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Research Article

Transition to Anterior Approach in Primary Total Hip Arthroplasty - Learning Curve Complications

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Abstract

Introduction: The recent emphasis on tissue preservation and minimally invasive outpatient joint replacements has resulted in a significant increase in the use of Direct Anterior Approach (DAA) total hip arthroplasty. It has gained interest recently because of its faster short-term recovery, despite concerns about increased complications and operative time, especially during the learning curve period. The primary objective of this study was to determine whether complications of transitioning to a direct anterior approach for primary total hip arthroplasty may impair patient safety.

Methods: A total of 51 primary hip arthroplasties were performed in 44 patients with the direct anterior approach technique: 37 unilateral arthroplasties and 7 bilateral arthroplasties, during the first 3 years of the learning curve of this technique and their complications were analyzed.

Results: No patient had severe complications or surgical reinterventions associated to transoperative complications. Tearing of the tensor fascia lata muscle was on average the most frequent complication (19.6%), followed by skin lesions (17.6%), difficulty in implant reduction (9.8%) and fractures of the greater trochanter (7.8%). No severe complications occurred.

Conclusion: This study demonstrates that the transition to the direct anterior approach can be done safely without a significant complication rate. These complications are usually associated with the use of inadequate special instruments, inadequate patient selection and the knowledge of maneuvers of the surgeon and his team acquired during the experience and development of the technique. Even so, they do not require additional treatment, which allows us to conclude that this technique is reproducible and can be safely transitioned.

Keywords: Anterior Approach; Hip; Transition; Learning Curve

Introduction

There are several approaches to the coxofemoral joint that can be used for total hip arthroplasty including, with some variations, the posterior approach (Moore or Southern), the lateral approach (Hardinge), the anterolateral approach (Watson Jones) and the direct anterior approach (Smith-Peterson). Although more recently the Direct Anterior Approach (DAA) originally described by Carl Heuter in 1881 has become popular for hip arthroplasty [1,2]. This incision accesses the anterior aspect of the hip joint and utilizes the interval between the tensor fascia latae muscle and the sartorius muscle. Light and Keggi published their experience using this approach for hip arthroplasty in 1980 and Judet described theprocedure with the use of a fracturing table in 1985 [2,3].

For total hip arthroplasty surgeries, the anterior approach to the joint has several advantages over other classic approaches due to its use of a natural intramuscular and internervous interval. The current desire to perform hip replacement using less invasive and tissue sparing methods was the key factor driving the new interest in the anterior approach [4]. This has led to an increase in its use over the last 15 years [5]. During this time, numerous authors have described variations of the technique and key concepts for the safe and successful performance of hip arthroplasty. Although many consider AAD to be appropriate exclusively for primary joint replacement, several authors have noted the routine use of this technique for complex revision surgery and

bipolar hemiarthroplasty for hip fractures [6-8]. This review summarizes our technique and intraoperative difficulties or complications that may arise during the anterior approach surgical procedure that have occurred in our experience in the short and medium term. Also, take into consideration certain tips or key maneuvers to avoid such complications.

Technique

Positioning

The direct anterior approach is usually performed with the patient in the supine position. Our team places the patient on a traditional operating room table with the pelvis positioned in a bulge that is placed transversely to the operating room table and centered at the level of the anterior inferior iliac spine. The bulge is approximately 10 cm thick. The bulge facilitates a small extension of the femur, which gives better access to the acetabulum and creates a space in which the femur can be displaced during exposure. The pelvis should be level when resting on the bulge. The patient is positioned on the left or right end of the operating table depending on the surgical hip (i.e., left side for the left hip, right side for the right hip) to allow maximum space for instrument placement.

Surgical Table

Although special tables (traction tables for fractures) represent a great advantage for the surgeon and allow an adequate exposure of the femur, most of the public and private institutions in the country do not have such beds since they represent a very high cost. Our team prefers the use of conventional tables or beds that allow flexion greater than 45° of the lower limbs.

Surgical Technique

The incision usually begins approximately 2 cm distal and 2 cm lateral to the anterior superior iliac spine. From the starting point, the incision progresses distally over the tensor fascia latae TFL muscle and is brought to the level of the fascia over the TFL (Fig. 1). It is important to confirm the location of the TFL muscle. Normally, several perforator vessels enter the muscle medially and are used to confirm the correct location.

