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Direct anterior approach total hip arthroplasty with an orthopedic traction table

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Abstract

Objective: Direct anterior approach total hip arthroplasty (DAA THA) has gained significant popularity in the last decade as it is a muscle-sparing procedure. Modern techniques for DAA THA utilize both a standard operating table and an orthopedic traction table. As the use of an orthopedic traction table shows technical ease and predictability, this article will focus on the use of the orthopedic table or table extension to facilitate DAA THA.

Indications: Primary or secondary arthritis requiring THA; revision surgery—both acetabular and femoral.

Contraindications: Posterior wall hardware requiring removal; posterior mass (tumor) to be removed at surgery; large, overhanging pannus; need for gluteal tendon reconstruction; anterior skin envelope not conducive to DAA.

Surgical technique: The incision is made over the tensor fascia latae. Capsulotomy is performed exposing the hip joint. After osteotomy of the femoral neck, traction is placed on the leg utilizing the orthopedic table and the head is removed. The acetabular cup is inserted. Traction, flexion, and internal reduction are used simultaneously while directing the femoral head into the acetabulum.

Results: In a meta-analysis, operative time (100 vs. 71 min), blood loss (531 vs. 382 ml), and intraoperative fracture rate (1.7 vs. 1.3%) were increased in the traction table cohort. All other complications and outcome measurements were the same. Traction-table related complications such as pudendal nerve palsy and ankle fractures were not found. An assessment of the senior author's initial 855 DAA THAs (2008–2014) showed a mean operative time of 65 min with a mean blood loss of 238 ml. Operative times decreased to average 56 min. Intraoperative fracture rate was 0.8%. Infection rate was 2.1%. Finally, 1.5% femoral implants did not osseointegrate and required revision after an average of 3.0 years.

Keywords

Muscle-sparing procedure · Treatment outcome · Adverse effects · Operating tables · Complications



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Introductory remarks

Direct anterior approach total hip arthroplasty (DAA THA) has gained significant popularity in the last decade as it is a muscle-sparing procedure. Advantages of DAA THA include preservation of dynamic hip stability, hastening patient recovery, and

decreasing postoperative pain. The DAA THA was originally described by Robert and Jean Judet in 1950 with the use of an orthopedic traction table [1]. The orthopedic table is still in use in Garches where it was used by a son Thierry Judet and even a son-in-law Marc Siguier. One of Judet's residents, Emile Letournel continued to



Fig. 1 ▲ Patient positioning. The patient is positioned supine on the orthopedic table. The affected extremity is placed into a traction boot. A perineal post provides countertraction and pelvic stability. The opposite leg is placed into a well-leg holder



Fig. 2 ▲ Right hip of patient with previous necrotizing fasciitis with skin graft. Skin envelope here is relative contraindication to DAA due to lack of subcutaneous fat

use the table for pelvic and acetabular fracture surgery. Letournel furthermore advanced the surgical approach with his tissue-sparing techniques and had specifically two trainees who would later help bring the orthopedic table to the peak of modern arthroplasty—Frederic Laude and Joel Matta. Laude began the technique in Paris on a table he made in his garage in the early 1990s. Matta returned to the US and designed an orthopedic table based on Letournel's Tasserit, originally performing fracture surgery, and later focusing on DAA THA. Matta et al. was the first to report the use of the orthopedic table in the United States [2].

Modern techniques for DAA THA utilize both a standard operating table and an orthopedic traction table. This manuscript will focus on the use of the orthopedic table or table extension to facilitate DAA THA. It is the author's preference to use the orthopedic traction table for technical ease and predictability. For example, use of the table essentially eliminates periacetabular retractors for cup preparation by allowing simple self-retainer retractors to be used. Furthermore, femoral preparation is easier given the ability to pull traction with rotation, flexion/extension, and abduction/adduction as needed. Assistants are not necessary nor fatigued with the use of a table.

Surgical principle and objective

DAA THA is performed through the Heuter approach. This interval is an intermuscular, internervous plane allowing direct access to the hip without sectioning muscle. The orthopedic traction table allows the surgeon with reproducible assistance facilitating the THA.

