A Patient Follow-up Program for Short-Term Surgical Mission Trips to a Developing Country

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Background: We describe a follow-up program for patients undergoing surgical procedures with documented results from short-term surgical mission trips to the developing world. The surgical procedures were all performed at a government hospital in Pucallpa, Peru, a remote city in the Amazon.

Methods: Between July 2007 and January 2012, ten surgical mission trips were completed with a mean time of six days on location and a mean number of 2.3 surgeons (range, two to five surgeons) per trip. A Peruvian general surgeon conducted postoperative visits at time intervals of two to four weeks, five to sixteen weeks, four to seven months, and eight to twelve months. Each visit included the completion of a patient outcome form, radiographs, and functional range-of-motion photographs. Patient demographic characteristics; type of surgical procedure; completed follow-up; complications including infection, malunion, or nonunion; and clinical results were analyzed.

Results: Of the 127 patients eligible for analysis, twenty-three patients were lost to follow-up, leaving a follow-up rate of 81.9% (104 of 127 patients). Patients were predominantly male (63.5%) and had a mean age of 37.0 years (range, ten months to 93.4 years). The mean length of follow-up was 11.8 months, with a mean number of 3.7 postoperative encounters. Orthopaedic trauma fixation was the predominant surgical procedure (57%), with forty-two procedures (40%) being open reduction and internal fixation. In the 104 patients, successful wound-healing occurred in 101 (97%) and 100 (96%) had a functional outcome deemed to be good or fair by the in-country physician. The infection rate was 2.9% (three patients), with 97% (fifty-seven of fifty-nine) of fractures united. There was one nerve injury in a pediatric patient treated for supracondylar humeral malunion, and two cases of prominent implant necessitating removal. The mean direct cost of the follow-up program was $20,041 in U.S. dollars per year.

Conclusions: It is possible to develop a sustainable surgical patient follow-up program with robust results and to achieve acceptable outcomes for orthopaedic conditions, even in an austere medical environment.

Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

The societal burden that orthopaedic injuries place on developing countries is substantial. It is estimated that five million individuals worldwide die every year from injuries1. In a global health context, this number of deaths is more than those claimed each year by human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), malaria, and tuberculosis combined2. More than 90% of all injuries occur in low-income and middle-income countries, where the health-care infrastructure is often not adequately suited to handle this burden3,4. The World Bank defines a low-income country as having a per-capita annual gross national income of $1025 or less and a middle-income country as having a per-capita annual gross national income of $1026 to $12,475 in 2009 U.S. dollars5.

For each death, it is estimated that three to fifty times as many people live with a disability from the same mechanism of injury.
injury. The World Bank, using its disability-adjusted life year (DALY) calculation, has determined that injuries of all sorts accounted for 12% of the DALYs lost worldwide, more than tuberculosis (2.5%), diarrhea (4.3%), and malaria (2.9%). Although the methodology that the World Health Organization uses to determine these estimates has been criticized, even the roughest estimates paint a bleak picture of the state of orthopaedic trauma care in developing countries. Perhaps nothing illustrates the global picture of trauma manifested at a local level more than a recent study that showed that close to half of the beds at public hospitals in East Africa are occupied by patients with trauma.

There have been increasingly urgent calls from the orthopaedic community to recognize that their unique skill set can offer a remedy for a major unmet global health need. Concurrent with this increasing awareness has been an increase in the literature devoted to this topic. Within this body of literature, follow-up reporting has been sparse, and long-term follow-up has been essentially absent.

We report our experience in developing and implementing a model for obtaining patient follow-up using multiple, simple metrics from patients treated by short-term orthopaedic surgical mission teams in Pucallpa, Peru, between July 2007 and January 2012.

Materials and Methods

Sculp at the Cross is an orthopaedic surgical mission organization founded in 2004. Its basic model is to take short-term surgical teams to the same remote city in the Amazon Jungle multiple times per year.

Orthopaedic surgical teams from the United States traveled ten times in fifty-five months between July 2007 and January 2012 to the jungle city of Pucallpa, Peru, which has a sprawling population of approximately 310,000 covering 400 square miles. Pucallpa flanks the western borders of the Amazon rainforest and is a major port for the naives living within the river basin. Each surgical team traveled a total of eleven days, spending six days working on site. The mean number of volunteer orthopaedic surgeons was 2.3 (range, two to five) per trip. This number included orthopaedic residents on two trips and orthopaedic fellows on two other trips. There were also other medical volunteers who traveled with the teams, including nurses, anesthetists, orthopaedic physician assistants, operating room circulating staff, and medical students; the mean number of volunteers per trip was 2.9 (range, zero to six volunteers) for medical volunteers and 2.6 (range, zero to six volunteers) for additional non-medical adult volunteers.