Figure 1: Demarcation for direct anterior hip approach: EIAS and greater trochanter are taken as reference points.

The fascia of the TFL muscle is divided in line with the muscle fibers. The medial border of the fascia is separated from the muscle and a strip of fat is observed. Blunt digital dissection is performed. A blunt Hohman spreader is placed over the extracapsular superior neck. Another sharp retractor is placed medial to the TFL muscle and over the lateral border of the femur. Careful dissection is performed to separate the TFL from the sartorius muscle. Between these two muscles are several large vessels (divisions of the ascending branch of the lateral femoral circumflex artery) that must be carefully ligated or cauterized.

Once the muscles are safely separated, a second blunt retractor is placed over the extracapsular inferior aspect of the femoral neck (Fig. 2). The anterior fat over the hip capsule is now visible. We use a Cobb-type curette to displace some of this fat, separate

the attached psoas fibers and allow visualization of the capsule. Subsequently, an assistant can hold the hip in slight flexion. This maneuver relaxes the rectus femoris muscle and femoral vessels while a blunt-tipped cobra retractor is placed over the anterior aspect of the acetabulum. Occasionally the reflex portion of the anterior rectus is gently released with an electrocautery to improve exposure.

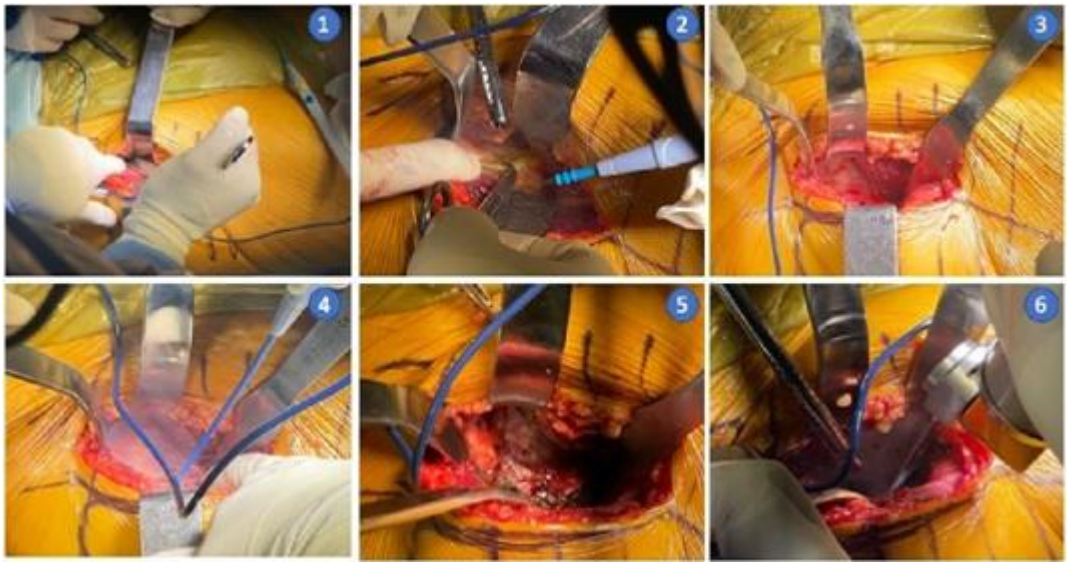

Figure 2: Technique for femoral neck exposure in the direct anterior hip approach. 1) Hohman-type retractor at the superior edge of the neck. 2) Identification and cauterization of lateral circumflex vessels. 3) Placement of the separators to expose the articular capsule. 4) Capsular opening in T. 5) Intracapsular location of the separators. 6) Osteotomy by oscillating saw.

