



## Original research

## Patient-Reported Outcomes After Total Hip Arthroplasty in a Low-Resource Country by a Visiting Surgical Team

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## ABSTRACT

**Background:** Total hip arthroplasty (THA) is a highly successful procedure but limited in many low-resource nations. In response, organizations globally have conducted service trips to provide arthroplasty care to underserved populations. Few outcomes data are currently available related to these trips. Our study aims to demonstrate the feasibility of tracking patient-reported outcomes and complications after THA in a low-resource setting and that outcomes are comparable to those in developed countries. **Methods:** We completed an arthroplasty service trip to Brazil in 2017 where we performed 46 THAs on 38 patients. The mean patient age was 48.8 years. Forty-seven percent were female. Patient-reported outcome scores were collected preoperatively and postoperatively at 2, 6, and 12 weeks and 1 year. A multivariate regression analysis was performed to identify associations between patient factors and 12-week outcomes.

**Results:** The mean modified Harris Hip Score, Hip Disability and Osteoarthritis Outcome Score, Patient-Reported Outcome Measurement Information System Short Form (PROMIS-SF) Pain Interference, and PROMIS-SF Physical Function all improved significantly compared to baseline at 2, 6, and 12 weeks and 1 year postoperatively. At 1 year, only 29% of patients (11 of 38) were reachable by phone for follow-up. Multivariate regression analysis at 12 weeks found that females had more improvement in Hip Disability and Osteoarthritis Outcome Score for Joint Replacement scores ( $P = .003$ ) and PROMIS-SF Pain Interference scores ( $P = .01$ ) than males, and patients with rheumatoid arthritis had more improvement in PROMIS-SF Pain Interference scores ( $P = .008$ ) compared with all other diagnoses.

**Conclusion:** Patients in low-resource countries benefitted significantly from THA performed by a visiting surgical team. However, following up patients is difficult in low-resource countries once they leave the hospital.

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## Introduction

Osteoarthritis (OA) is a leading cause of disability, causing pain in 1 of 7 people worldwide [1,2]. Rates of arthritis and disability are the highest in patients in lower socioeconomic classes. In addition to dramatically improving individual patients' health, joint

replacement surgery may help restore the economic health of communities. In the United States, for example, hip and knee replacement is estimated to save about \$19,000 per US citizen throughout their lifetime (through reduced inactivity and increased productivity) [3]. Other investigators have reported that well-over 90% of patients who undergo hip or knee replacement return to work [4,5]. Thus, despite the cost and complexity of these surgeries, hip and knee replacement are among medicine's most cost-effective surgeries. Sadly, these surgeries are unavailable in many communities around the world [6,7]. For example, over the last 5 years in Pernambuco, Brazil, rates of hip and knee replacement

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declined at a time of increasing need, resulting in several thousands of patients wait-listed for surgery [8].

One approach to meeting the burgeoning need for joint replacement surgery has been for experienced surgical teams from developed countries to travel to underserved areas to provide arthroplasty care [9–14]. These medical service “mission” trips, usually referred to as “surgical camps,” are increasingly common. Currently, the Operation Walk organization is composed of 20 teams who conduct 1–2 service trips a year with the average value of care provided for each trip estimated to be about \$500,000 [15]. The high level of expertise of visiting surgeons allows performance of complex surgeries, typically unavailable in the poor communities visited. However, medical service trips, if not well planned, can have unexpected negative effects. Postsurgical patients return to remote villages, without the follow-up care or rehabilitation necessary for good outcomes. Patients experience short- and long-term surgical complications, burdening local facilities that do not have adequate resources or skill. Despite the regularity of these projects, research evaluating the outcomes of such trips is limited.

Arthroplasty care in the United States has become highly standardized and has been optimized to expedite recovery and minimize risk for complications [16–20]. It remains unclear how well these processes can be translated to a community without longitudinal presence of an experienced surgical team and in the setting of poor resource availability. Furthermore, it is unknown if patients treated by a visiting surgical team can be tracked longitudinally to ensure good outcomes and appropriate follow-up care.

Considering these gaps in the literature, we report the outcomes of primary hip replacement surgeries performed by a visiting surgical team in Pernambuco, Brazil, on patients who otherwise were without access to joint replacement. Specifically, we hypothesized that (1) tracking patient-reported outcomes and complications after surgery is possible, and (2) the outcomes of total hip arthroplasty (THA) provided by a visiting surgical team would be comparable to those in the United States. Second, we sought to describe characteristics of patients presenting for care at a “surgical camp,” information which may be useful for future planning.

