Chapter

The Direct Anterior Approach: A Comprehensive Guide for the Learner and Educator

Bijan Dehghani, Avi Dravid, Praneeth Thota and Neil P. Sheth

Abstract

Total hip arthroplasty is one of the most widely performed procedures demonstrating excellent clinical outcomes and implant longevity. Enhanced imaging modalities, advancements in material science, and improvements in surgical technique have contributed to the global success of this procedure. One such technique has gained significant attention over the past decade – the direct anterior approach (DAA). First described by Carl Hueter in 1881, the DAA is now more commonly credited to Smith-Peterson. This technique demonstrates rapid recovery, reduced hospital length of stay, and enhanced stability. Despite these advantages, there is a well reported learning curve for surgeons, particularly for those who trained using an alternative surgical approach. In this chapter we explore a methodological approach to mitigate and decrease the learning curve; allowing for a safe and reproducible guide to teach surgeons how to transition to the DAA.

Keywords: total hip arthroplasty, direct anterior approach, learning curve, hip replacement, posterior approach

1. Introduction

Total Hip Arthroplasty (THA) is one of the most commonly performed orthopaedic procedures for the treatment of end-stage hip degeneration. With a robust track record of effectiveness and safety, THA has become a widely accepted method for providing pain relief, restoring function, and reestablishing a patient's quality of life [1]. Sir John Charnley pioneered one of the first low friction arthroplasties in the 1950s, laying the groundwork for future advancement in the field [2]. Since then, advents in technology in the arena of biomaterials, implant design, and surgical technique have contributed to THA's widespread acceptance [1]. An estimated 370,770 hip replacements were performed in 2014, with this number expected to reach 635,000 in 2030; this represents a projected 71% increase [3]. A rapidly aging population, widening surgical indications, as well as an increased prevalence of obesity and associated osteoarthritis have fueled this increase in demand [4].

Total hip arthroplasty can be performed through several surgical exposures, including the posterior, posterolateral, direct lateral, anterolateral, and direct anterior

approaches [2]. The direct anterior approach (DAA), in particular, has exhibited a tremendous amount of enthusiasm in recent years. German surgeon Carl Hueter first characterized the anterior approach for accessing the hip joint in 1881, describing an inter-nervous and inter-muscular plane between the tensor fasciae latae and sartorius muscles – known today as the Hueter Interval [5]. However, American surgeon Marius Nygaard Smith-Petersen is credited with popularizing this surgical approach. Although this surgical approach was first adopted as a means of reducing congenital hip dislocations, Smith-Petersen also used it to perform mold arthroplasties in 1949 [2, 5].

There is a growing body of literature substantiating the benefits of the DAA. This surgical approach is considered less invasive, exhibits greater stability compared to other approaches, and results in less overall tissue damage [6, 7]. A randomized clinical study comparing the DAA and the posterior approach demonstrated lower pain scores and better function during the early stages of recovery with the DAA [8]. Additional studies have reported lower pain scores, less blood loss, and increased walking speed compared to the direct lateral approach [9]. In the immediate post-operative period, the DAA patients were discharged from the hospital earlier and with greater mobility [10]. However, other studies have shown that differences in post-operative recovery may not be clinically significant as they equalize by 6 weeks, and maintain in the longer term [6] Regardless of surgical approach, clinical success in THA is predicated on adequate surgical exposure, correct component position, and proper soft-tissue balancing [11].

Patient demand, as well as marketing by industry and orthopaedic practices has contributed to the rise in popularity of the DAA [11]. In an effort to meet demand, surgeons may choose to switch from an alternative surgical approach, but, the steep learning curve has always been a major barrier, especially if the transition occurs once already in practice and dedicated time to pursue formal fellowship training is not practical. The DAA is typically performed with the patient in a supine position, requiring different sets of retractors, and often use of a specialized operative table [12]. Some studies suggest that surgeons should perform at least 100 such operations in order to become adequately proficient in the technique [12].

