

3-2012

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Unreconstructable Pilon Fractures: An Overview of Two Surgical Approaches and Their Outcomes

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ABSTRACT

Pilon fractures, or distal tibial fractures, are difficult injuries to treat, not only because of their propensity to sustain highly articulated fractures, but also because of the delicacy of the traumatized soft tissues (Johnson). Oftentimes the fracture is too comminuted to repair with open reduction and internal fixation alone (See Figure 1). The current practice of treating highly comminuted tibial fractures involves placing the patient in an external fixator which allows isolation of the tibio-talar joint so that the soft tissues can heal. After sufficient healing time the internal fixation and reduction is performed. Although this method is an improvement from how pilon fractures used to be treated in the past, the injuries are still subject to a high rate of delayed union and can develop post-operative wound complications, post-traumatic arthritis, and require multiple unplanned additional surgeries. This is why it is reasonable to suggest that primary arthrodesis of the tibio-talar joint through a postero-lateral approach could provide more long-term stability to the ankle joint while allowing the patient to have a “one and done” surgery that would help to prevent additional unplanned surgeries (Johnson).

BACKGROUND

The term pilon originates from the French word “pilon” which translates to “pestle” (“Pilon Fractures”). This term accurately describes the crushing and grinding action of the tibial bone as the talus is driven into the tibial plafond, shattering the tibia. These injuries typically result from a high-energy axial impact such as a fall from a height, a motor vehicle accident, or a skiing accident (Muller & Nerlich 2010). When detected on an x-ray, pilon fractures of the tibia appear as a fracture near the tibio-talar joint with the fibula oftentimes fractured as well (See Figure 2). The patient is initially placed into an external fixator so that the joint can be stabilized

while the traumatized soft tissue can heal (See Figure 3). In the past, the injury was operated on immediately but doctors soon discovered that when treating pilon fractures, managing the local soft tissue was just as important as reducing the fracture. Ignoring the outcome of the soft tissue and operating immediately led to poor union rates, a high instance of post-operation complications, and an increased number of additional surgeries needed (Panchbhavi).

There have only been a few previous studies that have sought to compare the posterolateral arthrodesis approach to the most current anterior approach; therefore, this retrospective study will be helpful in reviewing the new approach.

PURPOSE

After having interned with the FutureDocs program at the University of Tennessee's Department of Orthopaedic Surgery (UTC-DOS) for two years, I was presented with the opportunity to assist the residents with their research projects. I began to read the preliminary project proposals that each orthopaedic resident had submitted and was left to choose which project I wanted to help with. Initially I chose a study involving ipsilateral femoral shaft and neck fractures; however, the project was slow to start due to paperwork and permission issues at the hospital. Under those circumstances, then, I decided to help with the primary blade plate fusion study. When I started helping with the project in October 2011, I knew nothing about pilon fractures and experienced a slight learning curve as I sought to learn as much as I could about the study I was helping with. Eventually I became very familiar with the study and began to brainstorm ideas of how to make the project my own.

In the end I decided that I would write an informative and comparative study of the treatment of pilon fractures using the current surgical method and the method used at UTC-DOS. My main objectives were to inform others about pilon fractures, which are rare and difficult

injuries to treat, to track the evolution of the surgical treatment of pilon fractures, and to discover which surgical method was most effective in improving the long-term outcomes for patients with unreconstructable pilon fractures (See Figure 4).

HYPOTHESIS-1A-Erlanger Study

“Acute primary blade plate fusion with use of external fixation as a hindfoot positioning guide will eliminate the need for subsequent procedures” (Johnson).

HYPOTHESIS-1B-Journal Research Study

Primary blade plate fusion using a postero-lateral approach will provide better long-term outcomes for unreconstructable pilon fractures than an anterior open reduction and external fixation (ORIF) approach.

