

Direct anterior total hip arthroplasty: a retrospective study

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Abstract. *Background:* The quest for less invasive surgical approaches for total hip arthroplasty has gained much attention recently. There is very little information regarding differences about the main surgical access. The purpose of this study was to collect data regarding patients' subjective perceptions of the direct anterior hip arthroplasty, heterotopic ossification degrees, range of movement and complication and comparing these satisfaction results with the other surgical techniques. *Methods:* The study involved 51 patients operated in our Orthopedic clinic with direct anterior total hip arthroplasty between 2016 and 2017. We recorded and compared clinical and radiographic data at 1 year with anterolateral hip arthroplasty. *Result:* Only one patient described less than an 8/10 satisfaction; 5.45% of the patients restored the physiological ROM and 21.82 % lost only 5° of range of motion. According to Brooker Classification 58.33 % did not develop any Heterotopic Ossification. *Conclusion:* All standard approaches to the hip have been shown to be safe and efficacious, with particular advantages and disadvantages for each approach. DAA has some short term advantages like a faster recovery, less blood loss and less heterotopic ossification. Long term studies are required to demonstrate a cost benefit or quality of care advantage to other hip approaches. (www.actabiomedica.it)

Key words: THA, Direct Anterior, Approach

Introduction

Total hip arthroplasty (THA) is considered one of most successful orthopedic treatments for improving quality of life in patients with osteoarthritis (1,2). Improvement in THA has led to faster functional recovery, short hospitalization and higher patient satisfaction (3). Among these factors, different surgical approaches, can also affect the clinical outcomes after THA. The Direct Anterior Approach (DAA) was first described in 1881 by German surgeon Carl Hueter (4). It represents an increasingly popular surgical approach for total hip arthroplasty (THA). It is considered a less invasive technique as it exploits an intermuscular and nervous space. The aim of our study is to demonstrate the advantages of this approach.

Surgical technique

The oblique skin incision is marked approximately from 2 to 4 cm distally and laterally to the ASIS and

is directed along the TFL belly for 7-9 cm. A reported complication of this approach is the proximity to the Lateral Femoral Cutaneous Nerve. Blunt dissection through the subcutaneous fat is recommended to further minimize risk of nerve injury, which can result in paresthesia. (5) The interval between the TFL and Sartorius is entered by incision of the fascia over the medial TFL muscle belly, retaining an adequate sleeve of tissue for closure and offering protection to the LCFN. Care should be taken to ensure the appropriate interval, as dissection through the lateral TFL and not in the intramuscular portal, may result in damage to the motor branch of the superior Gluteal Nerve. If the exposure is too posterior, blood vessels should be seen entering the fascia. The fascia becomes denser as it overlies the Gluteus Medius, which should prompt recognition of the improper interval. Conversely, if the plane is developed too medially, dissection into the femoral triangle will occur, risking injury to the femoral neurovascular bundle. Blunt dissection separates

the TFL muscle belly from the fascia and facilitates entry into the interval for proper exposure of the hip capsule. A self-retraining retractor is positioned between the Vastus lateralis and the Rectus Femoralis. By blunt dissection, the ascending branch of the LFCA is isolated and closed. The retractor is now positioned deeper to expose the capsule. The portion of Iliopsoas adherent to the capsule is detached and then the capsule is incised with a triangular shape (with the apex pointing to the cranial portion of the acetabular edge). The strip of capsule is preserved for the closure. The leg is then extra-rotated so the osteotomy of the femoral neck is performed. Femoral head is removed by corkscrew. Chanley retractor is positioned to expose the acetabulum. The acetabulum is reamed with increasing size. The reamer head is positioned first and then is connected to the engine. A press fit acetabular cup may be inserted with a target abduction angle of 35-45° and anteversion angle 10-20°. Acetabular liner is then inserted. The medial and cranial portion of the great trochanter is exposed by a ligamentous and capsular release until an extra-rotation of 150-180° and then the leg is extended. During this movement the femur is elevated and the great trochanter is stayed in the acetabulum, avoiding acetabular edge lesion. The femoral canal is prepared until the achievement of correct fit. The lateral proximal portion of the intramedullary canal is enlarged using Luer tongs. X-Rays of the pelvis are useful to control the correct positioning of the stem. The definitive stem is implanted and external movements are performed to test the stability of the implant. Drains are positioned and soft tissue is sutured in order. Attention should be paid in order to avoid nervous injuries.

