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Original research

Scar Perception After Two Surgical Approaches for Total Hip Arthroplasty

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ABSTRACT

Background: There is a paucity of literature examining patients' and health-care providers' perception of surgical scars after total hip arthroplasty (THA). This study examined perception of surgical scars after direct anterior (DAA) or posterior approach (PA) for THA using validated scar-assessment scales.

Material and methods: Seventy-five DAA and 75 PA THA patients underwent scar assessment using the Patient Observer Scar Assessment Scale (POSAS) and Stony Brook Scar Evaluation Scales. Mean age was different between the cohorts (DAA 67 vs PA 62 years, $P = .01$). All patients had subcuticular running closure, secured with skin adhesive glue. Mean time from THA to scar assessment was 3.1 and 3.6 years for the DAA and PA groups, respectively ($P = .18$).

Results: Scar opinion on the POSAS patient-reported scale was graded closer to normal skin more often for DAA than for PA patients ($P = .03$). More irregularities were graded for the DAA scars on the POSAS observer scale ($P = .02$) and the Stony Brook Scar Evaluation Scales ($P = .04$). Age did not predict scar opinion on any of the scales ($P > .05$). Female gender and a history of keloids predicted poorer scar appearance ($P = .001$ and $P = .02$). Overall scar appearance was rated as "good" in 93% of the DAA and 91% of the PA patients ($P = .63$).

Conclusion: Differences exist in DAA and PA scar perception based on validated scales. Future randomized trials in scar assessment may control for confounding variables such as age and gender, as well as potential biases when using scar assessment scales.

Introduction

The incision marks the beginning and end of any surgical procedure. Psychologically, patients report increased confidence and satisfaction when the surgical incision heals uneventfully [1]. In orthopedic surgery, patient satisfaction after a procedure is predicated on successful mitigation of pain and restoration of function. However, patients report that scar length and scar healing may also influence their decision to choose a particular procedure [2].

The influence of surgical approach in total hip arthroplasty (THA) on scar healing and scar perception is unknown. One of the purported disadvantages of the direct anterior approach (DAA) to the hip is poor wound healing due to the incision's proximity to the groin crease [3,4]. In addition, patients with a large abdominal pannus may harbor a moist environment with repetitive shearing stress on the skin that may compromise wound healing [5]. Comparatively, the skin incision used for a posterior approach (PA) to the hip may experience shear stress during sitting or lying on the side, which may also affect wound healing and scar formation.

Currently, there is no literature outlining the quality of scar healing and patients' perception of their scar after a THA. The purpose of our study was to compare the results of 2 validated scar assessment scales after a DAA or PA THA to the hip. We looked to determine whether surgical approach or patient-specific factors predicted poor scar healing and a poorly perceived scar.

Material and methods

Patients from the clinic of 2 fellowship-trained arthroplasty surgeons were approached for study participation. Inclusion

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criteria included patients that had a THA performed using either a DAA or PA at least 1 year before study participation, were aged 19 years or older, were English-speaking, and had the ability to fill out a patient-reported outcome questionnaire. Exclusion criteria included patients with any prior hip surgery, simultaneous bilateral THA, cemented THA, bikini-incision DAA, any prior surgical treatment for scarring around the involved hip (ie, scar revision surgery), previous radiation treatment to the involved hip, previous superficial wound infection, and any hip revision surgery before the scar assessment date. Patients who met the aforementioned inclusion criteria were approached for participation in a consecutive fashion. Institutional review board approval was attained before the initiation of the study.

There were 75 patients in the DAA and 75 patients in the PA cohorts. A single surgeon performed each approach. Both surgeons were senior consultants who had been practicing for many years at the time of this study. The DAA and PA were each respective surgeon's primary approach. All wounds in both groups were closed with a subcuticular running closure, secured with skin adhesive glue. Wounds were assessed by designated members of the surgical team to ensure consistent assessments. The 2 surgeons performing the procedures were not permitted to examine the wounds to eliminate expectation bias. Demographic data such as age, sex, and body mass index were recorded. Medical comorbidities such as diabetes mellitus, peripheral vascular disease, corticosteroid use, and chronic renal or liver disease were recorded as these disease states can compromise wound healing [6-8].