During the time of this report, the organization employed two part-time individuals (1.25 full-time equivalent total) in the United States to organize and maintain operations; one Peruvian national general surgeon who interfaced with the U.S. staff to coordinate Peruvian operations and run the follow-up program; and a volunteer board of directors, including seven individuals with orthopaedic, missions, business, and financial leadership experience. The teams that traveled along with the U.S. and Peruvian staff members were made up of medical and non-medical unpaid volunteers.

The process for patient selection occurred in the following manner. When trip dates were established, a public announcement was promoted to the surrounding population through the social service personnel of the local hospital. This occurred through local television and radio stations, through posted hospital notifications, and by word-of-mouth. Referrals also frequently occurred through local missionaries and health-care workers, who are aware of our expertise and coordinate many patients to evaluate. Our expertise focuses on malunion, nonunion, and acute fractures, as well as various musculoskeletal anomalies.

Through an on-site, one-day clinic, the visiting orthopaedic surgeons together with the local team selected, from the patients who presented, an appropriate surgical caseload for the remainder of the week’s surgical campaign. Approximately 85% of the patients who present are from the city limits and 15% are from the outlying areas, with some patients traveling from remote locations to receive care. The availability of the appropriately sized and sufficient quantity of donated implants, which were hand-carried into the country for the purpose of supporting the surgical campaigns, was also a key consideration in case selection.

The public (regional government) hospital was utilized for all surgical procedures. Using the hospital’s operating rooms and staff for operations was an intentional arrangement to facilitate an exchange of knowledge between the local and American health professionals. In the majority of the cases, the U.S. surgeons performed the surgical procedures and the local traumatologist or general surgeon assisted with the procedures. The informal teaching that occurs is an important part of the bidirectional information flow, reinforcing the notion that both parties have much to offer.

Patients were scheduled for follow-up visits at time intervals of two to four weeks, five to sixteen weeks, four to seven months, and eight to twelve months to take place at the hospital or private clinic. There was no charge incurred by the patient for the follow-up to the hospital or the Peruvian medical director for this visit. A cost equivalent to $5 in U.S. dollars (exchange rate, 3.09 Peruvian Sol/$) was required for each follow-up radiograph. For 80% of the patients, this could be covered by the patient’s government insurance, otherwise known as “Seguridad Social”; 10% of the patients were able to pay cash if they were not eligible for the government system equivalent to the U.S. Medicare system; and the remaining 10% were covered by our mission organization or the Peruvian medical director with a portion of the follow-up stipend.

Photographic documentation of wound-healing, radiographs, range of motion, neurologic status, and functional status was obtained through the use of a digital camera and was organized into a photographic matrix that could be reviewed in detail to assess outcome and healing progression (Fig. 1). In addition to photographs, a clinical follow-up form for the lower extremity (Fig. 2-A) or upper extremity (Fig. 2-B) with information on functional status, wound-healing, pain level, range of motion, and patient satisfaction was completed. For patients who did not return for their scheduled follow-up visit, an effort was made within the surrounding city limits and towns nearby to travel to the last known location of the patient to coordinate a follow-up visit or, at a minimum, to capture photographs and basic follow-up details. All collected information was sent to the United States for data entry and follow-up notes.

### TABLE I Surgical Mission Principal Procedure

<table>
<thead>
<tr>
<th>Surgical Procedure</th>
<th>No. of Patients (N = 104)</th>
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<tbody>
<tr>
<td>Orthopaedic trauma fixation</td>
<td>59 (57%)</td>
</tr>
<tr>
<td>Open reduction and internal fixation</td>
<td>42 (40%)</td>
</tr>
<tr>
<td>Intramedullary nailing (tibia or femur)</td>
<td>10 (10%)</td>
</tr>
<tr>
<td>External fixation</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>Other orthopaedic procedure</td>
<td>45 (43%)</td>
</tr>
<tr>
<td>Arthroplasty (resection, hemi, total)</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>Implant removal</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>Irrigation and wound debridement</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>Miscellaneous*</td>
<td>21 (20%)</td>
</tr>
</tbody>
</table>

*This category includes congenital deformity correction, contracture release, meniscal and tendon repair, foreign body excision, and amputation.
States for record-keeping and patient tracking through a data registry. During the course of each independent follow-up trip, the medical director was able to be in electronic contact with our U.S. orthopaedic surgeon team members to consult regarding any questions or concerns. Each follow-up file obtained was reviewed for further instructions and questions necessary to ensure that adequate care was being provided. The payment structure established by the organization for the position of Peruvian medical director includes a graduated payment plan (Fig. 3). An incentive structure was achieved rewarding longer follow-up time points, which are more difficult to achieve.

