Screening for Deep Vein Thrombosis After Periacetabular Osteotomy in Adult Patients: Is It Necessary?

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Abstract

Background The periacetabular osteotomy has become a common procedure for treating symptomatic acetabular dysplasia. Like other major hip procedures, there is concern regarding the risk of associated venous thromboembolic disease. Nevertheless, there is limited information regarding the need for screening, and optimal prophylactic measures have not been established.

Questions/purposes We sought to determine the frequency of thromboembolic events (deep vein thrombosis

[DVT] and symptomatic pulmonary embolism [PE]) associated with the periacetabular osteotomy in patients receiving aspirin and mechanical compression prophylaxis. **Methods** We performed a retrospective review of 134 adult patients (149 hips) treated with the periacetabular osteotomy during an 8-year period. During this period, 136 (91%) of the hips treated with a periacetabular osteotomy were screened within 1 week for DVT, whereas 13 (9%) could not be evaluated for various reasons. The mean age of the patients at the time of surgery was 30 years (range, 18–60 years), and no patients were lost to followup during the 4 to 6 months after surgery. The same thromboembolic prophylactic regimen was used for all patients. This consisted of 325 mg aspirin twice a day and compression stockings for 6 weeks and lower extremity pneumatic compression devices while hospitalized. Screening bilateral lower extremity ultrasonography was performed within 1 week (mean, 4 days) of the procedure to detect asymptomatic DVTs.

Results Of the 134 patients, two patients (two hips) with negative postoperative screening ultrasounds presented at 14 and 38 days postoperatively with clinical symptoms of DVT. Repeat ultrasound confirmed this diagnosis in both cases. There were no symptoms of PE. Screening venous ultrasonography did not identify any DVTs during the early postoperative period before discharge. These two patients were treated with 3 to 6 months of warfarin anticoagulation. Neither patient had persistent symptoms related to the DVT.

Conclusions These data indicate that the risk of symptomatic DVT associated with periacetabular osteotomy is low (1%) with use of aspirin and mechanical compression prophylaxis. Furthermore, routine postoperative screening did not detect any patients with an asymptomatic DVT.

Each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request. Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained. This work was performed at Washington University School of Medicine, St Louis, MO, USA.

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Level of Evidence Level IV, therapeutic study. See the Instructions for Authors for a complete description of levels of evidence.

Introduction

The Ganz periacetabular osteotomy is one of several pelvic osteotomies used to treat residual acetabular dysplasia in adolescents and adults. It was first described by Ganz et al. [14], and since then has been used to treat mild to severe acetabular deformities [4, 6, 7, 27, 33, 39]. As with other procedures involving the hip and pelvis, there is interest in minimizing venous thromboembolic disease during the perioperative period. Prophylactic options include pharmacologic agents, mechanical compression modalities, and early postoperative mobilization. Despite agreement regarding the importance of preventing thromboembolic events in patients undergoing a periacetabular osteotomy, there is no consensus regarding specific prophylactic and disease-screening regimens. In addition, there is limited published information regarding the frequency and prevention of thromboembolic complications associated with this procedure [7, 43].

The frequency of venous thromboembolic disease during the postoperative period of patients undergoing periacetabular osteotomy seems to be low [7, 11, 32, 38, 43], yet specific prophylactic protocols have not been rigorously evaluated. Additionally, duplex ultrasound has not been used to routinely screen all patients after periacetabular osteotomy to determine the incidence of symptomatic and asymptomatic venous thromboembolic disease after the procedure. We therefore sought to determine the frequency of thromboembolic events (deep vein thrombosis [DVT] and symptomatic pulmonary embolism [PE]) associated with the periacetabular osteotomy in patients receiving aspirin and mechanical compression prophylaxis.