PRELIMINARY WORK

None; new area of study

MATERIALS

This was a retrospective cohort study which involved looking at patients’ histories, charts, x-rays, CT scans, gathering follow-up data, and assembling this information into an Excel-generated database. Therefore, the materials needed were a computer with Excel, appendices which contained follow-up questions, and consent/agreement binders in order to obtain permission from the patients to participate in the study.

METHODS 1A-Erlanger Study

This study was a retrospective cohort study. We gathered the data by collecting the charts of patients who had undergone a tibiotalar arthrodesis between January 1, 1996 and June 30, 2011 at the University of Tennessee-Chattanooga Unit Department of Orthopaedics (UTC-DOS)

at the Erlanger Health System Baroness Campus. Data points were collected on appendices A, B, C, & D which included the AOFAS hindfoot score scale, SF-36, and Foot Function Indexes (Johnson).

I. Study Subjects

- a. Patients who underwent tibiotalar arthrodesis in the last fifteen years or primary blade plate fusion for unreconstructable pilon fractures.

II. Sample Size

- a. Since blade plate fusion is only indicated in a small percentage of pilon patients, ten-fifteen patients will be evaluated.

III. Data Collection

- a. Appendix A (See attached)
- b. Appendix B
- c. Appendix C
- d. Appendix D

IV. Data Handling

- a. Data will be collected at patient visits and review of medical records.

V. Strengths

- a. Novel operating technique; results could provide evidence for an improvement in the surgical treatment of unreconstructable pilon fractures.

VI. Limitations

- a. Locating and gathering accurate data from the patient population.

METHODS 1B-Journal Research Study

I performed an extensive peer-reviewed scientific journal search of tibial pilon fractures and their surgical treatment in order to compare the outcomes of both the currently accepted treatment and UTC-DOS' method of treatment. I specifically searched for articles related to the surgical treatment of pilon fractures using an anterior approach and articles reporting about newer methods of treatment, such as a postero-lateral arthrodesis. Articles about new surgical methods were taken into account, but only results from postero-lateral arthrodesis surgeries were incorporated into my actual write-up so that the topic would stay focused.

My experience and involvement at UTC-DOS was vital for my research as I was able to not only read about the treatment of pilon fractures, but also to see patients who had had surgeries in order to repair their unreconstructable pilon fractures. In addition, I interviewed Dr. Johnson in order to get more information about the postero-lateral surgical approach and went on follow-up appointments with him so that I could gather data in the appendices for his study.

RESULTS

The study conducted at the University of Tennessee-Chattanooga Unit Department of Orthopaedics at Erlanger Health System Baroness Campus is still being finalized and analyzed; therefore publication of the actual figures and results is not permitted at this point in time. Dr. Johnson has allowed it to be released, however, that initial analysis has shown that only 25% of their patients had to have additional unplanned surgeries which is a much lower rate than other studies reported in scientific journals (Johnson). Other preliminary data has shown that their newer method is increasing the efficacy of surgical treatment of pilon fractures. Their data is expected to be published within the month.

Comparative data from studies using the currently accepted method have reported several problematic statistics. For instance, in a study by Harrison, Patterson, Sontich, & Vallier it was discovered that 39% of their patients developed post-traumatic arthritis, 7% had severe post-operation infections, and 8% had malunions/non-union (Harris, Patterson, Sontich & Vallier, 2006). The researchers concluded that open reduction and internal fixation (ORIF) was associated with fewer complications than external wire fixation (EF) and that the loss of function due to post-traumatic arthritis was common after ORIF. In addition, a retrospective study conducted by Arlettaz, Blanc, & Chevalley reported that 24% of their patients needed additional surgical procedures and adjustments and that 34% developed severe post-operation infections (Arlettaz, Blanc & Chevalley, 1998). They concluded that ORIF produced fewer complications without improving long-term results. Counter to these studies, comparative data of scientific literature using the primary arthrodesis from a postero-lateral approach produced encouraging results.