Adult reconstruction fellowships and orthopaedic residency training programs have taken notice of this enthusiasm for the DAA, and have addressed this demand through formal didactics, surgical videos, hands-on training, cadaveric workshops, and educational simulation platforms [13]. For surgeons that do not have the luxury of formally training, a systematic, dedicated methodology must be employed when transitioning to the DAA in order to minimize complications, achieve favorable clinical outcomes, and recognize the benefits associated with the surgical approach.

2. Surgical technique of the direct anterior approach

The first step in learning the DAA is understanding the anatomy, and more particularly the anterior structures of the hip. The important landmarks include the anterior superior iliac spine (ASIS) and the greater trochanter (GT). Proper equipment and positioning are paramount for successful procedure. A specialized surgical table is often used to allow for controlled manipulation of the extremity; however, many surgeons successfully perform this procedure using a regular table. The Hana table is commonly described for this purpose as it allows the surgeon to apply traction, rotate, and abduct/adduct the extremity as needed. The principal author of this paper utilizes a Medacta table extension which can be readily attached to a regular

surgical table. The patient is positioned supine with a triangular bump under the hip to assist with hip extension. The bump should be placed proximal 1/3 and middle 1/3 of the femur making sure that a hand can be freely moved over the bump.

The surgical incision is marked out 2 cm distal and 3 cm lateral to the ASIS (**Figure 1**); the top of the incision is typically at the midpoint between the ASIS and the tip of the GT. The superficial dissection is performed down to the level of the TFL fascia which can be identified based on the blue tint of the muscle belly deep to the fascia (**Figure 2**). Using electrocautery or a scalpel, the TFL fascia is incised in-line with the muscle fibers and carefully separated from the muscle belly. It is important to stay parallel with the muscle fibers to ensure minimal bleeding and muscle damage. Retracting the released TFL laterally completes the superficial dissection and should expose the fascial floor of the TFL. The TFL is a digastric muscle, therefore, it is critical to make sure that both muscle bellies are retracted laterally.

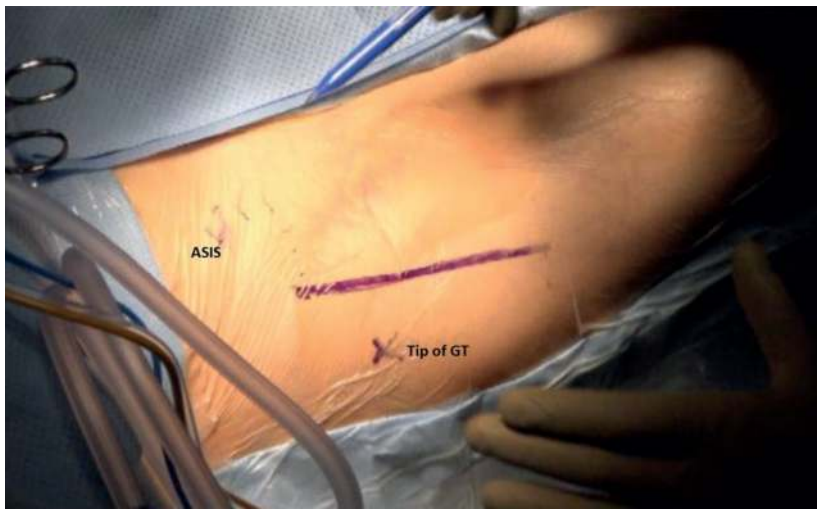

Figure 1.
Incision placement for the direct anterior approach. The trajectory of the incision follows the muscle belly of the tensor fascia latae (TFL) (Right hip).

