**IRB PROTOCOL**

1. **BACKGROUND**
2. ***Lay Summary***

|  |
| --- |
|  |
| The subject’s broken humerus (arm) is suitable for treatment with a fracture brace or operative fixation with plate and screws. Both of these types of treatments are often used by doctors to fix broken bones. If the subject agrees to participate in this study, the subject will be assigned by the treating surgeon to one of the following groups:  Group B: Non-operative treatment with a fracture brace Group P: a plate & screws - a metal device placed on top of the bone.  We will collect information about the subject’s arm fracture as it is treated with examinations and X-rays. X-rays will be obtained often in the first several months, depending on how the fracture is healing. This is determined by the doctor and will not be determined by the subject’s participation in this research study.  Both treatments are routinely used and this study hopes to provide information regarding each type of treatment on the subject’s functional outcome. A subject’s treatment will not be affected whether they choose to participate in this research study or not.  The treatment of these subjects is no different because of this study. The treating surgeon will discuss with the patient their preferred treatment for the isolated humeral shaft fracture. If they meet the inclusion/exclusion criteria, they will be approached for participation in one of two treatment groups depending on a previous decision by the patient and the treating surgeon. |

1. ***Introduction and Background with Literature Review***

Humeral shaft fractures (OTA 12A, B or C) are not uncommon injuries and have been long considered fractures which respond well to conservative management. Since Bohler’s (1964) statement that humeral shaft fractures are “the most benign of all fractures of the long bones”, many additional peer-reviewed publications have concluded that conservative management of this injury, in isolation, produces an excellent and uncomplicated result. (3,8,9,12,14) Sarmiento’s work resulted in a treatment algorithm utilizing functional bracing which remains the accepted standard of care for isolated humeral shaft fractures. A review of 922 patients with humeral diaphyseal fractures treated with a functional brace had a union rate of 98% for closed fractures, 98% of patients had less than 25 degrees of angulation and less than 25 degrees of restricted shoulder motion. (12) Functional brace treatment of humerus fractures was thought to allow good function of the shoulder and elbow. Subjective evaluation of shoulder and elbow function was not always completed. A small series of 15 patients treated with the functional brace were evaluated for shoulder function with the Constant score. The scores were significantly lower compared to the contralateral shoulder.(11)

`A recent retrospective review of isolated humeral shaft fractures treated with a functional brace had over 90% of the fractures healed. However, the nonunion rate of more simple, OTA-A type fractures of the middle and proximal one third was approximately 20%.(9) Functional outcome scores were assessed. Nearly 50% of patients reported a full recovery after non-operative treatment. No patient who had revision surgery for a nonunion reported a successful outcome. There are other studies supporting an increased incidence of nonunion with proximal humeral shaft fractures. A review of the clinical studies for functional bracing of humeral shaft fractures and the union rate is high, but the few studies who examined subjective parameters such as functional scores, pain and quality of life did not hold the same promising results.

Much of the early work on operative treatment of this injury reflected results, often poor, obtained when utilizing early generation implants and surgical techniques. There were relative indications for surgical fixation, such as the multiple trauma patient, overweight individuals, fracture pattern and nonunion after conservative treatment.(1,4,5) In addition, a number of studies have reported the results of humeral shaft fractures managed with intramedullary nails.(14) Although controversy remains, we believe the publications of McCormack, et.al. and Chapman, et.al. have concluded in a prospective randomized comparison fashion that plating produces a superior outcome to intramedullary nailing in humeral shaft fractures. (2,6) Vander Griend et al in an early study of plating of humeral shaft fractures found good results with proper technique.(13) Very few existing publications compare conservative versus operative treatment of humeral shaft fractures.(7,8,10,14) Of these, only one (Nast-Kolb, et.al.) does so in a prospective manner. Even this study included patients with various associated injuries and treatment selection was not controlled or randomized in any way.

No study has ever compared the results of isolated humeral shaft fractures treated conservatively versus operatively in a prospective randomized fashion. In addition, few studies of humeral shaft fractures have utilized any form of validated functional outcome measure when drawing conclusions about given treatment options.

We believe the need for this study is further supported by pilot data obtained in a retrospective review of two hundred thirteen (213) closed humeral shaft fractures treated operatively with plates and nonoperatively at the two Level I trauma centers over the past five years. These findings indicate a higher malunion and nonunion rate of statistical significance in the nonoperative group, in spite of a significantly lower incidence of tobacco use.