Advantages

Advantages of the orthopedic traction table include:

- Simple set up/draping (■ Fig. 1)
 - Positioning time approximately 7 min
- Stabilizes the pelvis and leg for the procedure
- Decreased need for assistants
- Positions limb facilitating exposure
- Allows intraoperative fluoroscopy use

Disadvantages

- Not universally available
- Expensive
- Requires training to operate
- Table-related complications (pudendal nerve palsy, ankle fracture)
 - Pudendal nerve injury theoretical only. No reported incidence in literature.

- Difficult evaluation of leg length discrepancy
- Inability to check full range of motion (possible as long a boot removed from the spar)

Indications

- Primary or secondary arthritis requiring THA
- Revision surgery—both acetabular and femoral

Contraindications

- Posterior wall hardware requiring removal
- Posterior mass (tumor) to be removed at surgery
- Large, overhanging pannus (relative only, depending on type of skin incision)
- Need for gluteal tendon reconstruction (better performed through lateral or posterior approach)
- Anterior skin envelope not conducive to DAA (skin grafts; ■ Fig. 2)

Patient information

As with all THA, potential risks include:

- Infection
- Muscle, nerve, vascular injury
- Fracture
- Dislocation



Fig. 3 ▲ MRI showing denervation of quadriceps muscles due to femoral nerve palsy

- Hematoma
- Medical complications (venous thromboembolism, cardiac, pulmonary complications)
- Unresolved pain syndromes

Risks encountered specific to the use of the orthopedic fracture table include:

- Pudendal, femoral nerve palsy (■ Fig. 3)
- Ankle fracture
- Knee injury
- Pressure wounds in perineum from traction post

Preoperative workup

- There is no specific preoperative workup specific for use of the orthopedic table in DAA THA. Routine medical clearance for the surgery should accompany an orthopedic physical and radiological examination. Preoperative planning is mandatory focusing on leg length. The authors' preference is to use digital templates to predict implant sizing as well as neck resection length. An assessment of the patient's preoperative subjective leg length is also performed.

Instruments and implants

Routine instrumentation and implants are readily available for DAA THA. The use of the orthopedic table requires:



Fig. 4 ▲ Draping for direct anterior approach total hip arthroplasty (DAATHA). The anterior hip is draped utilizing isolation drapes (shown in blue) around the hip and thigh followed by a simple "shower curtain" isolation drape. This draping solution is efficient and allows visualization of the foot during the procedure

- Orthopedic table
- Retractors specific for DAA THA

Anesthesia and positioning

- Spinal or general anesthesia is acceptable for DAA THA. The patient is positioned supine on the orthopedic table (■ Fig. 1). The operative foot is padded and is held in a traction boot. The contralateral leg is held in a boot or leg holder depending on the table (■ Fig. 4). The surgery is performed with the primary surgeon and only 1 assistant standing next to the surgeon toward the patient's chest.

Surgical technique

(Figs. 5, 6, 7, 8, 9, 10, 11, 12, and 13)