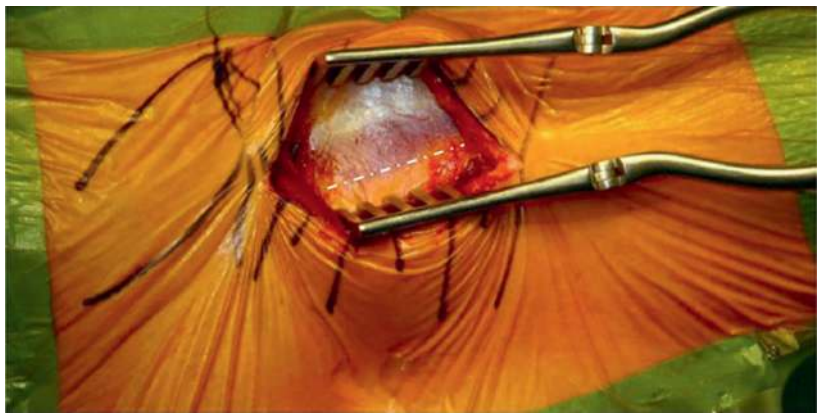

Figure 2.
Following the superficial dissection, the rectus femoris is visible. The deep layer of the dissection beneath the rectus is accessed by making a facial incision at the red-yellow junction (dotted white line) and retracting the rectus muscle belly medially (Right hip).

After retracting both the TFL and the rectus femoris muscle belly, the reflected head of the rectus (pars reflecta) can be seen inserting proximally on the anterior acetabulum (**Figure 3**). There is typically a fat pad with a small vessel at the insertion site. In cases where the pars reflecta is going to be released to allow the rectus femoris to relax and enhance surgical exposure, the fat pad needs to be resected and the vessel cauterized. *We recommend releasing the pars reflecta in all cases early on in the learning curve.* Carefully dissect the investing fascia over the rectus femoris to retract the rectus medially and expose the lateral femoral circumflex vessels (**Figure 4**). Once identified, these vessels need to be tied-off or thoroughly coagulated; electrocautery alone is typically not adequate.

After appropriately addressing the circumflex vessels, the peri-capsular fat is removed and the anterior hip capsule is exposed. While most surgeons are familiar with posterior capsular exposure, the anterior capsule creates a bare triangle between the iliocapsularis muscle medially, the gluteus medius laterally and the vastus lateralus distally. At this point, the option is to perform a capsulotomy (author's preferred technique) or a capsulectomy (**Figure 5**).

In addition to strong foundation of anatomy and surgical technique the use of retractors with appropriate placement is paramount for exposure and safety during the procedure. During acetabular exposure and preparation, the principal author utilizes two, 45 degree, pointed homan retractors for capsular exposure, placing one retractor inferior femoral neck space between the capsule and the muscle and the other retractor over the superior femoral neck protecting the gluteus medius muscle. Both retractors should be extracapsular; following capsulotomy, the retractors should be repositioned intracapsular. Additionally, a charnley retractor is used for hands free acetabular exposure. For right sided procedure, the anterior blade should be placed in the 1 o'clock position and the posterior blade in the 7 o'clock position. For femoral exposure, the use of a dark and stormy retractor placed over the posterior femoral neck, distal to the obturator externus muscle to elevate the femur for broaching.

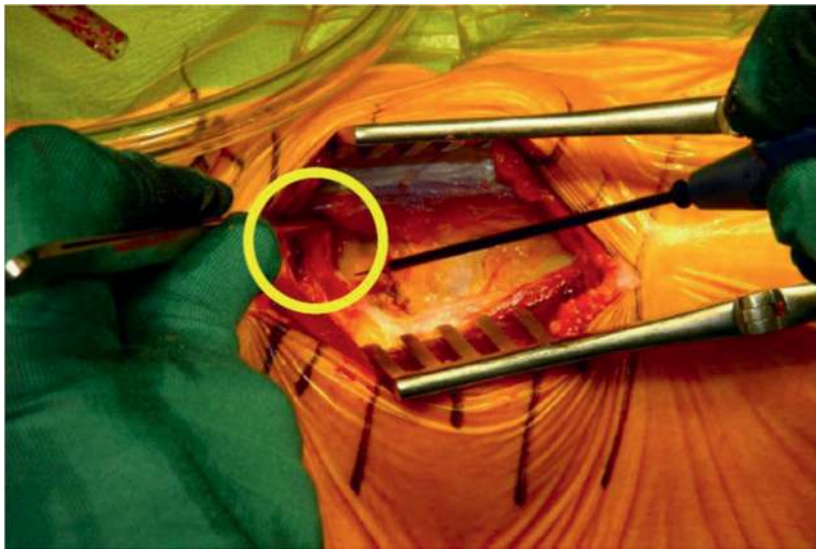

Figure 3.
The yellow circle denotes the pars reflects tendon as it originates from the anterior lip of the acetabulum (Right hip).