Once the coxofemoral capsule is satisfactorily exposed, a capsulectomy or capsulotomy can be performed to allow visualization of the femoral neck (Fig. 3). Our team prefers to perform a capsulotomy because at the time of capsulorrhaphy it provides additional anterior stability for the prosthesis. The upper and lower Hohman's spacers of the femoral neck are changed to be intracapsular. The femoral neck is cut in situ with an oscillating saw and the femoral head is removed. We find it easier to make two cuts in the femoral neck, creating a "napkin ring" of bone that allows the bone and femoral head to be removed separately, we also prefer to always use saws that are long and thin to avoid necessary to use surgical spoons and cut soft parts (capsule or round ligament) for a less soft tissue damage. A ring pull is used to remove the femoral head. Sometimes it is laborious extraction.

One of the blunt retractors is now moved into position so that the tip is over the transverse acetabular ligament to retract the inferior hip capsule and iliopsoas tendon. The inferior hip capsule can be divided using an electrocautery to allow insertion of the retractor and improve exposure. A sharp retractor is placed posterior to the acetabulum. Once the labrum and cotylar fat have been removed, reaming is initiated. When possible, it can be complemented with an image intensifier for better orientation of the acetabulum, especially when starting with this technique or to have more security.

Once the cup is in place, exposure of the femur begins. It represents for most surgeons and for our team the most complex stage during this approach. Before exposure, the femur is first moved to a position of adduction and external rotation in order to finish releasing the superior and medial joint capsule, we use a pointed Hohman to protect the gluteus medius fibers over the greater trochanter.

Once release is complete, a Mueller-type retractor is placed over the top of the greater trochanter with the hip abductor muscles behind it while a femoral exposure maneuver is performed: an assistant performs progressive hip extension while flexing the lower end of the surgical bed to a 90° angle and performing adduction and external rotation by crossing the knee under the other limb while elevating the ankle (Fig. 3). To facilitate the process the non- operated limb is temporarily placed on a mayo table with padding at the Achilles insertion site.

Figure 3: Positioning for femoral exposure: Extremity to be operated on: hip flexion 60° + knee flexion 90° + external rotation of the ankle. Contralateral Extremity: May table extension. (Lat: Lateral Visualization. Front: Frontal Visualization).

The femur should be moved to the anterior aspect of the wound, allowing sufficient exposure for scraping and stem implantation. Angled shanks can help scrape and seat the femoral stem safely and accurately, although not all hip prosthesis distributors have this. With the trial head, trial neck in a rasp and the hip reduced, the AAD easily allows radiographic confirmation of rasp size and position, if desired. Finally, the definitive components are placed.

Results

A total of 51 primary hip arthroplasties were performed in 44 patients under direct anterior approach technique: 37 unilateral arthroplasties and 7 bilateral arthroplasties (14), duringthe first 3 years of learning curve of this technique. The transition was performed from a modified Hardinge lateral approach. All patients were diagnosed with severe osteoarthritisby clinical and radiology, without previous surgeries of their hips to be operated, nor relevant alterations for the study, the average age was 68 years. For our revision cases or patients with Body Mass Index (BMI) over 30 we continued to use the lateral hip approach.

The average surgical time was 90-100 min per hip arthroplasty, the average hospitalization time was between 1 to 2 days, the average hemoglobin value was greater than 12 gr/dl in all cases, the average blood output was 600 cc (+/- 300) and the observation of the patients until the suture removal was approximately 4 weeks with a weekly control in medical office for cleaning and monitoring of the wound.

No patient had severe complications or surgical reinterventions associated with transoperative complications. No cases of post-surgical dislocations or hospitalizations in the intensive care unit were observed. The analysis of the relationship between the anterior approach and its intraoperative complications during the learning curve of our group is shown in Table 1.

No. (%) of Hip Arthroplasty Procedures				
Type of Complication	**First Year**	**Second Year**	**Third Year**	**Total (%)**
Fractures of the greater trochanter	2 (16.6)	1 (5.5)	1 (4.7)	4 (7.8)
Skin Lesions	4 (33.3)	3 (16.6)	2 (9.5)	9 (17.6)
Difficulty for definitive implant reduction	2 (16.6)	2 (11.1)	1 (4.7)	5 (9.8)
Tensor fascia lata muscle rupture	4 (33.3)	3 (16.6)	3 (14.2)	10 (19.6)
Total arthroplasties per year	12	18	21	51

Table 1: Frequency of intraoperative complications in anterior approach hip surgery during the first 3 years of the learning curve.