A retrospective study by Morgan, Thordarson, & Shepherd reported that 100% of their patients united at an average of 26 weeks and that no secondary procedures were needed (Morgan, Thordarson & Shepherd, 1999). They concluded that a postero-lateral arthrodesis was effective in stabilizing pilon fractures. In addition, a study by Eid determined that 100% of their study patients united at an average of 13 weeks and that none of their patients had major complications such as infections or malunions. Eid concluded that postero-lateral plate arthrodesis is a good and safe treatment of pilon fractures providing fracture healing, rapid functional recovery, and avoidance of major complications (Eid 2009).

DISCUSSION

Using objective research as well as data from published literature to compare outcomes, it appears that a postero-lateral arthrodesis of the tibio-talar joint is a more effective method of treating pilon fractures than the common anterior approach. Not only does a postero-lateral arthrodesis reduce the damage to the fragile soft tissue, it also reduces the number of unplanned surgeries because fusing the ankle joint initially increases the chances of a better union rate. The common anterior approach was once a revolutionary approach just as the postero-lateral arthrodesis is today. As technology and knowledge increase, medicine and health care tend to evolve and improve for the betterment of the patient. The future treatment of pilon fractures will most likely follow this trend and continue to evolve as technology and knowledge increase.



Figure 1-Severely Comminuted Tibial Fracture X-ray
(Moore, 2011)



Figure 2-Distal Tibial and Fibular Fractures
(Allely, 2010)

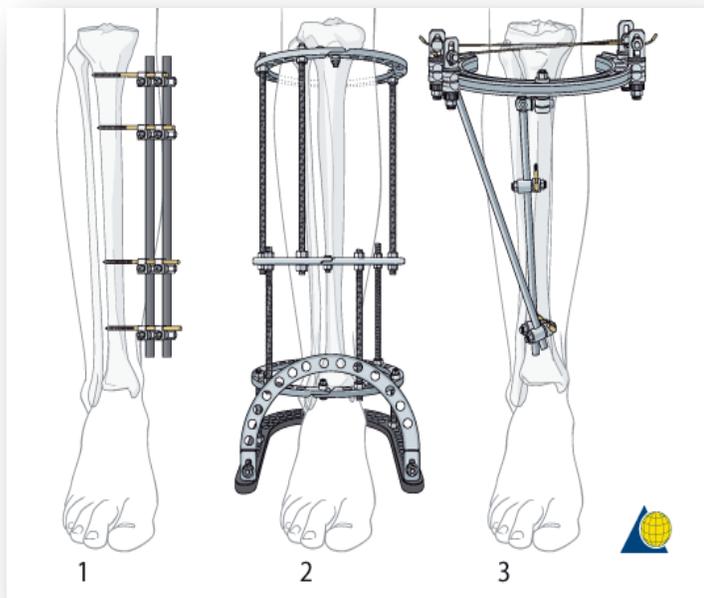


Figure 3-External Fixation (Apivotthakaku)