The scar assessment scales used to evaluate patients' scars included the Patient Observer Scar Assessment Scale (POSAS) and the Stony Brook Scar Evaluation Scale (SBSES). The POSAS is a validated, patient-reported and observer scar assessment tool used extensively in the plastic surgery literature [1]. The patient-reported portion includes 7 questions about the scar, including pain, itchiness, color, stiffness, thickness, irregularity, and an overall opinion. The observer scale includes an assessment of scar vascularity, pigmentation, thickness, relief, pliability, surface area, and an overall opinion. A score of 1 is close to normal skin, and a score of 10 is the worst scar imaginable.

The SBSES has also been validated for scar assessment after surgical procedures and is administered by a physician observer [9]. It has recently been used to assess the quality of wound healing after orthopedic surgery [10]. This assessment tool evaluates scar width, height, color, the presence of hatch marks or irregularities, and overall appearance. Each category is assigned a score of 0 or 1 depending on whether it is close to normal skin, for a best total score of 5 points.

The data were summarized using means and standard deviations for continuous variables and counts and percentages for categorical variables. A student's t-test was used to compare means of continuous variables. Categorical variables were tested using cross-tabulation with Pearson Chi-square, and scale variables were tested using a nonparametric Fisher's exact test depending on the distribution of the variable. Predictive nonparametric correlations of poor scar assessment scores were determined using Spearman Rho. All statistical tests were two-sided, and statistical significance was set at alpha = 0.05. Analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC).

Results

The mean time to scar assessment after surgery was 3.1 and 3.6 years for the DAA and PA groups, respectively ($P = .18$). Mean patient age was 67.1 years in the DAA and 61.6 years in the PA cohorts, which was significantly different ($P = .01$). All other demographic and comorbid variables were similar between the 2 cohorts (Table 1).

Table 1
Patient demographics and medical comorbidities.

Variable	Direct anterior (N = 75)	Posterior (N = 75)	*P* value
Age at scar assessment			
Mean (SD) range	67.1 (9.4)	61.6 (14.4)	.01
Sex			
Male	42	42	1.00
Female	33	33	
BMI (kg/m^2)			
Mean (SD) range	30.9 (5.3)	29.2 (7.3)	.08
Age-adjusted Charlson comorbidity index (CCI)			
Mean (SD) range	4.2 (2.1)	3.6 (2.6)	.12
Steroid use			
Yes	2	7	.14
No	73	68	
Diabetes mellitus			
Yes	16	7	.08
No	59	68	
Active smoker			
Yes	9	4	.19
No	66	71	
Rheumatoid arthritis			
Yes	2	2	1.00
No	73	73	
Peripheral vascular disease			
Yes	26	25	.82
No	49	50	
Psoriasis			
Yes	3	0	.12
No	72	75	
Known skin cancer			
Yes	6	7	.94
No	69	68	
Known keratosis			
Yes	11	7	.35
No	64	68	

On the patient-reported scale of the POSAS, the DAA cohort reported that their skin appeared closer to normal skin than the PA cohort ($P = .03$). Also, scar thickness was reported as closer to normal skin more often in the anterior approach cohort ($P = .04$). All other components of the patient-reported scale, including scar pain, itchiness, color, and irregularities, were comparable between the 2 groups. On the observer portion of the POSAS, skin relief, or the number of irregularities present throughout the scar, was graded to be closer to normal in the PA group ($P = .02$). Scar vascularity, pigmentation, thickness, pliability, surface area, and overall scar opinion were otherwise similar between the 2 approaches (Table 2).