We analyzed the results based on the most frequent types of intraoperative complications during the procedure described for the anterior approach technique, on average for the 3 years of the study in order of relevance or frequency (%):

Muscle Injuries

On average 19.6%. Although AAD is an intermuscular approach that should not injure muscular structures, there are certain inadequate maneuvers or with too much tension that can generate this complication. In our experience one of the most frequently injured fascicles is the muscular portion of the fascia lata (Fig. 4) followed by the rectus abdominis and in some cases the psoas. To avoid these injuries it is always important to place the retractors carefully in the correct plane and to release sufficient tension on the fascia when needed. The vast majority of occasions do not need further repair and do not represent major changes during the patient's recovery.

Skin Lesions

On average 17.6%. Excoriative lesions in the surgical wound associated with manipulation due to excessive traction on the skin (Fig. 4). Follow-up was performed in all cases with delayed healing process between 4 to 6 weeks for suture removal (being the usual removal at the third week). To reduce the risk of this complication, a sufficiently broad approach is suggested for each patient. Overweight patients have demonstrated in most cases greater flexibility of the soft tissues with a lower rate of skin complications with small approaches, while thin patients or those with good muscle mass require slightly wider approaches to avoid excessive skin traction. Difficulty for coxofemoral reduction: On average 9.8%. In our group we define that there is difficulty for implant reduction when it is necessary to perform soft tissue release techniques and/or modification of any of the implants (femoral or acetabular) in order to achieve an adequate coxofemoral reduction, thus delaying the surgical act. It can be interpreted in different ways: chronic shortening of the limb (and therefore muscle shortening), malposition of the prosthetic components and incomplete release of the posteroinferior articular capsule.

Fractures of the Greater Trochanter

On average 7.8%. The cases presented were partial fractures due to avulsion of the greater trochanter (Fig. 4). Surgical osteosynthesis repair maneuvers were not performed to avoid the risk of material loosening and subsequent postoperative discomfort. To reduce the risk of this complication, it is recommended to perform an adequate release of the posterosuperior capsule and to carefully manage the femoral exposure with a Mueller type retractor placed on the lateral aspect.

Figure 4: Fracture-Avulsion of the greater trochanter.

Discussion

The AAD is becoming increasingly popular among hip joint replacement surgeons. The approach being less traumatic to the muscles represents an early functional advantage that translates into less pain, quicker recovery and a biomechanically more adequate gait [9-12]. Although it is true that more multicenter studies demonstrating these results are still lacking.

Many studies have described the steep learning curve associated with AAD mastery [13-15]. Thus, associated complications during the first 100 cases or during the first year are more frequent [5,13]. For experienced surgeons, major complications associated with CTA via AAD are rare and comparable to other approaches [6,16,17]. Dislocation is a risk regardless of the approach used, including AAD, although it has been shown to be very stable, and dislocation rates after CTA using an AAD are 0.96% to 1.5% [18,19]. However, this low rate coincides with the increased use of larger femoral head implants, a phenomenon that has led to decreasing dislocation rates for all approaches [5].

Our results support the consistency of the direct anterior approach during the transition period. Although the results are not compared with those of a sample or population performed by another approach, current evidence comparing the results of anterior total hip arthroplasty with those of posterior total hip arthroplasty does not demonstrate a clear superiority of either approach [20]. Even when compared to the anterolateral approach, complications are clearly lower [21].

On the other hand, this study demonstrates that the transition to the direct anterior approach can be done safely without a significant complication rate. These results are in agreement with similar publications such as that of Schwartz, et al., in a high-volume surgeon with 412 patients (211 Anterior, 201 Posterior) or the study of Nistor DV, et al., with low volume surgeons where their study presented 75 patients (35 Anterior, 35 Lateral) [22,23].

Conclusion

In our team, the learning curve led us to certain intraoperative complications that we were able to identify and are associated with the development of this technique, such as the use of appropriate special instruments, adequate patient selection and the knowledge of maneuvers of the surgeon and his team that are acquired during the experience and development of the technique. Even so, these complications did not require special or additional treatment, which allows us to conclude that this technique is reproducible even for low-volume surgeons.

Conflict of Interest

The author has no conflict of interest to declare.

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