## Material and methods

After obtaining institutional board review approval, we prospectively enrolled all patients undergoing elective primary THA as part of an Operation Walk Chicago (OWC) arthroplasty surgical camp in Pernambuco, Brazil (January of 2017). OWC is a nonprofit organization that sponsors arthroplasty service trips to provide hip and knee replacements for minimal or no cost in low-resource communities. OWC supports ongoing projects in Nepal, Vietnam, Brazil, and Manilla, focusing on education, program development, and direct surgical care; nonreligious; and nongovernmental. OWC is staffed by volunteers, receives in-kind donations from industry, and funded through philanthropic donations. OWC negotiates formal agreements with their in-country hosts that detail responsibilities of each partner, including short- and long-term project goals, protocols of care, and follow-up responsibilities for complications. OWC is one of 20 Operation Walk programs internationally.

Our team conducted all operations at Hospital Dom Helder, one of 3 public hospitals in the metropolitan area of Recife (the capital of Pernambuco). The hospital has over 150 beds, carries out about 7900 hospitalizations a year, and offers services in multiple specialties, including orthopedic trauma, general surgery, cardiology, and internal medicine [21].

Inclusion criteria included patients referred by Hospital Dom Helder for primary THA during OWC’s surgical camp, after the patient was deemed appropriate for surgery by a hospital

orthopedic surgeon and medically cleared by an internist. All patients were diagnosed with end-stage degenerative joint disease of one or both hips, as a consequence of OA, osteonecrosis, or avascular necrosis, posttraumatic OA, rheumatoid arthritis (RA), or developmental dysplasia of the hip. Referred patients then underwent a final screening by OWC clinicians through an interdisciplinary evaluation that included an internist or anesthesiologist, orthopedic surgeon, and physiatrist, during which a plan of care was developed. Three patients who were referred by the hospital and cleared for surgery were denied by the OWC screening team and excluded from the analysis. The specific reasons for exclusion were untreated leprosy, mild hip disease in a young patient, and severe arterial insufficiency in the target leg.

Thirty-eight patients were included in our study (Table 1). Eight patients received bilateral simultaneous THAs. The mean patient age was 48.8 years with a standard deviation of 14 years (range: 21–72 years). Eighteen patients (47%) were female while 20 patients (53%) were male. Preoperative diagnosis included 23 patients (61%) with OA, 5 patients (13%) with avascular necrosis, 5 patients (13%) with posttraumatic OA, 3 patients (8%) with developmental hip dysplasia, and 2 patients (5%) with RA. Three patients (8%) had a preoperative diagnosis of type 2 diabetes, 4 patients (11%) identified as cigarette smokers, 4 patients were hypertensive (11%), and 2 patients (5%) had a history of a congestive heart failure episode. Other comorbid conditions included HIV-positive status ( $n = 1$ ), acromegaly ( $n = 1$ ), seizure disorder ( $n = 1$ ), thrombocytopenia ( $n = 1$ ), and atrial fibrillation ( $n = 1$ ). There were 17 patients (45%) with pain for 1–5 years, and the remaining 21 patients (55%) had pain for over 5 years.

Preoperatively, demographics and medical comorbidities were collected, and each patient completed a preoperative assessment including modified Harris Hip Score (mHHS) [22], Hip Disability and Osteoarthritis Outcome Score for Joint Replacement (HOOS JR.) [23], and Patient-Reported Outcome Measurement Information System Short Form (PROMIS-SF) for Pain Interference and Physical Function [24,25]. Postoperatively, the same 4 patient-reported outcome scores (mHHS, HOOS JR., PROMIS-SF Pain, and Physical Function) were administered at 2, 6, and 12 weeks and 1 year.

The local surgeon at routine follow-up collected outcome measures. When patients were unable to make longer term follow-

**Table 1**  
Patient demographics.

Demographics (n = 38 patients)	
Female	18 (47%)
Male	20 (53%)
Mean age (SD)	48.8 (14%)
Preoperative diagnosis	
OA	23 (61%)
AVN	5 (13%)
Post-trauma	5 (13%)
RA	2 (5%)
DDH	3 (8%)
Comorbidity	
Diabetes	3 (8%)
Smoking	4 (11%)
CHF	2 (5%)
Pain duration	
Pain for <1 y	0
Pain for 1–5 y	17 (45%)
Pain for >5 y	21 (55%)
Surgery factors	
Unilateral THA	30 (79%)
Bilateral simultaneous THA	8 (21%)
Total number of THA	46 (100%)

AVN, avascular necrosis; CHF, congestive heart failure; DDH, developmental dysplasia of the hip.

up, outcome measures were collected over the phone by one of the local team members. Local surgeons also tracked complications and shared this with the OWC team to include in the final analysis; OWC surgeon and medical team leaders discussed ongoing surgical and nonsurgical management of complications with the local surgical team.