Patients and Methods

After institutional review board approval, a blinded retrospective review was performed at this institution of all patients older than 18 years who underwent a Ganz periacetabular osteotomy during an 8-year interval. The STROBE initiative guidelines were followed for this study. All patients had been diagnosed preoperatively with symptomatic acetabular dysplasia without advanced secondary osteoarthritis. During this period, we used a standardized protocol for thromboembolic disease prophylaxis and screening. At the time of this study, the frequency of symptomatic DVT was unknown; thus, a similar protocol used for patients after joint arthroplasty was used for patients

Table 1. Patient demographics and risk factors for venous thromboembolic disease

Demographic	Number
Total patients (hips)	134 (149 hips)
Mean followup, months (range)	26 (1–96)
Mean age, years (range)	30 (18–60)
Mean BMI, range (kg/m ²)	25 (16–36)
Females	107 (72%)
Males	42 (28%)
Tobacco use at time of surgery	13 patients (10%)
Oral contraceptives	22 patients (16%)
Hormone replacement therapy	3 patients (2%)

in this study. All patients older than 18 years were treated with 325 mg aspirin twice a day (starting the morning after surgery). This dose of aspirin was chosen to meet the 90% reduction in cyclooxygenase activity and as reported in previous studies [18, 22]. High-high compression stockings and knee-high sequential compression devices were placed on the nonoperative leg in the preoperative holding area; whereas they were applied to the operative limb in the operating room after surgery. The compression stockings were worn for 6 weeks and the sequential compression devices were used in the hospital setting only for all patients. The patients were maintained on bedrest on postoperative Day 1, then mobilized to a chair on postoperative Day 2, and then advanced to toe-touch weightbearing on postoperative Day 3. Patients were excluded from the study if they were younger than 18 years at the time of the procedure. Patients also were screened preoperatively for a history of DVT and none of the patients reported a history of DVT or the routine use of warfarin.

One hundred forty-nine hips (134 patients) were identified with 87% of the hips having a duplex procedure performed (Table 1). All patients underwent periacetabular osteotomy for treatment of symptomatic acetabular dysplasia [5, 14]. Additional simultaneous procedures were performed in 101 hips (68%) to fully address the hip deformity and associated abnormalities (Table 2). The surgeries were performed through an anterior modified Smith-Petersen abductor-sparing approach. The mean age of the patients at the time of surgery was 30 years (range, 18–60 years) and the mean BMI was 25 kg/m² (range, 16–36 kg/m²). One hundred seven periacetabular osteotomies (72%) were performed in women and 42 (28%) in men. Screening duplex ultrasound was performed on postoperative Day 4, on average, (range, 1–8 days) before hospital discharge. The medical record was reviewed to identify patients who used tobacco, oral contraceptives, or hormone replacement therapy during the perioperative period.

Table 2. Concurrent procedures

Procedures performed	Number (%)
Periacetabular osteotomy alone	48 (32.2%)
Femoral osteochondroplasty	86 (57.7%)
Proximal femoral osteotomy	14 (9.4%)
Hip arthroscopy	23 (15.4%)
Surgical dislocation	3 (2.0%)
Open labral repair	6 (4.0%)
Labral resection	19 (12.8%)
Acetabular osteochondroplasty	3 (2.0%)
Periacetabular osteotomy + other procedure(s)	101 (67.8%)
	303 total procedures (149 hips)

Patients were counseled to stop smoking before and after the surgery until there was evidence of radiographic union of the osteotomy sites. After the surgery, they also were counseled to stop oral contraceptive use for two menstrual cycles and hormone replacement therapy for 2 months.

Routine postoperative duplex ultrasound was not performed in 13 hips (13 patients [89%]), because the patients were discharged from the hospital during the weekend, and therefore, lack of ultrasonography services at the time of discharge. These patients did not or were unable to return to the hospital after discharge for postoperative screening duplex examination. Chart review was performed to ascertain the presence or absence of late, symptomatic DVT and PE with a minimum followup defined as 4 months. One hundred thirty patients (97%) met this standardized 4-month followup, with an average followup of 26 months (range, 1–96 months). Four patients (four hips) did not have at least 4 months of followup, and these patients were contacted by telephone at an average of 2.5 months postoperatively (range, 2–3 months) and asked if they had received a diagnosis of a “blood clot, deep vein thrombosis, or pulmonary embolus” at any time after their periacetabular osteotomy. They also were asked if they had been hospitalized for any reason, and if so, they were questioned further to identify the reason for hospital admission. Patients presenting for followup with symptoms consistent with DVT (two patients, two hips [1.3%]) had definitive diagnosis made with duplex ultrasound. Patients with postoperative DVT who had diagnosis made with duplex ultrasound subsequently were treated for 3 to 6 months with warfarin with a target international normalized ratio of 2.5.