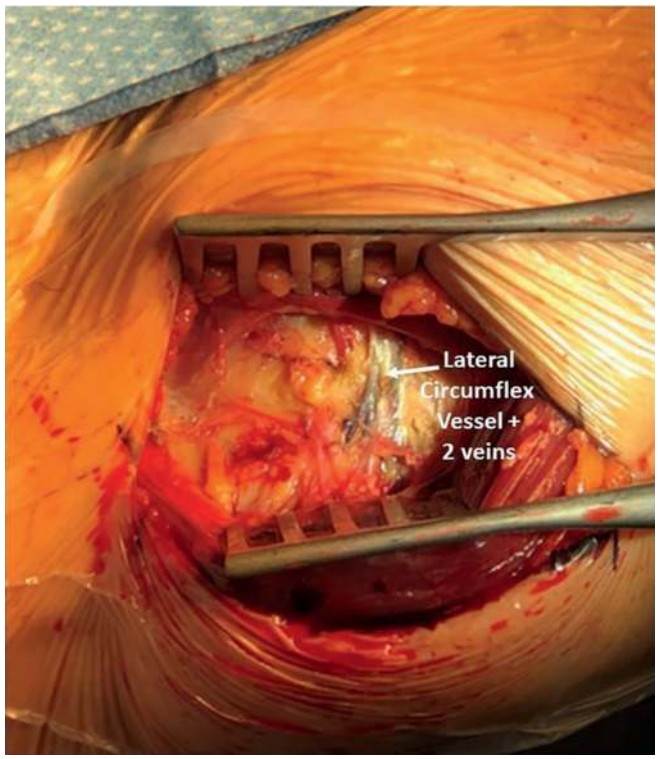

Figure 4.
The lateral circumflex vessels are typically visible just proximal to the vastus lateralis and course proximal lateral to distal medial. The artery typically courses with two accompanying venae comitantes (Right hip).

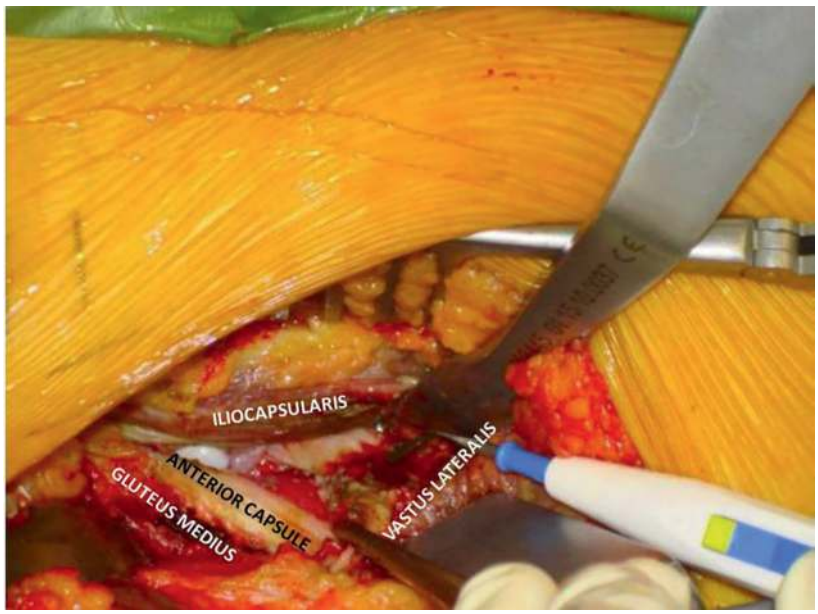

Figure 5.
The bare area in the anterior hip capsule is bordered by these muscles. This image shows the femoral head and neck after a triangular anterior capsulotomy has been performed (Right hip).