The differences in categorical variables were analyzed using Pearson's Chi-squared test. Continuous data were analyzed with two-sample Student's t-test. A multivariate logistic regression analysis was performed to determine association between preoperative patient characteristics and patient-reported outcomes. Twelve-week follow-up data were used, as there were not enough patients at 1 year. Statistical significance was set at  $P \leq .05$ . Statistical analysis was completed with JMP Pro v13 software (SAS, Cary, NC).

## Results

There were 46 primary uncemented THAs performed on 38 patients. Thirty patients had a unilateral THA, and 8 patients had bilateral simultaneous THAs (Table 1). All THAs were performed through a posterior approach. Implants were uncemented Stryker Accolade stems and Trident acetabular cups. Implant sizes ranged and were sized appropriately for each patient. OWC volunteers and in-country clinicians follow pre-established protocols of care to assure quality and standardize teaching. The protocol was shared with the hospital 3 months before the surgical camp and reviewed with hospital staff on the first day of the surgical camp.

We did have some early complications (Table 2). Two patients experienced postoperative anemia (hemoglobin  $<8.0$ ) requiring blood transfusion. One patient was diagnosed with superficial cellulitis, successfully treated with oral antibiotics. One patient was diagnosed by the hospital's orthopedist with a presumptive deep vein thrombosis; this patient was treated with an oral anticoagulant for 3 months. In addition, one patient had a major complication. This patient experienced an intraoperative acetabular fracture, which was diagnosed during the surgery. This was treated by an additional, planned acetabular open reduction internal fixation several weeks later.

Thirty-three patients (87%) followed up for their 2-week postoperative visit (Table 3). However, at 1 year, only 11 of 38 patients (29%) presented for their 1-year follow-up. An attempt was made to contact any patients that did not follow-up, and the mobile phones were no longer in service for 27 of 38 patients (71%).

Mean  $\pm$  standard deviation (SD) mHHS improved from the preoperative to 1-year postoperative time point ( $28.5 \pm 13.9$  vs  $92.5 \pm 15.9$ ) (Table 4). Mean  $\pm$  SD HOOS JR. improved preoperatively to 1 year postoperatively ( $29.8 \pm 18.4$  vs  $94.7 \pm 10.5$ ). Mean  $\pm$  SD PROMIS-SF Pain Interference improved from  $68.4 \pm 7.1$  preoperatively to  $43.1 \pm 6.8$  one year postoperatively (Decreased PROMIS-SF Pain Interference scores indicate decreased pain.). Mean  $\pm$  SD PROMIS-SF Physical Function improved from  $27.7 \pm 5.3$  preoperatively to  $53.3 \pm 9.5$  one year postoperatively.

Multivariate regression analysis compared the mean changes in preoperative outcomes and postoperative outcomes at 12 weeks and did not reveal any associations between patient-reported outcomes and age, gender, pain duration, preoperative diagnosis

**Table 3**  
Patient response rate.

	Preoperative	2 wk	6 wk	12 wk	1 y
Number of patients	38	33	32	25	11
Percentage	100%	87%	84%	66%	29%

or unilateral vs bilateral surgery (Table 5), with the following exceptions: Female patients had significantly more improvement in HOOS JR. scores ( $P = .003$ ) and PROMIS-SF Pain Interference scores ( $P = .01$ ) than male patients, and patients with RA had significantly more improvement in PROMIS-SF Pain Interference scores ( $P = .008$ ) than those with all other diagnoses.

## Discussion

Advanced hip and knee arthritis is disproportionately disabling in patients who live in low-resource countries, compounded by the problems with access to surgery in these countries [11,12,14]. Various organizations have sought to improve access through sending visiting surgical teams [10,13,26] to perform arthroplasty care. This approach is hampered by several factors, including implant costs, limited surgical resources, systemic community biases against surgery, tracking outcomes, and providing follow-up care.