Material and methods

Between August, 2016 to November, 2016 156 patients were treated for THA by anterior approach. We enrolled 51 patients in this retrospective study due to our inclusion and exclusion criteria. There were 24 male and 27 female patients, with a mean age of 68 year (49 – 85 years). The operation was executed by the same surgical team, using the same technique (Hueter anterior approach) and same instrumentation

and prosthesis (Medacta Switzerland, and BioloX delta fourth generation ceramic head, CeramTec, Stuttgart, Germany, ceramic or polyethylene liner). 21 patients were excluded and 84 did not answer our request. At 1 year of follow-up (mean 1,33 years, 0,51 – 1,56 years) we performed hip radiography (AP and Lateral projections) to measure correct positioning of prosthesis and for calcification (classified by Brooker index); we scored patients by Harris Hips Score, rated satisfaction scores and measured ROM. We considered complications and failures of the implant. Microsoft Excel was used for statistical analysis and linear regressions were performed for all factors collected at follow-up.

Results

The mean age of 51 patients (47% men and 53% women) was 68 years (min 49 years, max 85 years). The clinical and radiological mean follow-up was 16 months (min 6 months, max 19 months). Only 4 patients received blood transfusion after surgery (7,84%), and one of these patients was a bilateral implant. Average length of hospital stay was 5,5 (5,1 for men and 5,8 for women). Using a Brooker Index we discovered 42% of patients did not have calcifications, 31% had a first grade, 6% a second grade, 2% a third grade and 2% a fourth grade when analyzing X-Rays. All the prosthesis were correctly positioned with a 45° acetabular inclination and 15° of anteversion. None of the monobloc stem radiographs showed evidence of aseptic loosening. We did not have any breakages of implants. Regarding clinical appearance, on a scale from 0 to 10 (with 10 being the most satisfied), patients reported an 8 to 10 of satisfaction with the implant except for one patient. The only patient that did not report a high rate of satisfaction was the patient with the grade four calcification index. The mean Harris Hip Score (HHS) was 91 (94 men and 88 women), 73% excellent (90-100), 16% good, 7% fair, 3% poor. Mean Range of Motion (ROM) was 36° (5-50) of extrarotation, 28° (5-35) of intrarotation, 117° (70-135) of flexion, 36° (5-25) of extension, 30° (10-35) of adduction and 39° (5-45) of abduction; these values are near normal limits. It should be noted that 21% of patients actually had a physiological ROM value of the hip.

Complications were found in only 2,4% of patients: one case of infection, which was healed with antibiotics, VAC therapy and finally by spacer and revision surgery; a case of peri-prosthetic fracture, classified as Vancouver C that underwent osteosynthesis by plate and cerclage; one case of post-operative hematoma healed spontaneously; and one case of cup aseptic loosening treated with revision surgery. We performed linear regressions between HHS and ROMs ($R^2=0,02$; significance of $F=0,15$), HHS and perceived satisfaction ($R^2=0,001$; significance of $F=0,78$); there was no correlation or significance between these values. Therefore, HHS is not correlated with function of the arthroplasty.

Discussion

Total Hip replacement has undergone many technical improvements since its introduction in orthopedic surgery. Six different approaches have been described and used: the anterior (12), antero-lateral (13), posterior (14), posterolateral (15), lateral (16), and the double incision with fluoroscopy (17). Every approach has some advantages and disadvantages. So, how to decide? There are many factors to take into account. First, some surgical technical considerations. The DAA approach has lower wound complication rates in comparison to the Lateral approach (6). Also the prosthesis component positioning could be influenced by the surgical approach. Implant alignment is the key to stability and long term retention. The Lewinnek Safe Zone is defined by an inclination of $40^\circ \pm 10^\circ$ and an anteversion of $15^\circ \pm 10^\circ$. Positioning the acetabular cup between this range of degrees is associated with a lower rate of dislocation. Higgins et. al suggested that DAA is associated with higher rates of acetabular cup positioned in the safe zone compared to the lateral and posterolateral access. (7) The DAA performed with leg traction has even greater percentage of correct acetabular cup positioning thanks to better X-ray projections and better visualization of the acetabulum (10). In our study all of the acetabular cups were positioned with 45° of inclination and 15° of anteversion. A comparison of visually inspected muscle damage to cadaveric specimens undergoing