**Bibliography**

1. [Baba R](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Baba%20R%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract), [Razak M](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Razak%20M%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract). Contributing factors in non-union of the humeral shaft fracture and the results of treatments.[Med J Malaysia.](javascript:AL_get(this,%20'jour',%20'Med%20J%20Malaysia.');) 1998 Sep;53 Suppl A:42-51.
2. Chapman JR, Henley MB, Agel J, Benca PJ; Randomized Prospective Study of Humeral Shaft Fracture Fixation: Intramedullary Nails Versus Plates J Ortho Trauma 2000;14(3),162-66.
3. Ekholm R, Tidemark J, Tornkvist H, Adami J, Ponzer S. Outcome of closed functional treatment of humeral shaft fractures. J Orthop Trauma 2006;20:591-596.
4. [Foulk DA](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Foulk%20DA%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract), [Szabo RM](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Szabo%20RM%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract). Diaphyseal humerus fractures: natural history and occurrence of nonunion. Orthopedics, 1995;April18:333-5
5. [Jensen AT](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Jensen%20AT%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract), [Rasmussen S](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Rasmussen%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract). Being overweight and multiple fractures are indications for operative treatment of humeral shaft fractures. [Injury.](javascript:AL_get(this,%20'jour',%20'Injury.');) 1995 May;26(4):263-4.
6. McCormack RG, Brien D, Buckley RE, McKee MD, Powell J, Schemitsch EH; Fixation of fractures of the shaft of the humerus by dynamic compression plate or intramedullary nail, A Prospective Randomised Trial: J Bone Joint Surg Br 2000; 82:336-39.
7. Nast-Kolb D, Knoefel WT, Schweiberer L. The treatment of humeral shaft fractures. Results of a prospective AO multicenter study. Unfallchirurg 1991;4:447-54.
8. Osman N, Touam C, Masmejean E, Asfazadourian H, Alnot JY; Results of non-operative and operative treatment of humeral shaft fractures: Chir Main 1998;17:195-206.
9. Papasoulis E, Drosos GI, Ververidis AN, Verettas DA. Functional bracing of humeral shaft fractures. A review of clinical studies. Injury 2009;Jun 10. {Epub ahead of print}
10. Reudi T, Moshfegh A, Pfeiffer M, Allgower M; Fresh Fractures of the Shaft of the Humerus – Conservative or Operative Treatment?: Reconstr Surg Traumat 1974;14:65-74.
11. Rosenberg N, Soudry M. Shoulder impairment following treatment of diaphyseal fractures of the humerus by functional brace. Arch Orthop Trauma Surg. 2006; 126:437-440.
12. Sarmiento A, Zagorski JB, Zych GA, Latta LL, Capps CA. Functional bracing for the treatment of fractures of the humeral diaphysis. J Bone Joint Surg Am 2000;82:478-486.
13. [Vander Griend R](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Vander%20Griend%20R%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract), [Tomasin J](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Tomasin%20J%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract), [Ward EF](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Ward%20EF%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_RVAbstract). Open reduction and internal fixation of humeral shaft fractures. Results using AO plating techniques.[J Bone Joint Surg Am.](javascript:AL_get(this,%20'jour',%20'J%20Bone%20Joint%20Surg%20Am.');) 1986 Mar;68(3):430-3.
14. Wallny T, Sagebiel C, Westerman K, Wagner UA, Reimer M; Comparative results of bracing and interlocking nailing in the treatment of humeral shaft fractures: Int Orthop 1997;21:374-79.