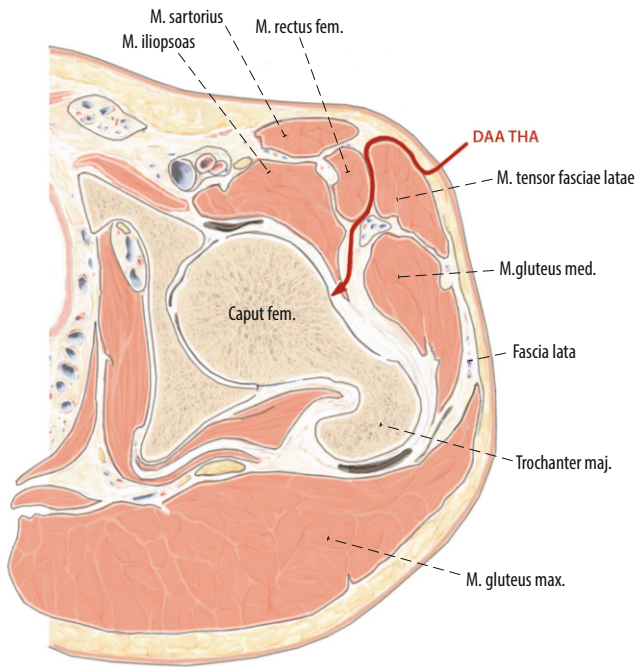


Fig. 5 ▲ Overview of DAA exposure. Direct anterior approach total hip arthroplasty (DAATHA) typically proceeds through the modified Hueter interval [3] between zones innervated by the femoral nerve medially and superior gluteal nerve laterally. Briefly, the incision is made over the tensor fascia latae (TFL). The TFL fascia is incised allowing access to the medial aponeurosis lateral to the sartorius. The rectus femoris (RF) is retracted medially and gluteus medius laterally exposing the lateral circumflex vessels over the bare area of the anterior hip capsule. Once ligated, a capsulotomy is performed exposing the hip joint

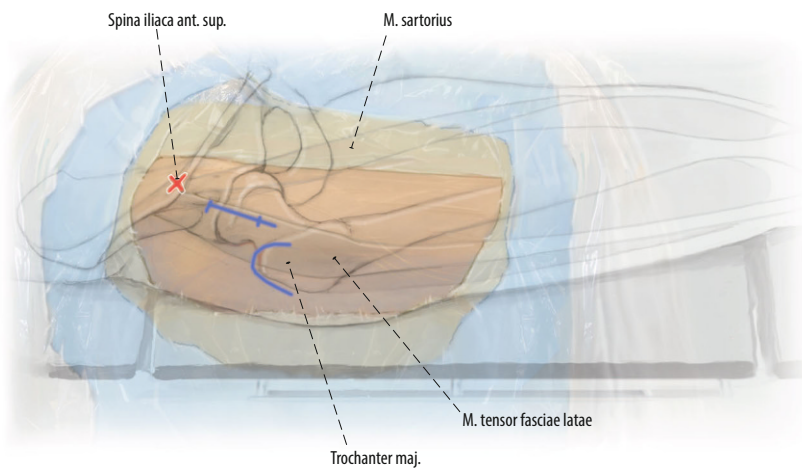


Fig. 6 ▲ Skin incision is positioned anterolaterally directly over the tensor fascia latae. It begins roughly 2 cm distal and 3 cm lateral to the anterior superior iliac spine (red X). It is centered over the summit of the greater trochanter

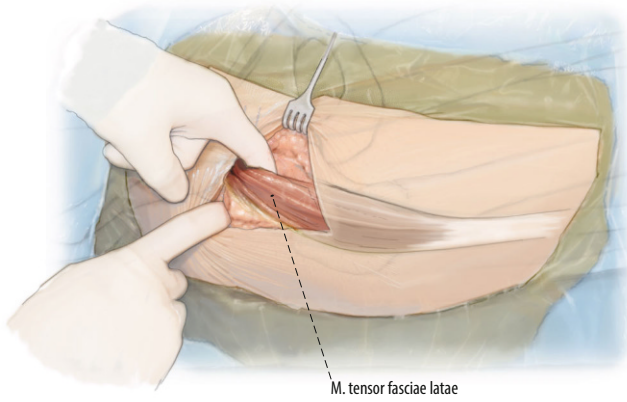


Fig. 7 ▲ Sheath of tensor fascia latae (TFL) incised gaining access to Heuter interval. The TFL is separated from rectus femoris sheath utilizing blunt dissection