Results

No patients in this series had clinically symptomatic DVT develop during their postoperative hospital stay. No

postoperative DVTs were diagnosed with the initial routine bilateral lower extremity duplex ultrasound. No patients had clinical signs and symptoms of PE, and none was diagnosed with a PE during the entire study period. There were no venous thromboembolic disease complications in the 13 patients (13 hips) who did not have a screening ultrasound. Chart reviews of the 130 patients (145 hips) with at least 4 months of clinical followup showed no evidence of symptomatic DVT or PE. None of the four patients (four hips) with less than 4-months followup reported a DVT or PE during our telephone survey.

Two female patients were diagnosed with symptomatic DVTs after discharge from the hospital for an overall frequency of venous thromboembolic disease in this cohort of 1.3%. Neither patient had a history of DVT nor had a positive postoperative screening duplex ultrasound. The first patient was a 32-year-old woman with a diagnosis of acetabular dysplasia treated with a periacetabular osteotomy. She presented 14 days postoperatively with unilateral calf pain. She had a history of oral contraceptive and tobacco use. She was otherwise healthy. The second patient was a 39-year-old woman who presented 38 days postoperatively with unilateral calf pain, swelling, and subjective “tightness”. Her medical history was significant only for a seizure disorder not requiring treatment at the time of her procedure. In both patients, duplex ultrasonography revealed a DVT involving only the common femoral vein with no evidence of distal DVT. They were treated with a therapeutic dose of warfarin for 3 to 6 months. Neither had a symptomatic PE develop, and both were asymptomatic at last followup of 4 years and 3 years, respectively.

Discussion

Venous thromboembolic disease is a potentially fatal complication associated with lower extremity orthopaedic procedures, the frequency and prevention of which are best described in patients undergoing THAs and TKAs [1, 8–10, 12, 16, 19, 21, 24, 28, 29]. However, there is a paucity of information in the literature reporting the frequency of thromboembolic disease, appropriate prophylactic measures, and the necessity of screening studies in skeletally mature patients undergoing elective pelvic osteotomy [11, 34, 39, 40, 43]. Our goal was to determine the frequency of thromboembolic disease in patients undergoing periacetabular osteotomy and treated with aspirin and mechanical compression prophylaxis. We found a frequency of two symptomatic DVTs in 134 patients (149 periacetabular osteotomies [1.3%]) with no patients experiencing symptomatic PE. Neither of these DVTs was diagnosed during the patients’ initial hospitalizations, nor were the initial venous duplex screening ultrasounds positive.

There are limitations to this study. First is the potentially small sample size ($N = 134$ patients, 149 hips). With the frequency of proximal DVT being uncommon and PE is a rare event, the study sample size may have been underpowered to determine the exact frequency of DVT. Power analysis may have been able to help determine the sample size needed to determine a more accurate frequency of DVT after periacetabular osteotomy in adults; however, the aim of our study was to determine the frequency. The periacetabular osteotomy is a relatively uncommon procedure and the study duration would be quite long to determine the frequency of DVT, compared with a similar sample size used in total joint arthroplasty studies. A multicenter study would be needed to gather sufficient data to determine this frequency.

Another limitation was the use of duplex ultrasound to detect DVT. Duplex ultrasound has been performed historically to detect DVT, with sensitivities between 88% and 100% [20, 42]. The ability to adequately image the iliac veins has been questioned, with one study citing only 79% of the time being able to adequately image these veins compared with 94% for the veins of the lower extremity (common femoral, superficial femoral, and popliteal) [25]. The use of duplex ultrasound is also technician dependent which might affect the ability to detect DVT. All sonographers at our institution have extensive experience performing these studies, with an average of 4323 studies performed each year for detecting DVT. The sensitivity was unable to be determined as venograms were not performed to confirm the presence or absence of DVT. However, the use of duplex ultrasound is less expensive, less invasive, and requires less time to perform compared with CT or a venogram.

