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In-Hospital Cost Analysis of Total Hip Arthroplasty: Does Surgical Approach Matter?

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ABSTRACT

The purposes of this study were to determine the impact of surgical approach on costs of total hip arthroplasty (THA) from a hospital perspective and to provide an updated cost estimation of THA. A prospective, microcosting analysis was performed on 118 patients undergoing a THA through an anterior, lateral, or posterior approach. We determined that overall costs (intraoperative costs and hospital stay) were significantly less for the anterior ($7300.22; 95% confidence interval [CI], 7064.49-7535.95) vs lateral ($7853.10; 95% CI, 7577.29-8128.91; $P = .031$) and anterior vs posterior approach ($8287.46; 95% CI, 7906.42-8668.51; $P < .001$). A reduction in hospital length of stay when THA was performed through an anterior approach contributed significantly to an overall reduction in costs from a hospital perspective.

The disease burden of hip osteoarthritis continues to rise, largely attributable to improved management of chronic diseases and prolonged life expectancy [1]. The increasing prevalence of hip arthritis may overwhelm the available resources within health care systems to treat this debilitating condition. Despite the substantial financial resources consumed by total hip arthroplasty (THA) within any health care system, few studies have provided accurate cost estimations of this procedure [2,3].

In the United States, more than 300 000 THAs are performed annually [4]. In Canada, more than 40 000 THAs were performed in 2013, a number that is expected to rise gradually over years to come [5]. There are pressures to produce the best clinical outcome, while remaining fiscally responsible. Cost analyses have been used in the realm of THA to assess bearing surfaces, implant fixation, and new prosthetic designs [6–8]. Surgical approach may have an impact on costs for THA; however, it has never been evaluated using a rigorous, cost-analysis process.

Surgical approach in THA has been an area of interest in the orthopedic literature over the past decade. Many studies have examined the impact of surgical approach on multiple outcome measures including patient reported outcomes, hospital metrics such as operating room time and hospital length of stay (LOS), and tissue trauma analysis through cadaveric and imaging studies [9–14]. Several studies suggest that the anterior approach reduces LOS and promotes earlier restoration to function postoperatively [10,11,15,16]. However, whether the reduction in days spent in hospital translates into a cost reduction for the procedure has not been elucidated.

Our institution's early anecdotal experience with the anterior approach suggested that there was a significant reduction in hospital LOS compared with THAs performed through a posterior or lateral approach. Many of the studies reporting the impact of surgical approach on LOS in hospital have mixed methodologies (ie, case series and retrospective and prospective comparisons). The objectives of the current study were as follows:

1) To determine if surgical approach for THA causes significant differences in various hospital metrics such as operating room time and hospital LOS
2) To determine if there are significant cost differences for THA depending on which surgical approach is used
3) To provide an updated estimation of the cost of THA from a single academic institution

Methods

Patients meeting enrollment requirements were recruited consecutively from the clinics of 1 of 3 fellowship-trained arthroplasty surgeons at our institution after research ethics board approval was obtained. Participating surgeons performed only 1 of 3 surgical approaches to the hip: anterior (B.L.), posterior (J.H.), and lateral (E.V.). Informed consent for THA was attained for those patients whose hip arthropathy was deemed most appropriately treated with surgical intervention.

Patients were included if they consented to THA performed through either an anterior, posterior, or lateral approach; were 19 years or older; and did not meet any of the exclusion criteria. Patients were excluded if the body mass index (BMI) was greater than 40 kg/m^2; they had any

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previous hip surgery or cemented THA, bilateral THA cases, or decisions to change implants other than those standardized for the study; they were non–English speaking patients; they had cases performed by trainees (residents or clinical fellows); or they had hip arthropathy due to Legg-Calve-Perthes disease, slipped-capital femoral epiphysis, developmental dysplasia of the hip, or posttraumatic or inflammatory arthritis. Demographic characteristics including patient age, sex, and BMI at enrollment were recorded. The Charlson Comorbidity Index was calculated preoperatively to ensure that our cohorts were similar with regard to their risk of perioperative complications [17]. The primary diagnosis causing hip arthropathy was determined based on patient history and radiographic analysis.

Surgical technique

The anterior approach was performed using a modified Hueter approach [18]. The patient was positioned supine on a specialized operating table (Hana fracture table; Mizuho OSI, Union City, California). All anterior approaches were performed using a general anesthetic. The posterior approach used the technique popularized by Moore [19]. Either a general or spinal anesthetic was based on the discretion of the anesthetist and the patient. Finally, the lateral approach was performed using the technique described by Hardinge [20]. The anesthetist and the patient determined the type of anesthesia used. A detailed outline of each surgical approach technique can be found in a recently published article by the authors [21]. All patients received a periarticular anesthetic injection of either ropivicaine with morphine and ketorolac, or plain ropivicaine if there were contraindications to nonsteroidal anti-inflammatories, prior to wound closure.