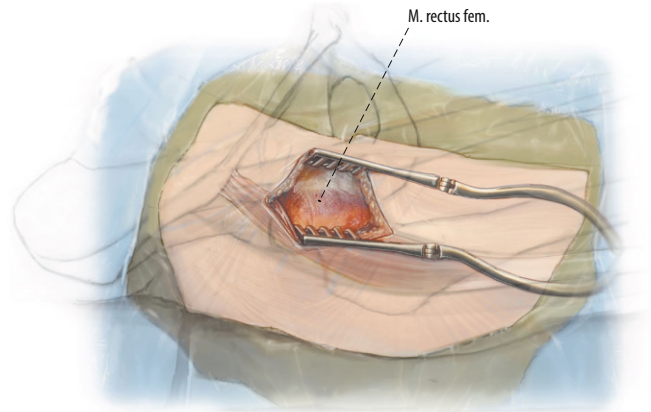
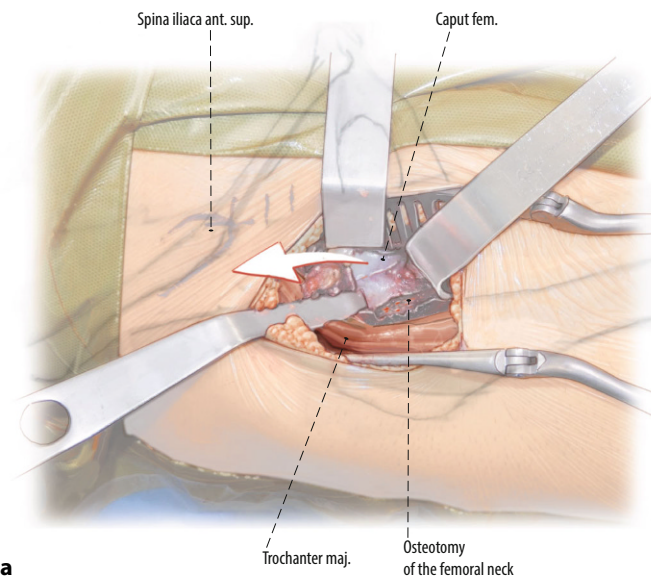


Fig. 8 ▲ Exposure of the rectus femoris muscle by retracting the tensor fascia latae (TFL) posterior and lateral



a



b

Fig. 9 ▲ Osteotomy of the femoral neck. Traction is placed on the leg utilizing the orthopedic table to help elucidate the completion of the cut. The head is removed utilizing a corkscrew placed into the medullary neck canal

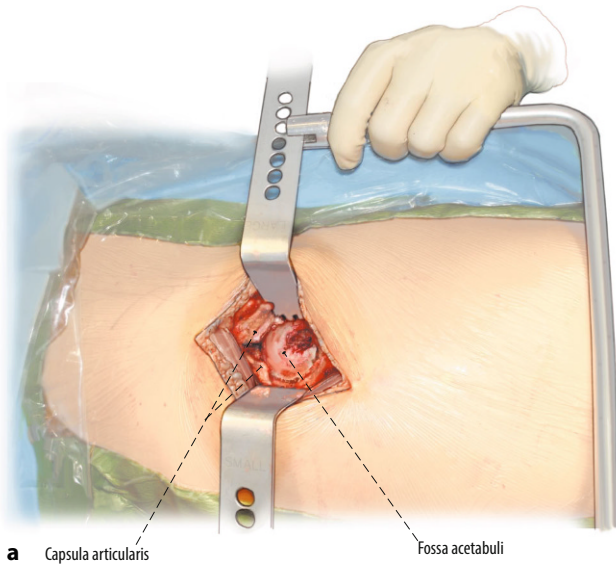


Fig. 10 ◀ Acetabular exposure. The traction table is slightly flexed and externally rotated 45°