Hip implants make up a significant portion of the cost for a THA, and its price often makes surgery unattainable in low-resource countries even if care is available to them. In the United States, a hip implant may cost anywhere between \$3000 to \$10,000 [27]. To put things into perspective, in 2010, the average per capita income in the state of Pernambuco, Brazil (where our team traveled to), was about \$100 per month [28]. Thus, if implants are not donated by a company, it is often prohibitively expensive for a patient in a low-resource country to pursue joint replacement surgery. Furthermore, the difficulty in obtaining sufficient proper surgical instrumentation due to the limited sterile processing capacity in low-resource countries adds an additional barrier to receiving surgery in a low-resource country [29].

In many low-resource countries, there is a systemic community bias against joint replacements. In these settings, joint replacements, such as a THA, are much less common than in a developed country. Consequently, patients may have a fear of the unknown, as there is less familiarity with the procedure. Patients presenting late in the disease course coupled with the lack of proper surgical resources may also result in poorer surgical outcomes, which could make a lasting negative impression in the patient's community. In addition, patients' own cultural beliefs, including their understanding of how their diseases manifest and preferring more natural treatments, contributes to the bias against surgery. Thus, assessment and incorporation of cultural factors into the care model, as proposed by Bido et al. may enable improved care coordination and follow-up [30].

The feasibility of tracking outcomes from these surgeries, and the outcomes themselves, has not been well defined. Here, we report outcomes from a series of THA cases performed by a visiting surgical team in Pernambuco, Brazil. We found that in patients who we could track, patient-reported outcomes improved at a level equivalent to studies from developed countries. However, we found that our ability to track patients dropped substantially beyond 6 weeks and declined to only 29% by 1 year after surgery. For patients with tracked outcomes out to 1 year after surgery, outcomes were comparable to those reported in developed countries [31,32]. Similar findings of comparable arthroplasty outcomes in underserved areas were reported by Bido et al. [26].

**Table 2**  
Complications.

Postoperative anemia	2 (5%)
Superficial cellulitis	1 (3%)
Deep vein thrombosis	1 (3%)
Intraoperative acetabular fracture	1 (3%)

**Table 4**  
Patient-reported outcomes.

	Preoperative		2 wk		6 wk		12 wk		1 y	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Modified Harris Hip Score	28.5	13.9	54.7	18.5	69.1	12.6	88.0	5.4	92.5	15.9
HOOS JR.	29.8	18.4	66.5	14.2	82.0	15.3	99.0	4.8	94.7	10.5
PROMIS-SF Pain Interference	68.4	7.1	50.9	8.8	45.1	6.5	43.0	5.2	43.1	6.8
PROMIS-SF Physical Function	27.7	5.3	35.4	7.1	43.0	8.1	50.6	7.9	53.5	9.5

This study was not powered to detect differences in outcomes by demographic or comorbidity factors. We did, however, identify an association between female gender and larger improvements in HOOS JR. and PROMIS-SF Pain Interference scores, as well as RA diagnosis and larger improvements in PROMIS-SF pain interference scores. This is in contrast to previous research that has shown no differences in arthroplasty outcomes in males and females [33] and in pain relief between RA and OA [34]. Given the small study size, further analysis of a larger population is necessary to more confidently confirm or reject our associations.

We had limited ability to follow up patients over time. This is in stark contrast to reported follow-up in series of arthroplasty patients from developed countries. One other study of arthroplasty performed in an underserved country by a visiting surgical team found a follow-up rate of 80.4% at minimum 1 year in the Dominican Republic [26]. Our trip targeted patients without economic resources to obtain arthroplasty care, and as such, many patients did not have reliable access to a phone or to the internet. Many patients lived long distances from the hospital and did not have the resources to travel to follow-up visits. Methods typically used for follow-up in developed countries may need to be adapted for use in developing countries. Furthermore, buy-in from local surgeons and medical professionals is essential to ensure longitudinal follow-up care for patients. Finally, repeated visits by the same team to the same location over time may also provide an avenue for follow-up.

As low-resource hospitals begin to offer more primary joint replacement surgeries, they will soon be faced with the issue of revision surgeries. Revision joint replacement surgeries can cost up to 76% more and lead to more postoperative complications than primary joint replacement surgeries [35]. Thus, it will be essential for low-resource hospitals to anticipate these barriers, so that they are prepared for the consequences of increased total joint arthroplasty procedures. In addition, education of local surgeons is an

important aspect of the mission trip and will allow for sustainability of increased joint replacement surgeries over time.