anterior or posterior approaches showed less damage to the gluteus medius and minimus with the anterior approach. 31% of the anterior hips showed evidence of tensor fascia lata (TFL) damage and 12% had damage to the direct head of the rectus femoris. The greatest difference was in damage to the gluteus minimus. All external rotators were released as part of the posterior approach, whereas 50% of anterior hip procedures required release for mobilization (8). A study of 421 DAA hips estimated that increasing TFL damage was related to the male sex and increasing body mass index (BMI)(9). The incidence of heterotopic ossification (HO), possibly related to retraction damage to the TFL or rectus femoris, has also been evaluated in anterior hips. According to the Brooker classification and X-ray analysis we discovered only 2% of patients had a grade 4 of calcification Brooker index: 58,33 % didn't had calcifications, 31% had a grade 1, 6% a grade 2, 2% a grade 3 and 2% a grade 4. The direct anterior approach could be performed using a standard table with a manual leg control or with a leg positioner. There are many comparative study between the two approaches that show a decreased surgical time in traction DAA with a positive learning curve. (10) In this study we chose to always use a medacta leg traction. In our surgical approach the protection of the TFL with a strip of capsule and the release of the lateral capsule avoided to damage the extrarotator muscles could be the explaining of the lower heterotopic calcification compared to the lateral access and to the anterior approach in literature. A retrospective comparison of 100 minimal-incision DAA and 100 transgluteal lateral approaches showed decreased hospital length of stay, decreased pain on post-operative day zero and one, and decreased time to reach defined range of motion for the anterior approach. (11) In our study Mean Range of Motion (ROM) were 36° (5-50) of extrarotation, 28° (5-35) of intrarotation, 117° (70-135) of flexion, 36° (5-25) of extension, 30° (10-35) of adduction and 39° (5-45) of abduction; these value are near normal ones. It's to be notice that 21% of patients had exactly physiological value of hip ROM. Hip joint kinetics and kinematics are influenced by the surgical approach in the short term follow up. In comparing DAA to ALA approach, DAA showed faster recovery with a peak during the first three months. In

a study of Queen et al., the ALA group exhibited a higher adduction movement compared with the unoperated hip, while a decreased hip adduction moment was observed in the DAA group compared with the unoperated hip. (18) Such outcomes are probably due to the relative increase in adductor movement at the operative hip in patients included in the ALA group, which may have corresponded with pelvic drop during the propulsion phase. It may be attributed to weak abductor mechanism. The internal rotation of hip joint and internal rotation of foot progression angle correlated with reduced abductor function. Abductor momentum arm is compensated by internal rotation of hip in patients with reduced abductor function. Regardless, one year after operation the functional outcome was similar between groups. We performed linear regressions between HHS and ROMs, HHS and rated satisfaction ($R^2=0,001$; significance of $F=0,78$); there was no correlation or significance between these values. Therefore, HHS is not correlated with function of the arthroplasty. The time of recovery, the emetic loss and complications are other parameters of comparison between the surgical approaches. Review of comparative studies indicates DAA tends toward shorter hospital stays and high rates of patients discharged home. However, rates of intraoperative femur fracture, operative time and blood loss are notably higher for those developing familiarity with this approach. However, when surgeons have performed a modest number of procedures, the complication rates tend to markedly decrease in most studies to levels comparable to other approaches and the learning curve seems to be faster with a leg positioner. In our study, complications were found in only 2,4% of patients: one case of infection, healed with antibiotics, VACtherapy, and finally by spacer and revision surgery; a case of peri-prosthetic fracture, classified as Vancouver C that underwent osteosynthesis by plate and cerclage; one case of postoperative hematoma which healed spontaneously; and, one case of cup aseptic loosening treated with revision surgery. Additionally, only 4 patients received blood transfusions after surgery (7,84%), one of them who was a bilateral implant. The days of hospitalization were 5,5 (5,1 for men and 5,8 for women).

Conclusion

All standard approaches to the hip have been shown to be safe and efficacious, with particular advantages and disadvantages for each approach. DAA has been associated with a steep learning curve. The leg traction allows for a more repeatable operation with a faster learning curve. The rates of complication decrease with the growth of the surgeon's experience. The advantages of this technique are less invasion, a better visualization of the acetabulum, less heterotopic ossification, faster recovery time, and less blood loss. Long term studies of a larger number of patients are still required to demonstrate a cost benefit or quality of care advantage to other hip approaches.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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