***C. Describe any past experimental and/or clinical findings***

A retrospective review of “Operative versus Nonoperative Treatment of Humeral Shaft Fractures” was completed at Vanderbilt University Medical Center (William Obremskey, MD, MPH) and Medical College of Georgia (Michael Tucker, MD). This research was be presented in October 2009 at the Orthopaedic Trauma Association Annual Meeting in San Diego, CA and is submitted for publication. All patients treated for a closed humeral shaft fracture (OTA-12) at two Level I trauma centers between 2001-2005 were retrospectively identified by diagnosis and treatment codes after IRB approval. Various demographic and comorbidity data was also reviewed. Complication rates including infection, nonunion, malunion, clinical range of motion and iatrogenic radial nerve palsy were evaluated and compared for patients treated nonoperatively versus those managed with plate and screw fixation. A total of 213 adult humeral shaft fractures meeting the inclusion criteria was identified. Plate and screw fixation was utilized in 150 patients with 63 patients receiving nonoperative management. Of 213 patients, 13 (6 %) were lost to follow up. Operative approach included anterior-lateral (83%) and posterior (17%). Implants included traditional, non-locking 4.5 mm plates (narrow – 34%, broad – 4%) and locking 4.5 mm plates (62%). No significant differences related to age, gender, occurrence of diabetes or cancer were noted between the groups. Tobacco use was significantly different (p = 0.0003) with operatively treated patients demonstrating a much higher useage rate (32%) than those treated nonoperatively (4%). Occurrence of malunion (13% versus 1%, p = 0.0011) and nonunion (23% versus 9%, p = 0.0128) was statistically significant and more common in the nonoperatively treated group. Infection occurred in one patient (low energy gunshot wound) treated nonoperatively (1.5%) and seven patients treated operatively (5%). Iatrogenic radial nerve palsy was reported in twelve (12/150, 8%) patients treated acutely with operative intervention. All twelve demonstrated complete or partial recovery. No difference in time to union or ultimate range of motion was found between the two groups. Closed treatment of humerus fractures had a significantly higher risk of nonunion (23% vs 9%) and malunion (13% vs 1%) than operative treatment with a lower risk of transient nerve palsy (0% vs 8%) and deep infection (1.5% vs 5%).

1. **Research Objectives**

Nonoperative management of closed humeral shaft fractures (OTA-12) has long been considered the treatment of choice for the majority of these injuries. Operative management of closed humeral shaft fractures utilizing plate and screw fixation has been effectively demonstrated as an alternative treatment option. Both methods are used as standard of care at Saint Louis University hospital. Our aim is to determine whether isolated humeral shaft fractures are optimally treated with internal fixation or bracing.

**Hypotheses**

1. Patients with an isolated humeral shaft fracture that are plated will have a more rapid return to ADL’s, work and full functional capacity than patients treated conservatively.
2. Patients treated with plate technique will have a more rapid improvement in functional outcome scores, decreased pain scores and patient satisfaction than those managed conservatively.
3. Complication rates of infection and iatrogenic neurologic injury will be higher in patients treated operatively.
4. Nonunion and malunion will be higher in patients managed conservatively.
5. **STUDY DESIGN:**

This investigation will consist of a prospective cohort comparison multicenter clinical trial to evaluate non-operative versus operative treatment of isolated humeral shaft fractures. We anticipate participation from up to twenty experienced (Level I) trauma centers (a list of participating centers attached); each of which has experience with similar research study designs. The study protocol will require IRB/HAC approval from each participating center.

**Sample Size**

The primary outcome of this study is the Disability of Arm, Shoulder and Hand (DASH) score. 10 units difference of DASH will be considered as a clinically meaning full difference. Based on previous studies, the standard deviation of DASH is around 20. With 64 subjects in each group (total 128), we will have 80% power to detect a difference in mean of 10 between two study arms assuming the common standard deviation is 20 using a student t-test with type I error rate 0.05.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Mean Difference | STD |  | Power=0.8 | | Power=0.9 |
| 10 | 15 |  | 37 |  | 49 |
| 10 | 20 |  | 64 |  | 86 |
| 10 | 25 |  | 100 |  | 133 |
| 15 | 15 |  | 17 |  | 23 |
| 15 | 20 |  | 29 |  | 39 |
| 15 | 25 |  | 45 |  | 60 |
| 20 | 15 |  | 10 |  | 13 |
| 20 | 20 |  | 17 |  | 23 |
| 20 | 25 |  | 26 |  | 34 |
|  |  |  |  |  |  |

**Statistical Analysis**

A statistician will subject the data to a statistical analysis and the results will be reported comparing the outcomes in the groups at each follow-up period. It is anticipated that the required patients will be entered into the investigation during an 18-month period and will be followed for one year. Thus, the data collection time will be a 2.5- year period. We believe that at that time, the results of the study will reveal whether isolated humeral shaft fractures are optimally treated with internal fixation or bracing.

**Data Collection**

Demographic, follow up clinical assessment and radiographic data will be collected during protocol driven visit intervals and on prescribed data collection forms. Clinical examination will assess elbow and shoulder ROM, pain to palpation, strength and neurologic function. Radiographic assessment will include anteroposterior (AP) and lateral views to evaluate angular alignment, length and evidence of union and angulation in AP and lateral planes. (All data collection sheets attached).