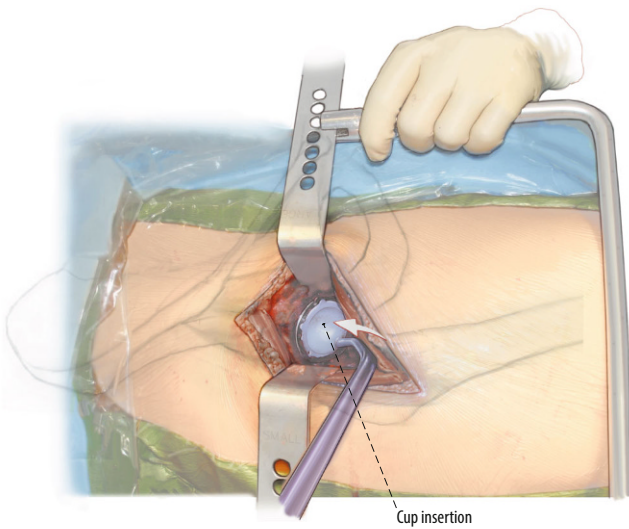


Fig. 11 ◀ Cup insertion. The table is in the same position

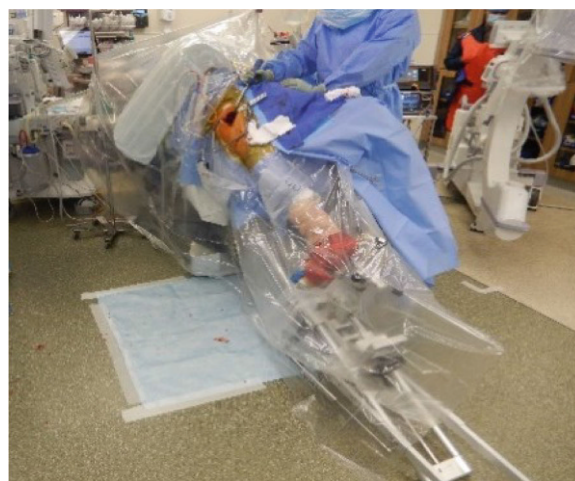
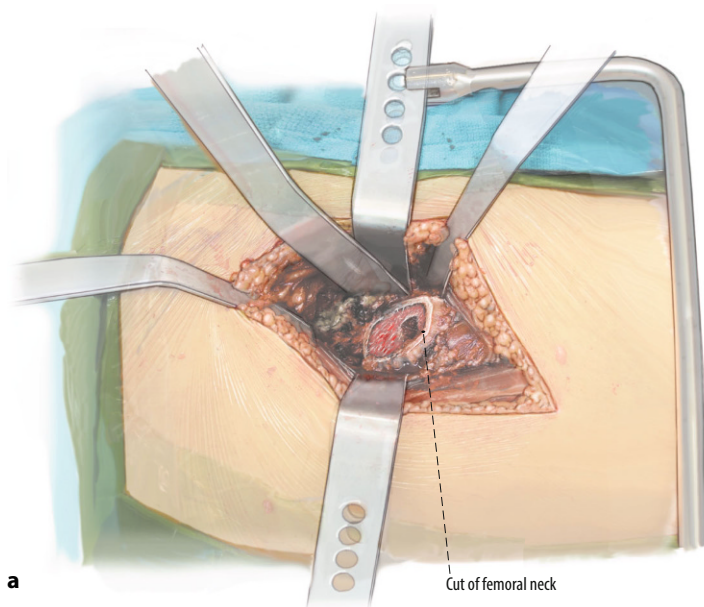


Fig. 12 ▲ Femoral exposure after release of capsule. Orthopedic table holds the leg externally rotated almost 180° and fully extended allowing delivery of the femur into the wound



Fig. 13 ▲ Reduction of hip with orthopedic table. Traction, flexion, and internal reduction are used simultaneously while directing the femoral head into the acetabulum



Fig. 14 ▲ Preincision fluoroscopy check

Special surgical considerations

- As stated previously, the orthopedic traction table is ideal for utilization of intraoperative fluoroscopy. A preincision check of the x-ray should be performed (■ Fig. 14). This allows a baseline view of the affected hip before reconstruction. This can then be compared to a postreconstruction x-ray utilizing an overlay technique (■ Fig. 15).

- The senior author uses a fluoroscopic overlay technique to measure leg length and offset for the patient. The patient is asked preoperatively how they feel their leg lengths are. Then a preoperative fluoroscopy x-ray is obtained and the new hip is reconstructed based on the patient's desire utilizing an "overlay technique".
- A range of motion check can be performed if desired with the leg in or out of the traction spar. A range of motion check is seldom needed

however once the hip is reconstructed to an anatomic fashion.

Postoperative management

- Postoperative management of patients undergoing DAA procedures is uniform with or without use of the orthopedic table. Patients are discharged from hospital once mobilization criteria are met. Patients are allowed to progress as tolerated with use of walking aids the first 2 weeks postoperative.