On the SBSES scale, patients were graded as having a darker scar than normal skin in the posterior cohort ($P = .04$). Hatch or suture marks and irregularities were present more often in the anterior approach cohort ($P = .04$). The scar width and height comparisons were similar between the groups. The overall appearance of the scar was reported as "good" in 93% of the DAA and 91% of the PA patients ($P = .63$). The total scores on the SBSES were also similar between the groups ($P = .52$; Table 3).

With regard to predictive factors, female patients reported a poorer opinion of their scar on the POSAS patient-reported scale ($P = .001$). The presence of keloids predicted a "poor" scar appearance on the SBSES scale ($P = .02$). Despite the significant difference in mean age between the cohorts, patient age did not predict a poor scar rating across all 3 scales (Table 4).

Discussion

Our study demonstrated that most patients undergoing a THA through either a DAA or PA were satisfied with the overall

Table 2
POSAS Patient and Observer Scale results.

POSAS Patient Scale Results			
Category	Anterior approach	Posterior approach	*P* value
Painful scar	1.1 (0.5)[a]	1.0 (0.1)[a]	.83
Itchy scar	1.0 (0.1)	1.1 (0.3)	.09
Scar color	1.5 (1.0)	1.7 (1.2)	.16
Scar thickness	1.4 (1.0)	1.8 (1.6)	.04
Irregular scar	1.6 (1.6)	1.9 (1.8)	.14
Overall scar opinion	1.5 (1.0)	2.0 (1.8)	.03
POSAS Observer Scale Results			
Category	Anterior approach	Posterior approach	*P* value
Vascularity	1.5 (0.9)	1.4 (1.2)	.67
Pigmentation	1.8 (1.3)	1.7 (1.3)	.63
Thickness	1.7 (1.0)	1.7 (1.5)	.51
Relief	1.6 (1.0)	1.2 (0.7)	.02
Pliability	1.5 (1.0)	1.2 (0.9)	.06
Surface area	1.7 (1.0)	1.7 (1.6)	.42
Overall opinion	1.8 (1.0)	1.6 (1.3)	.19

[a] Mean scores reported with standard deviations; significance $P < .05$.

appearance of their scar. Patients in the anterior approach group reported that their scar appeared closer to normal skin with more normal thickness than the PA. There were fewer irregularities with the PA scars as graded by the POSAS observer scale, with no significant group differences in overall scar appearance. Female gender and the presence of keloids predicted poorer scar ratings on various scales, where multiple other comorbid conditions did not predict poorer scar ratings.

Patients in the DAA cohort reported more near-normal scar attributes on almost every attribute of the POSAS patient-reported scale, including overall scar opinion. Interestingly, on the POSAS observer scale, observers reported better scar ratings for the PA on almost every category. Patient-reported scales often succumb to various forms of bias [11]. Specifically, expectation and response bias may be a concern with regard to the anterior approach. This approach is marketed as a minimally invasive approach, and patients may interpret that if their scar is smaller, the scar should heal more normally. This phenomenon can result in an extreme response style, where patients will grade the scar as normal even if imperfections are present [11]. One method to reduce the potential for bias would be randomized patient selection before surgery, which was not possible with our retrospective design.

On both the POSAS observer scale and SBSES, the DAA was graded as having more irregularities. Wound healing complications

Table 3
SBSES scores.

Category	Anterior approach	Posterior approach	*P* value
Width			
>2 mm	19 (25%)	20 (26%)	.88
≤2 mm	56 (75%)	55 (74%)	
Height			
Elevated or depressed	5 (7%)	7 (9%)	.63
Flat	70 (93%)	68 (91%)	
Color			
Darker	6 (8%)	17 (23%)	.04
Same color or lighter	69 (92%)	58 (77%)	
Hatch marks/suture marks/ irregularities			
Present	11 (15%)	3 (4%)	.04
Absent	64 (85%)	72 (96%)	
Overall appearance			
Poor	5 (7%)	7 (9%)	.63
Good	70 (93%)	68 (91%)	
Total score, mean (SD)	4.4 (1.2)	4.4 (0.9)	.52

Table 4
Predictive factors of overall scar appearance on POSAS and SBSES.