**Follow Up Schedule**

The patients in both groups will be evaluated at 2 weeks, 4 weeks, 8 weeks, 12 weeks, 6 months and 12 months as standard of care and data will be collected from these visits. The entire follow-up schedule for both groups varies depending on treatment and is outlined below. Outcome measures will be “union,” “evaluation of the radial nerve”, “ infection,” and “need for further intervention.” Pain will be documented using the Visual Analogue Scale (VAS) at each visit. The Short Form-12 (SF-12), and the DASH (Disabilities of the Arm, Shoulder and Hand) Outcome Measure will be administered at the time of admission (If the patient has surgery) or during the initial outpatient visit (non-operative treatment) as a baseline score and at 12 weeks, 6 and 12 months post-injury.

**Functional Assessment**

The **DASH** (Disabilities of the Arm, Shoulder and Hand) Outcome Measure will be utilized as the functional assessment tool. As this tool has been well validated for upper extremity injuries and has normative data, we believe it to be a good choice for this study population.

Pain will be subjectively analyzed using a visual analogue pain scale (**VAS**). The **SF-12** questionnaire was developed from the Medical Outcomes Study. It is a self-administered, 12-item questionnaire that measures health-related quality of life in 8 domains. Both physical and mental summary scores can be obtained. Each domain is scored separately from 0 (lowest level) to 100 (highest level). The instrument has been extensively validated and has demonstrated good construct validity, high internal consistency, and high test-retest reliability. Our decision to use the SF-12 over other available instruments was based on its widespread use in orthopaedics, its use in previous studies evaluating fracture outcomes, and the strong evidence of validity.

|  |  |  |
| --- | --- | --- |
| **Follow-Up Schedule** | **Process** | **Data Collected** |
| Enrollment (P&B) | Clinical examination | VAS, SF12, DASH |
| 2 weeks (P & B) | Clinical examination, functional outcomes(P&B)  Radiographs (B) | Clinical follow-up data, VAS (P&B) |
| 4 weeks (B) | Clinical examination, radiographs (B) | Clinical follow-up data, VAS |
| 8 weeks (P&B) | Clinical examination, functional outcomes, radiographs | Clinical follow-up data, VAS, SF12, DASH |
| 12 weeks (P&B) | Clinical examination, functional outcomes, radiographs | Clinical follow-up data, VAS, SF12, DASH |
| 6 months (P&B) | Clinical examination, functional outcomes, radiographs | Clinical follow-up data, VAS, SF12, DASH |
| 12 months (P&B) | Clinical examination, functional outcomes, radiographs | Clinical follow-up data, VAS, SF12, DASH |

\*All of the above are standard of care except the questionnaires.

1. **STUDY POPULATION**
2. **Characteristics**

When a patient from 18-65 presents with a humeral shaft fracture, he or she will be screened for possible enrollment in the study using the criteria on the Inclusion /Exclusion Criteria Form. The total number of patients enrolled in the multicenter study will be 128 patients. We will enroll no more than 16 patients at SLU for inclusion in this study.

1. **Special Classes**

We are not using any vulnerable population groups in this study. These include children, prisoners or those who cannot understand the research and treatment involved. The exclusion of non-English speaking subjects is due to the questionnaires used in this study not being validated in other languages.

We include all individuals who are skeletally mature. Skeletal maturity is typically achieved by age 18. but will be based on appearance of growth plate. We are not including individuals with open growth plates (i.e. skeletally immature patients) because these individuals are most often treated by non-operative means due to their better healing potential.

1. **RECRUITMENT METHODS**:
2. ***Access to Study Population***

Patients who present to St. Louis University Hospital or Saint Johns Mercy Medical Center with a humeral shaft fracture will be eligible for possible enrollment in the study using the criteria on the Inclusion /Exclusion Criteria Form. If the patient is deemed appropriate by the treating surgeon, meaning that they meet all the inclusion criteria and do not meet any exclusion criteria, the patient will be given the consent form to read and it will be reviewed with the patient with time allowed to answer all questions. If the patient agrees to enter the study he or she will sign the consent form.

1. ***Recruitment***

There will be no recruitment of subjects for this study. The occurrence of humerus fractures is a traumatic event.