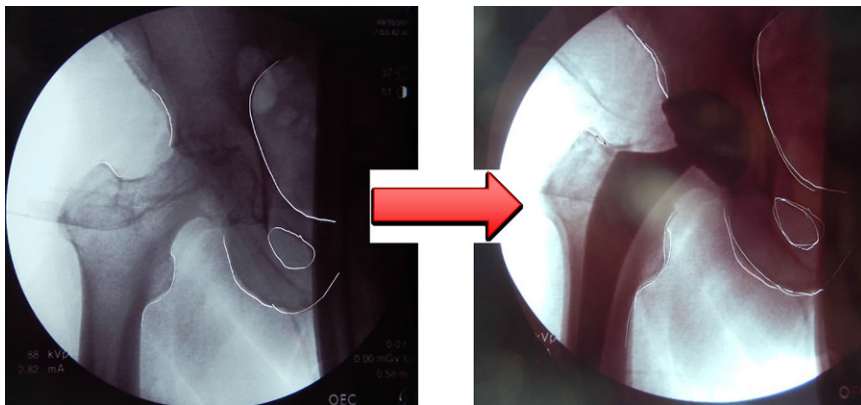


Fig. 15 ▲ Overlay technique for leg length and offset. The pelvis and femur are outlined and compared to the final x-ray. In this case the patient did not notice any differences in the length preoperatively and did not desire any change in length

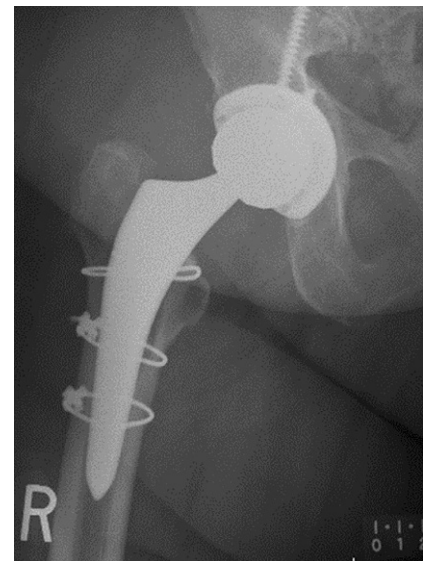


Fig. 16 ▲ Intraoperative femur fracture treated with cerclage cables. The surgical dissection proceeds distally by elevation of the vastus lateralis muscle from lateral to medial. This allows 3 needed for the fixation—1 above the lesser trochanter and 2 below

Table 1 Currently available orthopedic tables or table extensions for direct anterior approach total hip arthroplasty (DAA THA)									
	AMIS	ARCH	PURIST	ROTEXTABLE ^a	Hana	Hana SSXT	Maquet Yuno II	E.T.O.I.L.E.	Adapt-able
Company	Medacta	Innovative Orthopedic Technologies, LLC	Innovative Orthopedic Technologies, LLC	Condor (Schaerer)	Mizuho OSI	Mizuho OSI	Getinge	Amplitude	DJO
Table or table extension	Extension	Extension	Extension	Extension	Table	Table	Table	Extension	Extension
Use of table (purchase vs. implant related)	Implant related	Rent/Purchase	Rent/Purchase	Purchase	Purchase	Purchase	Purchase	Implant Related	Implant related

^aThis table is operated electronically by the surgeon. No additional personnel is needed. All other tables are manual and require operation by a nonsterile assistant

Physical therapy is physician/country dependent. The authors do not utilize physical therapy.

Errors, hazards, complications

- Intraoperative acetabular or femur fractures must be addressed: acetabular fractures typically occur during cup impaction; most greater trochanter fractures can be managed with observation. Calcar and shaft fractures must be treated with cerclage. The orthopedic traction table is an ideal assistant to fix femoral fractures as the

bone is stabilized and can simply be internally and externally rotated to provide the necessary exposure to pass cerclage wires/cables (■ Fig. 16).

- Pudendal nerve palsy is a rare injury associated with excessive traction: conservative treatment allows healing
- Few authors have reported ankle fractures. The etiology of these is the torque applied to the ankle during external rotation of the limb: open reduction with internal fixation may be required if displaced.

Results

Sarraj et al. published the only systemic review of results comparing DAA THA with and without an orthopedic traction table [4]. Their meta-analysis reviewed over 26,000 patients utilizing 45 separate publications. No difference between the two groups was found regarding demographic data—age, sex, body mass index. Operative times (100 min vs 71 min), blood loss (531 ml vs 382 ml), and intraoperative fracture rate (1.7% vs 1.3%) were increased in the traction table cohort. All other complication and outcome measurements were

the same. Interestingly, they did not find traction-table-related complications such as pudendal nerve palsy and ankle fractures.

