, debridement of all aspects of the joint, irrigation with an antiseptic solution, and pulsatile lavage.

In one subject a femoral crack was noted after stem placement and treated with a cerclage wire and no alteration in postoperative physical therapy. Yet another revision was necessary in one patient suffering from extensive heterotopic ossifications. Finally, one patient was diagnosed with a partial gluteal insufficiency that caused a prolonged phase of rehabilitation but resulted in no remaining functional deficit.

Discussion

The numbers of minimally invasive hip arthroplasty are continuously rising. We and others have reported on decreased intra-operative blood loss [1], lower peri-operative pain levels, and shorter time frames to recovery [2, 3, 11, 12]. With these minimally invasive techniques, short-term results were shown to equal the clinical outcomes observed after THA through standard approaches [3, 13, 14]. Nevertheless, there is still ample debate over potential benefits and disadvantages associated with the various surgical approaches. These debates are nurtured by studies which clearly demonstrate the influence of surgery-independent factors on the clinical outcome such as patient preconditioning, and variations in anaesthesia, analgesic and rehabilitation protocols [15]. Moreover, a multitude of studies predominately report on specific benefits regarding the early postoperative outcome [16] rather than mid- and long-term effects of these minimally invasive approaches.

Our retrospective analysis of 171 hip arthroplasties 3.7–5.4 years postoperatively as assessed by the HHS, SF-36, and DAQ shows comparable outcomes with the anterior and lateral approach. Obtained scores are within the expected range determined in previous studies [13].

Generally, the UCLA score is considered a simple, valid and reproducible tool for assessment of the potential to regain sport activity levels in patients who undergo arthroplasty. However, the simplicity of the UCLA score also compromises its accuracy as it equates the level of maximum stress with overall activity. Notably, the UCLA score differed significantly with an average of 5.9 (anterior) and 6.4 (lateral) points. In contrast, the DAQ measured a similar level of activity in both groups. Interestingly, studies correlating UCLA scores with pedometer measurements have previously demonstrated up to a 15-fold difference regarding the average steps per day for individual patients with the same UCLA score [17] resulting in a reduced validity when compared to the DAQ [8].

Radiographic analysis of stem positioning showed a higher incidence of varus positions in the anterior group. This may result from the direct anterior approach generally tending to force stem placement into a varus position [18]. To avoid varus positioning, the femoral canal must be entered as laterally as needed.

We also observed a higher incidence of lateral femoral cutaneous nerve (NCFL) impairment using the direct anterior approach (4.3 %). Even higher rates of affections are reported in the literature (14.8 %) [19, 20]. The lateral femoral cutaneous nerve supplies sensation to the anterior and lateral thigh. The anatomic location of the nerve varies greatly in relation to the tensor muscle and the inguinal ligament [21, 22]. As a result, the NCFL will always be in the vicinity of the surgical field.

Dislocation after THA remains a serious problem, with anterior approach rates of 0.6–1.6 % reported [23]. In our study, one patient was diagnosed with a dislocated hip.

Certainly, one potential advantage of the anterior approach is the preservation of the gluteus medius and minimus tendons, which are left undisturbed. In contrast, gluteal insufficiency, as observed in one of our study patients, is known as a common complication with lateral approaches [17].

Our study had several limitations. It is a non-randomized, non-blinded retrospective follow-up study the nature of which favours confounding and bias. In addition, the possibility of an inadequate sample size must always be considered in cases without determinable differences. However, in the present study, we included a relatively large sample size that may have prevented this error of statistical nature. Thirty-eight patients (22.2 %) refused a clinical examination and radiographic follow-up and were therefore interviewed over the telephone instead. While functionality, daily activity, pain and quality of life can readily be assessed over the phone, a number of factors such as aseptic loosening and heterotopic ossifications can only be assessed by imaging analysis.

Despite the aforementioned limitations, however, our results summarise that the minimally invasive direct anterior approach results in comparable mid-term clinical outcomes when compared to the lateral transgluteal approach.

Ethical approval For this type of study, formal consent is not required.

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