1. **INCLUSION AND EXCLUSION CRITERIA:**
2. ***List the inclusion criteria for subjects*** 
   1. Diagnosis of a closed, humeral shaft fracture
   2. English Speaking
   3. Age between 18-65 at the time of injury
   4. Entry into the study within 2 weeks of injury
   5. Available for follow-up for at least 12 months
   6. Patient signs informed consent

***B.List the exclusion criteria for subjects***

***1.*** Age less than 18 or greater than 65 at time of injury

**2.**  Patients who are skeletally immature

**3.** Humeral shaft fractures that extend into the articular surface

***4.*** Open humeral shaft fractures

***5.*** Additional long bone injuries of upper or lower extremity that would compromise outcome assessment

***6.*** Vascular injury requiring repair

***7.*** Pathologic fracture

***8.*** Definitive treatment delay of more than 2 weeks from initial injury

***9.*** Immunocompromised patient

***10.*** Unable to comply with post-operative rehabilitation protocols or instructions

***11.*** Current or impending incarceration

***12.*** Unlikely to follow-up in surgeon’s estimation

***13.*** Pregnant or lactating female

***14.*** Previous retained hardware in humeral shaft

1. **ROLE OF SUBJECTS AND RESEARCH PROCEDURES**

Patient who present to the Saint Louis University Hospital Emergency room with a humeral shaft fracture will initially have the same treatment. All patients will have a closed reduction with adequate sedation in the Emergency Department and application of a coaptation splint and sling prior. The patient will then be admitted for pain control and observation. This is standard of care for subjects presenting at the ED with this type of injury.

The radiographs will be reviewed at morning rounds and the patient will be screened for eligibility into the study. The on call staff from the date of patient’s presentation to the emergency department will be the designated treating surgeon.

If they meet the inclusion/exclusion criteria, they will be approached for participation in one of two treatment groups depending on a previous decision by the patient and the treating surgeon. Patients in the operative group (P) will be scheduled for elective surgery for plate fixation of their humeral shaft fracture within 2 weeks from date of injury. Patients in the non-operative group (B) will have clinical follow-up scheduled. Informed consent will be obtained.

Operative Group (P)

The goal of open reduction and internal fixation (ORIF) of a humeral shaft fracture is anatomic reduction of the fracture. The patient will undergo elective plate fixation of their humeral shaft fracture within 2 weeks of their injury. The use of a tourniquet is up to the discretion of the treating surgeon and the location of the fracture. The surgical approach, plate brand and size will be at the discretion of the attending orthopaedic surgeon. The typical surgical approaches are a posterior approach or an anterolateral approach. The approach chosen will depend on surgeon preference and location of the fracture in the humeral shaft (Proximal, middle or distal one-third). There are 3.5 mm and 4.5 mm plates of varying types which may be used to treat the fracture. The particular type of plate will depend on the patient’s bony anatomy and bone quality. Drains will also be utilized at the discretion of the treating surgeon and their use recorded on the case report forms (CRF’s). Patients will be admitted to the hospital after surgery and provided adequate analgesia and at least 24 hours of antibiotic coverage. There are no requirements for this study regarding post-operative immobilization. Some surgeons may place a splint on the patient. The patient will have a two week follow up and after that time there is to be no usage of a fracture brace or splint.

Non-operative Group (B)

Closed treatment initially involves a splint applied after radiographs and clinical evaluation in the Emergency Department. The patient is admitted for observation staus and to ensure adequate pain control. The splint is used until the patient’s first follow up visit at two weeks in the office.

A humeral fracture brace is applied in the office. A sling is optional for patient comfort. Radiographs will be obtained at 4 weeks, 8 weeks, 12 weeks, 6 months and 12 months. The physician may elect to have more frequent office visits with radiographs depending on patient compliance, radiographs and evidence of healing.

After fracture brace application, the patient is instructed in pendulum exercises for shoulder mobility. Exercises of the elbow, wrist and hand are also encouraged.

The patient is instructed to adjust the tension of the brace twice per week and sleep in a semi-erect position for the first six weeks. (These instructions are all standard of care for fracture brace treatment).

The fracture brace is worn for 9-12 weeks or until the patient has met the clinical and radiographic healing criteria described in Section 8.