Another potential limitation is patients who either did not have direct clinical followup during the 4 months after surgery or patients who did not have a duplex ultrasound before hospital discharge. This could be considered failure of treatment in these patients; however, given the steps required for diagnosis and treatment for a symptomatic DVT or PE and the young patient age (cognitively intact), we think it is unlikely that either would go unnoticed or misinterpreted. We do not expect that a symptomatic DVT or PE was missed in this population. We chose a 4-month cutoff for clinical evaluation of a venous thromboembolism event because the majority of reported thrombotic complications occurring after THA occurred within the first 3 postoperative months [2, 3, 13, 31]. Another limitation is that in 67.8% of the cases, the periacetabular osteotomy was performed in addition to another surgical procedure, which may increase the likelihood of a thromboembolic event. These additional procedures theoretically may increase the risk of DVT because of increased operative time, muscle retraction, tissue swelling, and leg manipulation. Because of

the low frequency of venous thromboembolic disease in this population, it is not possible to perform a logistic regression analysis to identify the surgical risk factors that may predispose to a thromboembolic event.

The 1.3% frequency of symptomatic DVT after periacetabular osteotomy that we report is similar to some of the previously reported data in the literature, which range from 0% to 5% frequency [11, 34, 36, 39, 40, 43]. There are published case series describing the outcomes and complications after periacetabular osteotomy that did not mention thromboembolic complications and specifically address prophylaxis regimens or screening for such events [23, 26, 30, 37]. Thawrani et al. [36] specifically addressed complications after periacetabular osteotomy in adolescent patients with a mean age of 15 years and reported no thromboembolic events in their series of 83 periacetabular osteotomies. However, the incidence of DVT in adolescents (younger than 18 years) is different from that of young adults (older than 18 years) [35]. Davey and Santore reported one DVT in 70 hips (1.4%) in their study that focused on complications after periacetabular osteotomy [11]. The highest frequency of 5% was reported by Trousdale et al. in a description of their experience with periacetabular osteotomy combined with intertrochanteric osteotomy for hip dysplasia [39]. Our frequency of 1.3% symptomatic DVT after periacetabular osteotomy occurred in an adult patient population using a strict chemical and mechanical prophylaxis protocol. All patients, while inpatients, used mechanical prophylaxis with sequential compression devices and chemical prophylaxis with aspirin. However, compliance was not monitored and is a limitation of our study. Zaltz et al. [43] reported on a multicenter survey study including 1067 patients treated with periacetabular osteotomy, citing a frequency of 9.4 per 1000 cases (0.94%). However, the study population was not limited to an adult patient population with the inclusion of patients younger than 18 years (range, 13–56 years) and an average patient age of 24 years compared with 30.2 years in our patients. Zaltz et al. also included multiple nonstandardized modes of DVT prophylaxis with combinations of mechanical and chemical prophylaxis [43] as opposed to our regimen of mechanical and chemical prophylaxis and postoperative ultrasound screening. Because of the potential devastating effects of untreated DVT, some surgeons have advocated using screening postoperative duplex ultrasonography after total joint arthroplasty [13, 15, 16, 41]. One previous study included patients of all ages and potentially falsely lowered the true frequency of venous thromboembolic disease in the at-risk adult population [43]. A study analyzing a cohort of only adults (older than 18 years) has, to our knowledge, not been done to date. This is an important, unresolved issue for pelvic osteotomy surgeons attempting to optimize thromboembolic disease prophylaxis and minimize postoperative bleeding complications. By using a

standardized thromboembolic disease prophylaxis protocol, we have established a relatively homogenous study cohort to analyze venous thromboembolic disease associated with the periacetabular osteotomy in the skeletally mature patient. To our knowledge, there are no published studies evaluating the use of screening duplex ultrasonography after periacetabular osteotomy. Furthermore, because our screening ultrasound examinations failed to detect any postoperative DVTs after periacetabular osteotomy in our patients, we have discontinued its use as a screening tool after periacetabular osteotomy at our institutions. The frequency of symptomatic DVT after periacetabular osteotomy in adult patients is low (1.3%) when a 6-week regimen of aspirin and compression stockings is combined with postoperative mechanical compression devices during the early postoperative period. In a similar fashion, the American Academy of Orthopaedic Surgeons' evidence-based guidelines on preventing thromboembolic disease after hip and knee arthroplasties recommended against the use of routine postoperative duplex ultrasonography screening [17].

In our study, routine inpatient screening duplex ultrasonography found few asymptomatic DVTs before hospital discharge after periacetabular osteotomy. Given these data and the apparently low frequency of DVT and symptomatic PE associated with the periacetabular osteotomy, we do not recommend routine postoperative screening.

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