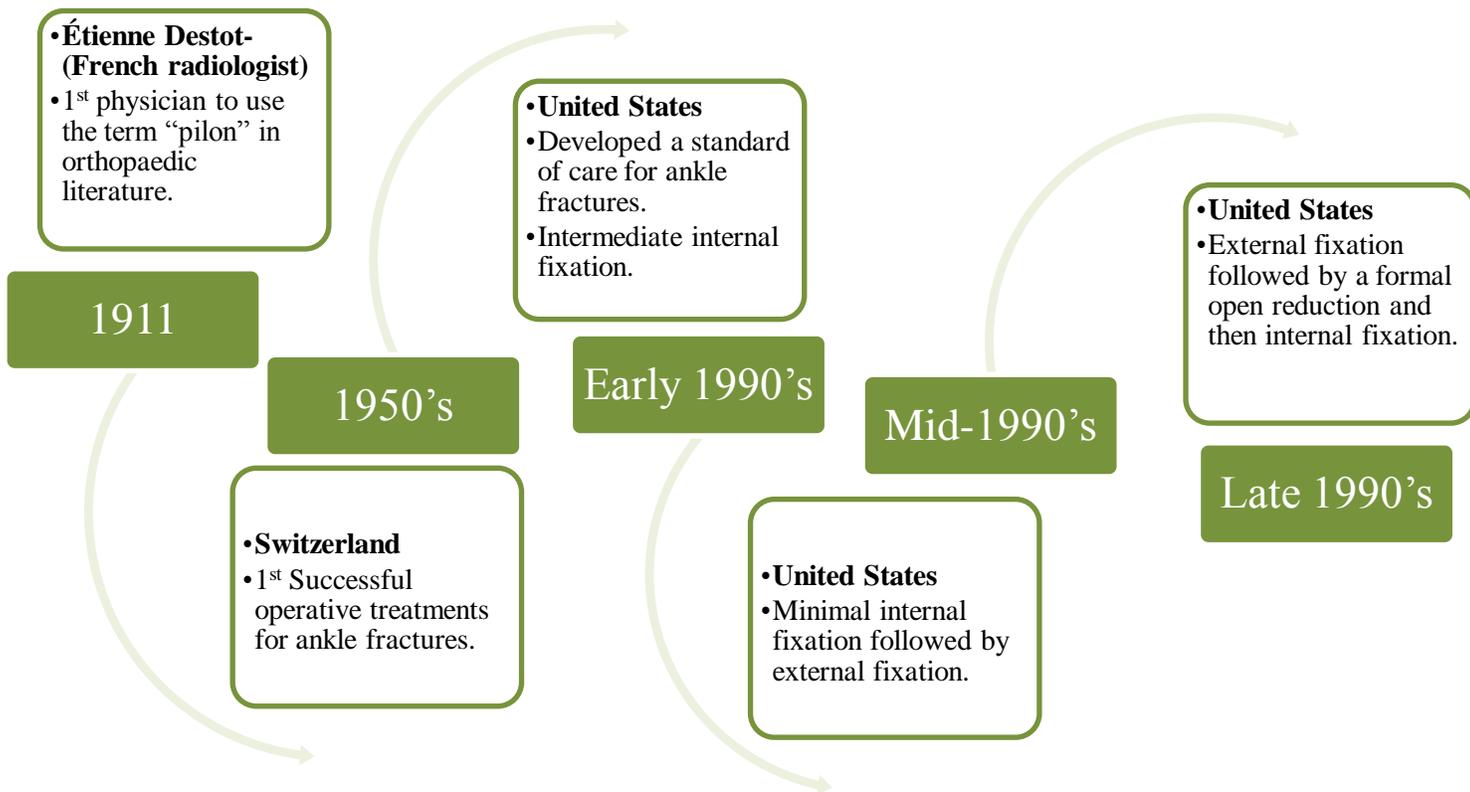


Figure 4-Timeline of the evolution of surgical treatment of pilon fractures.

Appendix A

BLADE PLATE FUSION – DATA COLLECTION

Name: _____ Age at time of injury : _____

Patient Demographics at time of injury:

Smoker/tobacco use: yes no

Height: _____

Weight: _____

BMI: _____

Employment status: _____

Prior history of trauma admission: _____

Date of Injury : _____

Date of External Fixation: _____

Treatment of Fibula: None Plate IM rod

Date of Definitive Surgery: _____

Injury Mechanism: _____

Fracture: Open or Closed
Gustilo Grade: _____
AO classification: _____

Bone graft: ICBG Allograft None Other: _____

Soft Tissue Coverage needed: Yes No
If yes, was coverage prior to or after blade plate procedure? Prior After

What size blade was used? 30mm 40mm 50mm
What was the length of plate used? 4-hole 6-hole 8-hole other: _____

Date of last follow-up: _____

Any additional procedures performed on the involved ankle or foot, if so give procedure, date, surgeon, indication for procedure.

Date	Procedure	Indication	Surgeon
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Patient Demographics currently:

Smoker/tobacco use: yes no

Height: _____

Weight: _____

BMI: _____

Employment status: _____

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