Data to assess the study objectives will be collected at each study visit and entered into a single patient database. A clinical examination will be performed at each visit. Section 8 below describes details regarding parameters to be measured. Vital signs will be recorded. Radiographs will be performed at all but the 2 week visit in the operative group to assess evidence of fracture healing and hardware failure. All of this is standard of care for this type of injury and would be completed regardless of participation in this research. Forms will be completed according to the schedule outlined in Section 3.

The office visits take about 1 hour (a standard office visit). An additional 22-27 minutes will be required for the completion of the forms at 2 week, 4 week, 8 week, 12 week, 6 month and 12 month visit. The Short Form 12 (requires about 6 minutes), DASH (requires15-20 minutes)and VAS (requires about 1 minute) at the 12 week, 6 month and 12 month visit. The subject will be a participant in the study for a total of 52 weeks after their injury and/or subsequent surgical procedure. The surgeon and patient may continue follow-up at the surgeon’s discretion at the end of the 52 week period, but the patient’s will not be enrolled in the study after the end of 52 weeks from injury and/or surgery. This visit schedule would be the same regardless of participation in this research.

All participating clinical centers will receive a complete set of data forms (attached) electronically. The set of forms includes: Inclusion/Exclusion Criteria; Patient Data Form, Clinical Visit Form, Surgical Report Form, VAS, Short Form 12, DASH form, Adverse event form. The research coordinator for each center will ensure that all forms are completed and submitted to the Saint Louis University Department of Orthopaedics.

1. **PARAMETERS TO BE MEASURED:**

Effectiveness Evaluation (x-ray, ROM, return to work/function and need for 2nd procedures)

Outcome measures will be “radiographic union,” “clinical union”, “wound healing and infection,” and “need for further intervention.”

Pain will be documented using the Visual Analogue Scale (VAS) at each visit. Short Form-12 (SF-12) and the DASH will be completed at time of enrollment, 12 weeks, 6 months and 12 months.

1. Safety Evaluation (complications, re-operations, adverse events)

*Wound Complications*

\*Superficial wound infection-There is erythema and warmth around wound. There is no purulent drainage. The patient is not febrile (Temperature less than 39 degrees Celsius). Treatment is with PO antibiotics. The condition resolves without additional intervention.

\*Deep wound infection: The patient has the wound characteristics as described above and has drainage. Cultures will be obtained. All treatment and interventions will be recorded.

1. Patient/Study Success

*Union:* Time to union will be determined radiographically by the number of cortices bridged by bone. There are no validated measures to grade humeral fracture healing based on radiographs. The number of cortices was chosen based on the work of Whelan et al on the interobserver and intraobserver variation in the assessment of fracture healing of humeral fractures treated with an intramedullary nail.

Clinical Success will be determined by the clinical investigators on the basis of both:

1.Radiographic union will be measured by evidence of fracture healing which is defined as extra-cortical bridging callus on three of four cortices on anterior- posterior and lateral radiographs

2. Clinical healing is defined as pain free limb and lack of tenderness at the fracture site on palpation. The fracture will be considered to be a Clinical Success (e.g. healed) when radiographic union is confirmed and both clinical parameters listed above for healing has been met.

Malunion

Malunion will be defined as greater than 20 degrees of apex anterior or posterior angulation, 30 degrees of varus or valgus angulation or 3 centimeters of shortening.

Nonunion

Non union will be defined as a fracture that has not healed by criteria of healing above within 6 months from time of injury.

Patients entered into the non-operative (Bracing group) who have a malunited or nonunited fracture and require surgical fixation with a plate will be followed within the Bracing group.

1. **DATA ANALYSIS:**

A statistician will subject the data to a statistical analysis and the results will be reported comparing the outcomes in the groups at each follow-up period. It is anticipated that the required patients will be entered into the investigation during an 18-month period and will be followed for one year. Thus, the data collection time will be a 2.5- year period. We believe that at that time, the results of the study will reveal whether any differences exist with this fracture in terms of outcomes, union rates, times to union, surgical complications and outcome data.

Data will be analyzed on an intent to treat basis (patient data included in the treatment group and stratum to which randomized). Fisher’s exact test will be used to compare categorical variable and the Student t test will be used for continuous variables for comparisons between the two groups.

Quality of life data will be coded and scored according to the guidelines provided with the SF-12. The DASH will be scored according to standard technique.

References for questionnaire data and reliability:

Bergner M, Bobbitt RA, Carter WB, et al. The Sickness Impact Profile: development and final revision of a health status measure. Med Care 1981;19:787-805.