Other than the treatment rendered by the surgical teams and the therapy directed at the time of follow-up visits, there were no other surgical interventions in between or after the index procedures on this patient cohort. Rehabilitation was supported by myriad adjunctive patient supports, including

**Table 1**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Anatomy</th>
<th>X-rays</th>
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</thead>
<tbody>
<tr>
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<td>![Image](Fig. 1)</td>
</tr>
<tr>
<td>Surgery</td>
<td>![Image](Fig. 1)</td>
<td>![Image](Fig. 1)</td>
</tr>
<tr>
<td>2-wks</td>
<td>![Image](Fig. 1)</td>
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<td>6-wks</td>
<td>![Image](Fig. 1)</td>
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<tr>
<td>16-wks</td>
<td>![Image](Fig. 1)</td>
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<tr>
<td>36+wks</td>
<td>![Image](Fig. 1)</td>
<td>![Image](Fig. 1)</td>
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</tbody>
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Fig. 1
An example of the data collection matrix utilized to monitor follow-up progress via photographs recording wound-healing, clinical examination, and radiographic results across the follow-up visits.
a local professional with physical therapy and orthotic expertise, missionary nurses who serve local mission organizations, and family support. A retrospective review of the 127 patients in the database who underwent operative treatment between July 2007 and January 2012 was conducted. Twenty-three patients (18.1%) were lost to follow-up, leaving 104 patients (81.9%) for inclusion in this analysis.

Patient characteristics that were analyzed included age, sex, time from injury to the surgical procedure, type of surgical procedure, length of follow-up, functional outcome, wound-healing, number of postoperative clinical encounters, and complications. In cases of fracture fixation, union was defined as the combination of the ability to bear weight for lower-extremity surgical procedures, or absence of pain with weight-bearing, and radiographic evidence of union both by virtue of no failure of fixation and by cortical bridging.

The timeframe of the patient’s injury relative to the surgical procedure was classified as acute (fewer than thirty days) or neglected (thirty days or longer). The type of surgical procedure was classified into one of six categories: open reduction and internal fixation, intramedullary nailing, external fixator placement, arthroplasty (including resection, hemi-arthroplasty, or total joint arthroplasty), irrigation and debridement, and other procedures (including implant removal, contracture release, and other soft-tissue excisions and procedures).

Functional results were classified as good, fair, or poor, by the subjective assessment of a Peruvian general surgeon; good was defined as the patient had normal or near baseline activity, the patient was free from pain, and the patient was glad to have undergone the surgical procedure; fair was defined as the patient had improved function over the preoperative status but it was not normal, the patient had minimal pain, and the patient was glad to have undergone the surgical procedure; and poor was defined as the surgical procedure did not help function or symptoms. Radiographic bone-healing was also assessed at each time point via radiographs.
Infections, nerve injury, a prominent implant necessitating removal, initial treatment failure, and construct failure were all classified as complications. All data capture and analysis were done with Microsoft Excel.

**Results**

The patients were predominantly male (sixty-six male patients and thirty-eight female patients), with a mean age of 37.0 years (range, ten months to 93.4 years). There were twenty-four patients with acute injuries, and the mean time from injury to the surgical procedure was 10.5 days. In comparison, there were forty-nine patients with neglected injuries, and the mean time from injury to the surgical procedure was 35.4 months. Of the remaining thirty-one patients, sixteen underwent multiple procedures and fifteen were treated for nontraumatic conditions.

The 104 patients underwent a total of 122 surgical procedures, as sixteen patients underwent two or more surgical procedures by the surgical mission teams. Orthopaedic trauma fixation procedures were performed in fifty-nine patients. Open reduction and internal fixation, including reconstructive orthopaedic extremity surgical procedures, was the most common, with 40% (forty-two patients) undergoing this procedure. The complexity of surgical procedures performed ranged from superficial foreign body removals to open reduction and internal fixation of complex periarticular fractures (Table I).

The mean length of follow-up was 11.8 months (range, 0.5 to forty-eight months), with a mean number of 3.7 postoperative clinical encounters. The mean length of follow-up in fifty-nine patients undergoing orthopaedic trauma fixation procedures was 13.4 months (range, three to forty-eight months).
In the 104 patients, successful wound-healing occurred in 97% (101 patients), and the infection rate was 2.9% (three patients). Functional results were classified as good in seventy-nine patients (76%), fair in twenty-one patients (20.2%), and poor in four patients (4%). In sixteen patients (15%) undergoing two or more procedures, the outcome provided was at the time of the final follow-up.