Overall, this study has several limitations. Our results are specific to one trip in a specific country and may not be generalizable to other visiting surgeon trips or to other countries. The specific care protocols and pathways for follow-up used by this mission trip do not necessarily reflect those in use by other trips, and caution should be taken in extrapolating any results. The small sample size may also limit interpretation of the multivariate regression analysis. In addition, the outcomes may be heavily biased by the lack of follow-up for a large portion of the cohort. Our low response rate at 1 year (29%) stemmed from the expiration of our patients' phone card subscription before we were able to contact them for follow-up. In addition, patients who live in remote rural areas may have great difficulty in finding transportation to a hospital for follow-up. In future trips, more permanent forms of contact, such as email, physical mail, and mobile messaging applications (WhatsApp, Messenger, and so forth), may lead to higher response rates. Follow-up rates may also be improved by collecting permanent contact information of close family members, particularly of those patients who live in remote areas and do not have access to digital communication technologies. An organized plan to help coordinate transportation of patients back to the hospital where the surgery was performed or another local hospital for follow-up may also increase response rates. Finally, language barriers may have introduced bias to the instruments used. Medical professionals fluent in the native language provided translation services, but instruments used have not been validated in Portuguese.

## Conclusions

We found that patients in a developing country benefitted significantly from THA when performed by a visiting surgical team.

**Table 5**  
Twelve-week logistic regression analysis.

	Modified Harris hip score		HOOS JR.		PROMIS-SF pain interference		PROMIS-SF physical function	
	Mean $\Delta$	<i>P</i> value	Mean $\Delta$	<i>P</i> value	Mean $\Delta$	<i>P</i> value	Mean $\Delta$	<i>P</i> value
Gender								
Male	51.5	.24	<b>57.3</b>	<b>.003</b>	<b>21.1</b>	<b>.01</b>	21.3	.30
Female	59.8		<b>81.8</b>		<b>26.1</b>		24.4	
Age <sup>a</sup>	<i>P</i> = .34, r-square = 0.05		<i>P</i> = .35, r-square = 0.03		<i>P</i> = .43, r-square = 0.02		<i>P</i> = .22, r-square = 0.06	
Pain duration								
Pain for 1–5 y	53.2	.48	72.8	.72	23.3	.56	22.6	.29
Pain for >5 y	58.0		68.4		20.3		23.3	
Preoperative diagnosis								
Osteoarthritis	59.5	.46	72.5	.53	22.5	.28	26.0	.18
Osteonecrosis	54.8	.93	57.7	.70	15.8	.19	23.0	.23
Developmental dysplasia of the hip	50.5	.56	73.5	.85	20.5	.49	14.1	.17
Posttraumatic osteoarthritis	55.1	.94	69.3	.51	16.9	.24	12.9	.07
Rheumatoid arthritis	58.2	.75	83.4	.27	<b>37.3</b>	<b>.03</b>	26.9	.25
Unilateral vs bilateral								
Unilateral THA	50.9	.24	72.0	.46	22.1	.24	22.6	.75
Bilateral simultaneous	60.3		65.2		20.1		24.5	

<sup>a</sup> Bivariate analysis. Bold values indicate statistical significance.

Of those that could be contacted, outcomes were significantly improved from preoperative values after 1 year. While managing complications remotely is difficult, the benefits of surgery far outweigh the risk of adverse events for most patients. This study also highlights the difficulty of following up patients in low-resource countries once they leave the hospital. Methods need to be developed to assure that the outcomes of these potentially valuable procedures can be determined. We are currently establishing the capability of using more permanent contact information, such as email and smart phone applications linked through email addresses, to improve follow-up on future missions.

### Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: V.A.B. is a paid consultant for Pacira Pharmaceuticals; received research support as PI and lead author for the study “A Prospective, Randomized Double Blind Trial of Synvisc One vs. Saline for Mild to Moderate Osteoarthritis of the Hip” SOLAR trial Sanofi Corporation completed in 2016 and for “Evaluating the use of intra-articular injections as a treatment for painful hip osteoarthritis: a randomized, double-blind, multicenter, parallel-group study comparing hylan G-F 20 and saline.” Osteoarthritis and Cartilage 27 (2019). She also serves as a founder and director for Operation Walk Chicago—medical humanitarian nonprofit organization that provides hip and knee replacement surgeries and clinical educational programs for impoverished patients throughout the world. This article describes the outcomes from one Operation Walk Chicago charitable surgical project”. S.D.S. received royalties from Stryker, Zimmer, Implex, and Consensus and is the Managing Director of International Society for Technology in Arthroplasty (ISTA). He is a Clinical Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery, Northwestern University Feinberg School of Medicine and also serves as a founder and director for Operation Walk Chicago.

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