Assessment scale and predictive factor	Spearman *P* value
POSAS—patient opinion of scar	
Age	.11
Gender (female)	.001
Steroid use	.27
Biologic agents	.81
Peripheral vascular disease (PVD)	.83
Type II diabetes (DM2)	.93
Smoking	.41
Connective tissue disease (CTD)	.30
Psoriasis	.81
Skin cancer	.93
Keloids	.56
POSAS—observer opinion of scar	
Age	.33
Gender (female)	.59
Steroid use	.53
Biologic agents	.25
PVD	.64
DM2	.06
Smoking	.71
CTD	.42
Psoriasis	.97
Skin cancer	.65
Keloids	.90
SBSES—overall scar appearance “poor”	
Age	.60
Gender (female)	.71
Steroid use	.47
Biologic agents	.69
PVD	.57
DM2	.37
Smoking	.37
CTD	.78
Psoriasis	.69
Skin cancer	.68
Keloids	.02

$P < .05$, Spearman correlation nonparametric.

are not uncommon with this approach, with rates of wound complications requiring intervention as high as 12% [3,4,12,13]. Tensile forces across the groin folds and a patient’s pannus increase stress observed by a DAA scar [3,12]. In addition, soft tissue retraction through a small incision has been associated with poorer scar appearance and wound healing [14]. Although all wounds were closed with a uniform technique, any wound closure would also be susceptible to variations in quality of closure that could result in irregularities.

Female gender was associated with a poorer scar assessment on the POSAS patient-reported scale. This may be due to gender differences in body image and importance placed on a well-healed scar [15]. The difference in mean patient age is a confounding variable when interpreting the results. Skin tension, scar hypertrophy, and scar irregularities are less common in older patients undergoing surgery, largely due to reduced skin tension during wound healing [16]. A history of keloids also predicted poor scar appearance on the SBSES. The pathogenesis of keloid formation is due to dysfunction of fibroblasts and an overproduction of type 1 collagen during the wound healing process [17]. An inheritance pattern exists with keloid formation [18]. Therefore, a history of keloid formation should prompt a discussion of wound healing after THA.

Our study is not without limitations. The study sample size is relatively small, and we are likely underpowered to detect differences in some metrics. For instance, detecting a true statistical difference between the number of “good” ratings may require over 3000 patients in each group. As mentioned earlier, the lack of randomization exposes our results to expectation and selection

bias. Some patients may have been included or excluded from having an anterior approach because of their body habitus, which reduces the generalizability of the results. It is possible, also, that the location of the scar may make the scar more or less visible to patients, although this limitation is felt to be small. In addition, while all incisions were made in a similar fashion, we did not account for precise obliquity of each incision or how this may influence the results. However, bikini-style DAA incisions were not included in this study. The external validity of the study is limited by being a single institution with only 2 surgeons performing the procedures. We did not include another commonly performed approach, the lateral approach, in our analysis. In future studies, it would have been worthwhile to educate patients on what various healed scars may look like to facilitate their assessment and help reduce response and expectation bias.

Differences exist in scar appearance and perception after THA through either a DAA or PA with the use of validated patient-reported and assessor scales. Patients undergoing a THA with a DAA should be cautioned about scar irregularities; however, this may be a consequence of the closure technique. Patient factors, including patient age, sex, and history of keloid formation, were associated with a poorer scar assessment after THA. A blinded, randomized, controlled trial is required to control for various forms of bias to draw more definitive conclusions regarding scar perception.

Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: M. W. Pagnano receives royalties from DePuy Synthes and Stryker; is a paid consultant for Turbett Surgical; receives financial or material support from Walters Kluwer; and is a board member of the Knee Society. R. J. Sierra receives royalties from Zimmer Biomet and Link; is a paid consultant for OrthoAlign; receives research support from Zimmer Biomet and Cytori; receives financial or material support from Springer; is a *Journal of Arthroplasty* Elite Reviewer; is a board member of AAHKS, MAOA, ANCHOR Study Group, and Muller foundation. M. J. Taunton receives royalties from and is a paid consultant for DJO Global; receives research support from Stryker and DePuy; receives financial or material support from and is in the editorial or governing board of *Journal of Arthroplasty*; is a board member of AAHKS and AAOS. R. T. Trousdale receives royalties from DePuy.

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References

[1] Mundy L, Miller H, Klassen A, Cano S, Pusic A. Patient-reported outcome instruments for surgical and traumatic scars: a systematic review of their development, content, and psychometric validation. Aesthetic Plast Surg 2016;40(50):792.

[2] Chechik O, Khashan M, Lador R, Salai M, Amar E. Surgical approach and prosthesis fixation in hip arthroplasty world wide. Arch Orthop Trauma Surg 2013;133(11):1595.

[3] Jewett B, Collis D. High complication rate with anterior total hip arthroplasties on a fracture table. Clin Orthop Relat Res 2011;469:503.

[4] Barton C, Kim P. Complications of the direct anterior approach for total hip arthroplasty. Orthop Clin North Am 2009;40:371.

[5] Jahng K, Bas M, Rodriguez J, Cooper H. Risk factors for wound complications after direct anterior approach hip arthroplasty. J Arthroplasty 2016;31:2583.

[6] Singh N, Armstrong D, Lipsky B. Preventing foot ulcers in patients with diabetes. JAMA 2005;293:217.

[7] Reddy M. Skin and wound care: important considerations in the older adult. Adv Skin Wound Care 2008;21:424.

[8] Abu-Rumman P, Armstrong D, Nixon B. Use of clinical laboratory parameters to evaluate wound healing potential in diabetes mellitus. J Am Podiatr Med Assoc 2002;92:38.

[9] Singer A, Arora B, Dagum A, Valentine S, Hollander J. Development and validation of a novel scar evaluation scale. Plast Reconstr Surg 2007;120:1892.

[10] Davids J, Diaz K, Leba T, Adams S, Westberry D, Bagley A. Outcomes of cutaneous scar revision during surgical implant removal in children with cerebral palsy. J Bone Joint Surg Am 2016;98:1351.

[11] Dowling N, Bolt D, Deng S, Li C. Measurement and control of bias in patient reported outcomes using multidimensional item response theory. BMC Med Res Methodol 2016;16:1.

[12] Alvarez-Pinzon A, Mutnal A, Suarez J, et al. Evaluation of wound healing after direct anterior total hip arthroplasty with use of a novel retraction device. Am J Orthop 2015;44:17.

[13] Matta J, Shahrdar C, Ferguson T. Single-incision anterior approach for total hip arthroplasty on an orthopaedic table. Clin Orthop Relat Res 2005;441:115.

[14] Mow C, Woolson S, Nharmukos S, Park E, Lorenz H. Comparison of scars from total hip replacements done with a standard or mini-incision. Clin Orthop Relat Res 2005;441:80.

[15] Bolton M, Lobben I, Stern T. The impact of body image on patient care. Prim Care Companion J Clin Psychiatry 2010;12(2). PCC.10r00947.

[16] Son D, Harijan A. Overview of surgical scar prevention and management. J Korean Med Sci 2014;29:751.

[17] Chike-Obi C, Cole P, Brissett A. Keloids: pathogenesis, clinical features, and management. Semin Plast Surg 2009;23:178.

[18] Marneros A, Norris J, Olsen B, Reichenberger E. Clinical genetics of familial keloids. Arch Dermatol 2001;137:1429.