3. Methodological transition

The decision to transition from an alternative surgical approach is not one to take lightly. A surgeon must acknowledge that although they may have significant experience with performing a THA from an alternate surgical approach, the DAA THA is an entirely different procedure, especially if transitioning from a posterior approach – the anterior approach is oriented 90 degrees from your normal surgical view. Several reports highlight the dangers of inadequate preparation/planning for surgeons starting to perform the DAA leading to significantly increased surgical times and higher intra/post-operative complications [14]. Therefore, any surgeon deciding to take this step should create a comprehensive and thorough plan involving self-learning, mentorship, and cadaver sessions.

Once the decision to transition to the DAA has been made, and familiarization with the anatomy and surgical steps has been completed, the focus should be on proper surgical indications, common pitfalls, and understanding why you may struggle with portions of the procedure. E-learning (technique guides, digital modeling, online tutorials, surgical videos) has emerged as a powerful tool with many diverse teaching modalities, 24/7 access, and real-time measures progress through testing [15].

Surgical mentorship has been a pivotal aspect of training, emphasized by the Halstedian model of educating new surgeons [16]. Identifying a mentor is critical and it should be someone that is equally invested in you [17]. Observation of the surgical technique should be accompanied by creating a detailed, annotated surgical technique guide. This is the most critical part of making the transition and decreasing the learning curve. Similar to the sequence of surgical steps, the process of creating this surgical technique guide requires patience, diligence, and attention to detail. Additionally, this document should be used to acquaint the surgical team with the procedure, so they too can participate in minimizing the learning curve.

After an extensive observership and creating of a technique guide, hands-on cadaveric training is the next step in the sequence. The senior author assisted his mentor in the lab during a cadaveric demonstration of the procedure. Following the demonstration, the senior author performed a DAA THA on the contralateral hip with the assistance of his mentor. This cadaveric workshop helped to translate what was seen in the operating room during observation into the tangible ability of performing the procedure prior to going live on an actual patient.

After selectively identifying patients that should be considered candidates for a DAA THA (**Table 1**), reverse surgical observation by the mentor was arranged. The first two DAA THAs were observed by the mentor with real-time feedback and guidance provided during the operation. This portion of the training significantly decreased the anxiety associated with performing a DAA for the first time. The mentor should help with identifying your tendencies and anticipating difficulties (e.g. improper retractor placement or limb positioning) before they arise.

All team members should be a part of the learning process. This is not limited to the surgical team performing the procedure (surgeon, Fellow/Resident, advanced practice provider) but should include the scrub technician, circulating nurse, radiology technician, and the anesthesia team. A pre-operative planning session with the entire team can be very helpful early on in the learning curve. More importantly, a post-operative debrief after every case should be conducted with the team to determine what went well, what didn't go well, what did we learn, and what should we should do differently for the next case. This process allows for iterative improvements with performing the DAA safely and reproducibly.

Indications	Contraindications
Non-muscular patients	Muscular patients
Thin patients	Obese patients
Patients with normal bone quality	Patients with osteoporosis
Long valgus femoral necks	Short varus femoral necks
Narrow iliac flares	Wide iliac flares
Dorr Type B femoral canal	Dorr Type A femoral canal
	Retained hardware
	Severe dysplasia
	Proximal femoral deformity

Table 1.
Indications and contraindications to guide patient selection during the learning curve.

4. Continued learning

Creating a schedule that allows for continued learning is imperative. The senior author re-visited his mentor after case #30; the surgical team was included as a part of this visitation. After 60 cases, the senior author arranged for repeat reverse visitation by the mentor to observe and identify any additional tweaks in the technique that should be incorporated. Lastly, data collection is helpful to monitor your tendencies and refine the technique to recognize additional efficiencies.

5. Conclusion

It is important to stress that although you may be a skilled arthroplasty surgeon and experienced in other THA approaches, learning the DAA approach is like starting from scratch. Creating a comprehensive, and methodological, training plan is crucial to achieving clinical success while maintain the safety of your patients. Embracing the significance of self-learning and critique, active mentorship, and substantial hands-on training will maximize your time spent re-training. It is important to understand that once the training period is complete, the learning period continues. Finally, it is imperative to incorporate every member of the operative team as each member plays a critical role in executing the procedure and thus achieving a favorable clinical outcome. In conclusion, transitioning to the direct anterior approach is not a spectator sport – this approach requires dedication, diligence, attention to detail, and patience!

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