The senior author (TDG) recently reviewed results of his initial 855 DAA THAs (2008–2014). Operative time was mean 65 min with a mean blood loss of 238 ml. Operative times decreased to average 56 min. The intraoperative fracture rate was 0.8%. However, there was a 2.1% infection rate managed either by acute irrigation and debridement with implant retention versus 2-stage revision depending on timing of infection. Furthermore, 1.5% femoral implants did not osseointegrate and required revision at average 3.0 years postop.

Current orthopedic tables or table extensions are listed in [Table 1](#).

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Declarations

Conflict of interest. T.D. Goldberg, S. Kreuzer, F. Randelli and G.A. Macheras declare that they have no competing interests.

For this article no studies with human participants or animals were performed by any of the authors. All studies performed were in accordance with the ethical standards indicated in each case.

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Direkter anteriorer Zugang zur Hüfttotalendoprothese mit orthopädischem Traktionstisch

Zielsetzung: Die Hüfttotalendoprothese mit direktem anteriorem Zugang („direct anterior approach total hip arthroplasty“, DAA-THA) hat im letzten Jahrzehnt erheblich an Ansehen gewonnen, da es sich um ein muskelschonendes Verfahren handelt. Bei modernen Techniken für die DAA-THA werden sowohl ein Standardoperationstisch als auch ein orthopädischer Traktionstisch verwendet. Da sich der Einsatz eines orthopädischen Traktionstisches als anwenderfreundlich und gut planbar erwiesen hat, liegt der Schwerpunkt dieses Manuskripts auf der Verwendung des orthopädischen Tisches bzw. einer Tischverlängerung, um die DAA-THA zu unterstützen.

Indikationen: Primäre oder sekundäre Arthritiden und Arthrosen, die mit einer Hüftgelenktotalendoprothese zu versorgen sind, sowohl azetabuläre als auch femorale Revisionsoperationen.

Kontraindikationen: Posterior gelegenes, zu entfernendes Material, posteriore Läsion (Tumor), die im Rahmen der Operation entfernt werden soll, großer, überhängender Pannus, Notwendigkeit für eine Glutealsehnenrekonstruktion, ungeeigneter Hautmantel im Zugangsgebiet.

Operationstechnik: Die Inzision wird über den Tensor fascia latae gesetzt. Unter Freilegung des Hüftgelenks wird die Kapsulotomie durchgeführt. Nach Osteotomie des Femurhalses wird das Bein mithilfe des Traktionstisches angezogen, der Femurkopf wird entfernt, die Hüftpfanne eingesetzt. Unter gleichzeitiger Anwendung von Traktion, Flexion und interner Reposition wird der Hüftkopf in die Hüftpfanne eingebracht.

Ergebnisse: Nach einer Metaanalyse waren in der Gruppe der am Traktionstisch operierten Patienten die Operationszeit (100 vs. 71 min), der Blutverlust (531 vs. 382 ml) und die intraoperative Frakturrate (1,7 vs. 1,3 %) erhöht. Alle anderen Komplikationen und Ergebnismessungen waren identisch. Traktionstischbedingte Komplikationen, z. B. Pudendusparese und Knöchelfrakturen, wurden nicht gefunden. Eine Auswertung der ersten 855 DAA-THAs des Erstautors (2008–2014) ergab eine mittlere Operationszeit von 65 min bei einem mittleren Blutverlust von 238 ml. Die Operationszeiten verringerten sich auf durchschnittlich 56 min. Die intraoperative Frakturrate betrug 0,8 %. Die Infektionsrate lag bei 2,1 %. Schließlich kam es bei 1,5 % der femoralen Implantate nicht zu einer ossären Integration, sodass nach durchschnittlich 3,0 Jahren eine Revision erforderlich war.

Schlüsselwörter

Muskelschonendes Verfahren · Behandlungsergebnisse · Unerwünschte Wirkungen · Operationstische · Komplikationen

Hier steht eine Anzeige.