There was one radial nerve injury in a five-year-old patient treated for a supracondylar malunion of the humerus, two infections, two cases with prominent implant necessitating removal, two construct failures, and four initial treatment failures. The two infections occurred after the placement of an external fixator for a proximal humeral fracture in one patient and after plating the distal part of the tibia in another patient. One construct failure occurred following dynamic hip screw placement in an eighty-four-year-old female patient, and the other occurred immediately after reconstruction of a distal humeral fracture. Of the four initial treatment failures, two involved fractures that initially did not unite but, after revision open reduction and internal fixation, progressed to union. The third treatment failure involved an initial tenotomy for clubfoot correction that required a second, more extensive surgical release for complete correction. The last treatment failure involved a patient who presented with osteomyelitis following operative treatment of the diagnosed infected tibial nonunion. Although the nonunion reconstruction was united at the time of the final follow-up, the treatment course did not eradicate the infection, and the patient chose to live with the draining sinus but was happy with the functional weight-bearing outcome of the healed limb.

The payments for monthly salary and follow-up base pay stayed the same over the course of this time period, but the incentive program cost varied each year of the study period, with the mean cost of the program equaling $20,041 in U.S. dollars per year. These costs consisted of 30% monthly salary, 45% incentive-based follow-up pay, and 25% travel and expenses.

Although all 104 patients followed had a clinical assessment, of the fifty-nine patients requiring orthopaedic fixation-related procedures, fifty-seven (97%) had fractures that had complete union at the time of the final follow-up. Fifty-five patients (93%) successfully completed the radiographic follow-up, and all four patients who were followed but did not have a radiograph did have a clinical examination and were deemed as healed.

### Discussion

The follow-up rate in our series (81.9%) compares favorably with that reported in a series of 34,361 intramedullary nailing operations in fifty-five low-income and middle-income countries (18.1%)\(^3\). It is difficult to contextualize the mean length of follow-up in our series (11.8 months) because, to our knowledge, no other contemporary literature exists for these types of data. However, when the follow-up rate, the mean length of follow-up, and the mean number of clinical encounters after the surgical procedure (3.7) are examined together, it is reasonable to conclude from these three values that the model presented in this study is robust and effective for achieving a high follow-up rate and short-term to intermediate-term duration.

The model presented puts the incentive for follow-up on the provider. It is a fundamentally new way of thinking about successfully collecting follow-up information from patients. Many programs have incentives for follow-up geared to the patients. Patients do not pay for follow-up visits, but the time, effort, and cost of public transportation to travel to appointments can be a substantial burden for a great number of our patient population. Although we have not recorded how often any financial or material incentive was passed from the Peruvian medical director to a patient, to our knowledge this happened rarely, other than some support for transportation.

The vast divide between acute and neglected injuries in our series is another area that deserves further examination. The patients with neglected injuries made up the vast majority and presented at a mean time of 35.4 months after their injury. These data indicate that the orthopaedic surgical pathology that is encountered in the developing world is vastly different from what is encountered in clinical practice in North America or other developed societies, requiring new ways of thinking about the skills and approaches used to treat this neglected trauma. Given the projected increase in trauma in the developing world, neglected trauma in the developing world could quickly become a robust and much-needed new field of study within orthopaedic trauma.

The main limitations of the model related to the austere context in which the study took place. Infrastructure in Pucallpa is marginal at best, and travel to a clinic for follow-up represents a financial burden that many of the patients in this series could not handle. Multiple follow-up visits requiring extensive travel by primitive means (such as by foot or by
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**Abstract**

The authors of this study present a comprehensive follow-up program developed for short-term surgical missions to a developing country. The program is designed to systematically follow up on orthopaedic surgical cases, ensuring responsible care during short-term visits. The authors discuss the challenges and limitations of delivering surgical services in resource-poor settings and highlight the importance of long-term follow-up for sustained outcomes.

**Methods**

The follow-up program was developed through a model that included detailed reporting of patient follow-up results. The model was adapted to the demands of delivering surgical services in resource-poor environments, where follow-up rates vary from 75% to 95% depending on the location. The authors emphasize the necessity of such programs to ensure patient outcomes are not compromised by the temporary nature of the missions.

**Results**

The follow-up program was implemented in a clinic in Peru, where 18% of patients were lost to follow-up initially. However, by the end of the study period, the follow-up rate increased to 81.9%, demonstrating the effectiveness of the program. The authors also note the importance of patient satisfaction with care, indicating that continued follow-up can ensure that patients who were lost to follow-up may have been dissatisfied with their care.

**Conclusion**

In conclusion, follow-up of orthopaedic surgical cases in the developing world is an important aspect of delivering responsible care during short-term surgical trips. It is possible to sustain, with robust results, a follow-up program for patients undergoing surgical procedures, and to achieve good patient outcomes even in an austere setting. Experience with this model to date has generated ongoing interest and gratitude for volunteer medical team members through the reporting of patient follow-up results. In addition, through a

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**References**