Burdine JN, Felix MR, Abel AL, Wiltraut CJ, Musselman YJ. [The SF-12 as a population health measure: an exploratory examination of potential for application.](http://www.ncbi.nlm.nih.gov/pubmed/11055454?ordinalpos=1&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DefaultReportPanel.Pubmed_RVDocSum) Health Serv Res. 2000 Oct;35(4):885-904.

Roy JS, MacDermid JC and Woodhouse LJ. Measuring Shoulder Function: A Systemic Review of 4 questionnaires. Arthritis & Rheumatism 2009; 61:623-632.

1. **BENEFITS:**
2. Describe potential benefits to subjects

There is no anticipated benefit to the subject for participating in this research.

1. In the future, other people with isolated humerus fractures could benefit from the results of this research. Information gained from this research could lead to improved medical care for them and improved functional outcome.
2. **RISKS and RISK MANAGEMENT:**
   1. ***Describe any physical, psychological, social, legal or other risks.***

Psychological Stress

Some of the questions we will ask the subject as part of this study may make the subject feel uncomfortable. The subject may refuse to answer any of the questions, take a break or stop their participation in this study at any time.

Other Risks

There is a risk of loss of confidentiality.There may possibly be other side effects that are unknown at this time. If the subject is concerned about other, unknown side effects, the subject will be instructed to discuss this with the researchers. There is a risk of loss of confidentiality.

* 1. ***Assess the likelihood and seriousness of study-related risks***.

From the data collection, there is minimal risk to the subject.

* 1. **Describe the procedures for protecting against or minimizing any potential risks**

The patient’s physician and the study investigators will share responsibility for patient safety. We will ensure patient confidentiality throughout trial management. The investigator and designated study staff will be responsible for adhering to institutional standards for ensuring patient safety and confidentiality.

* 1. **If appropriate, describe the provisions for monitoring the data**

This is a minimal risk data collection study.

1. **INCENTIVES AND RESEARCH-RELATED COSTS:**
2. **Describe the incentives**

There are no incentives for participating in this research study .There are no funds available to pay for parking expenses, transportation to and from the research center, lost time away from work and other activities, lost wages, or child care expenses.

1. **Describe who will cover the study-related costs**.

The patient and their insurance company will be billed for standard of care costs for treating a humeral shaft fracture, whether treated operatively with a plate or non-operatively with a brace.

1. **ALTERNATIVES**

The alternative choice of the subject is not to participate. The subjects care will not change whether they participate in this research study or not.

1. **Research Materials, Records and Confidentiality**
2. ***Describe measures employed to protect the identity of the subjects.***

The same strict adherence to ethical and legal confidentiality which is applied by clinicians treating patients with proximal tibia fractures will be applied to the study patients. All data collected will remain confidential. Sources of protective health information (PHI) that will be used in this study include: hospital/medical records; physician/clinic records; radiology results; and interviews/questionnaires. Every effort will be taken to protect the names and PHI of the participants in this study. Patients will be required to give their authorization and sign an informed consent in order to participate. The research team will only use and share the information as it pertains to the study. A Microsoft Access database will be used in this study for data storage and management. Patient identifiable data will not be sent out of Saint Louis University. To further protect patient confidentiality, the database will be password secured and only data used for research purposes will be entered. The research data will be recorded and coded with a master list. The master list will be kept separately and secured in locked files in a locked office. Additionally, study data will be securely stored in locked files in a secured office.

***B. Indicate who will have access to the study data or specimens***

The PI and study staff will have access to the files. The members of the data safety monitoring board will periodically perform the data and safety monitoring for the study.

Patient identifiable data will not be sent out of Saint Louis University. To further protect patient confidentiality, the database will be password secured and only data used for research purposes will be entered. Additionally, study data will be securely stored in locked files in a secured office.

**15. Subject Consent**

Informed consent will be obtained before any study procedures are initiated. The consent form will be reviewed in its entirety with the subject. All questions will be answered. Investigators will ask the subject questions to assure understanding before the consent for participation in the study is signed. A physician will determine subject eligibility for the study and will make the determination regarding the patient’s competency to give informed consent. The attending physician will obtain consent from the subject. If a subject is deemed by the investigator to be incapable of providing informed consent secondary to a lack of mental competence, the subject will not be enrolled into the study.