A single surgeon was designated to perform every case using the surgical approach of their expertise. There were no cases performed by trainees (ie, residents or fellows). Each patient received standardized implants: a collared, hydroxyapatite-coated, cementless femoral stem (Corail stem; DePuy Orthopaedics Inc, Warsaw, Indiana), a cementless acetabular cup (Pinnacle Sector II acetabular cup; DePuy Orthopaedics Inc), a highly cross-linked polyethylene liner (AltrX polyethylene liner; DePuy Orthopaedics Inc), and a cobalt chrome femoral head (Articul/eze cobalt chrome; DePuy Orthopaedics Inc). Cancellous screws (DePuy Orthopaedics Inc) were inserted in order to augment acetabular fixation at the surgeon's discretion.

Cost analysis

All costs were acquired prospectively using a microcosting method reported in 2013 Canadian dollars [22]. The cost analysis was from the perspective of a public health care payer (Ontario Ministry of Health).

The total cost of the operating room time was calculated from the moment patients entered the room to the time they left the room to recover in the postanesthetic care unit (PACU). A per-minute direct and indirect operating room cost was acquired from the costing department at our institution. Costs applicable to the billing surgeon and anesthetist were acquired through the Ontario Ministry of Health's schedule of benefits [23]. The Inventory Control Clerk for our institution provided the cost of implants and operating room supplies such as drapes and sutures. The procedure time, which was time from the skin incision to wound closure, was also recorded.

There were some items that were used specifically for the anterior approach. Intraoperative fluoroscopy was monetized on a per-minute basis, capturing the direct and indirect costs of the technician and use of the C-arm fluoroscopic machine. The cost of the radiologist reading the film postoperatively was acquired from the Ontario Ministry of Health's schedule of benefits [23]. Lead aprons were required during all anterior approach procedures in order to protect against fluoroscopic radiation. The cost of each lead apron was distributed on a per-case basis using 1 year as the longevity of the item.

The traction table (Hana fracture table; Mizuho OSI) was also incorporated into the final cost based on 5-year longevity, as recommended by the manufacturer.

After each operation, the patient was transferred to the PACU. Patient care and resource use costs in the PACU were represented on a per-minute basis in consultation with the London Health Sciences Centre costing department. The length of each PACU admission was determined as the time leaving the operating room to the time of admission to the inpatient ward. This information was gathered from paper and electronic chart review.

After discharge from the PACU, the patient was admitted to the inpatient orthopedic ward. Each patient received 24 hours of postoperative antibiotics. Dalteparin or rivaroxaban was used for prophylaxis against deep vein thrombosis. Analgesia was managed by our institution's acute pain service. Narcotic consumption (acetaminophen-tramadol, acetaminophen-oxycodone, hydromorphone) was recorded during the hospital stay. All patients were permitted to weight bear as tolerated with the use of a gait aid as needed. All patients received standardized, unblinded physiotherapy in accordance with our institution's hip arthroplasty discharge pathway.

Nursing care costs were based on an average hourly wage. Administered medications, care items (ie, dressing changes and urinary catheterizations), and investigations performed were recorded from paper and electronic chart review prospectively throughout each patient's hospital stay. These costs were acquired from the costing department and pharmacy. The Ontario Ministry of Health's schedule of benefits was used to determine costs for consultations from other physicians (ie, acute pain services, internal medicine, infectious diseases, and radiology) [23]. Allied health resources such as physiotherapy, occupational therapy, and social work were assigned a per-hour cost based on information from the costing department. The time allotted for each allied health assessment was retrieved from paper chart review. Clearance for discharge occurred when patients met all required milestones outlined in our institution's THA discharge pathway. Our institution's target time to discharge for THA is postoperative day 2. The total LOS in hospital, including time in the operating room, was recorded from the patient's electronic chart. The in-hospital costs were dependent on time spent in day surgery preoperatively and time spent in PACU, plus time on the inpatient orthopedic ward.

Complications occurring in-hospital and after discharge were recorded up to 3 months postoperatively. Any readmissions and care occurring after discharge were not included in the cost analysis, as this would change the perspective of the analysis.

Statistical analysis

The association between the anterior, posterior, and lateral approaches was evaluated by means of a nonparametric Pearson χ^2 for categorical data. A 1-way analysis of variance (ANOVA) was performed for continuous demographic variables such as age and BMI.

A 1-way ANOVA was used to compare the various hospital metrics and cost data of the 3 surgical approaches, including operating room time, operating room costs, in-hospital costs, hospital LOS, and total costs of the procedure. Post hoc analysis was performed using the Scheffé test to determine significant differences between the groups when necessary. Statistical significance was set at $P < .05$. The SPSS v.22 (SPSS Inc, Chicago, Illinois) was used for all analyses.

Results

A total of 178 consecutive patients were referred to the 3 study surgeons during the recruitment period. After exclusions, 118 patients were enrolled in the study (Figure). Patient demographics were similar across all 3 cohorts (Table 1). All patients had complete intraoperative and in-hospital cost data.

There were statistically significant differences between the groups for procedure time and total time in the operating room (Table 2).