

Total Operating Room Time and Total Surgical Procedure Time in Treating Pelvic Ring Fractures with Calcium Phosphate: A Guide for Surgery Scheduling

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Received: 11 Sep 2022; Accepted: 26 Oct 2022; Published: 01 Nov 2022

Citation: Ray JM. Total Operating Room Time and Total Surgical Procedure Time in Treating Pelvic Ring Fractures with Calcium Phosphate: A Guide for Surgery Scheduling. J Med - Clin Res & Rev. 2022; 6(11): 1-5.

ABSTRACT

Introduction: The purpose of this study is to look at total surgery time and to calculate surgical procedure time as well as surgery set up time.

Methods: Over an eighteen-month period, 6/2018 -12/2019, we retrospectively reviewed the results of 45 cases of pelvic injuries consisting of fragility fractures. Data consisting of Total OR Time (TOT), Total Surgical Time (TST) and Total Set Up Time (TOT – TST = Total Set Up Time) was recorded at surgery. This information comprises the rationale of this report.

Results: Classification of the fracture types were 28 Type Ia, 1 Type Ib, 1 Type IIa, 7 Type IIb, and 8 IVb. Total Operating Room time for Type Ia was one hour. Types IIb which include an ipsilateral sacral alae fracture was again found to take 60 minutes. The Total Set Up Time for Type Ia was 30 minutes. The Total Surgery Time for Type Ia was 30 minutes. The combined Total Operating Room Time for Type IIb fractures, which include the ipsilateral sacral fracture, was 1 hour. Total Surgery Time was less than 1 hour. The 8 bilateral sacral fragility fractures Type IVb was 47 minutes. The times as reported demonstrate procedures representative of the minimally invasive treatment of pubic rami fractures.

Discussion: The purpose of this report was to look at the surgical time required to complete a new surgical technique to treat Fragility Fractures of the pelvis. Calcium Phosphate treatment for these fractures provides a delivery system that accommodates comminuted fracture patterns, minimally invasive, and supplies a supportive endothermic material adding stability to the fracture site.

Conclusion: Calcium Phosphate treatment is minimally invasive and easily performed. All fracture Types are amendable for this treatment. The times as reported demonstrate procedures representative of the minimally invasive treatment of pubic rami fractures.

Keywords

Osteoporosis, Aging, Surgery, Pelvic Ring Fractures.

Introduction

Osteoporosis is becoming a difficult disease process to manage in our aging population. Aging produces a specific and consistent decline in bone mineral density, mainly in elderly females. Pubic rami fractures are associated with osteoporosis and are the result

of a low energy, simple fall [1]. These fractures are different from those in the younger age population. Depending on the pain, location, and the amount of instability, conservative or surgical treatment has been recommended [2]. A Fragility Fracture of the Pelvis in the elderly population can greatly affect their Quality of Life. The WHO defines Quality of Life as *an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals,*

expectations, standards, and concerns [3]. The Quality-of-Life concept includes subjective evaluations of both positive and negative aspects of one's life. The primary goal of any treatment is restoring mobility, independency with re-establishing a semblance of Quality of Life. A new interest in operative treatment using various forms of internal fixation have been found useful and are recommended as the treatment of choice [4].

The surgical technique selected should be minimally invasive and time sensitive regarding the successful completion of the procedure. Pelvic bone anatomy is key to the complexity of placement of devices for fixation. The superior ramus is an irregularly shaped osseous structure that can provide an osseous conduit for intramedullary fixation. A spectrum of change between the curve and obliquity of the rami osseous anatomy exists in both the anteroposterior and the coronal planes. A surgical understanding of the osseous anatomy and fluoroscopic imaging is mandatory. Obtaining the correct intra-operative inlet and combined obturator oblique-outlet fluoroscopic views specific to each patient's anatomy is necessary for safe surgical fixation (Figure 1). Trans-pubic screw fixation has been advocated as a treatment of choice for the fragility fractures [5]. However, there is risks and complications with placement of hardware in these osteoporotic fractures. There is also significant preoperative planning for guidewire placement and screw fixation [6]. Comminuted fractures in the superior and inferior rami make screw fixation tenable and, in some cases, the inferior pubic ramus is not fixed.

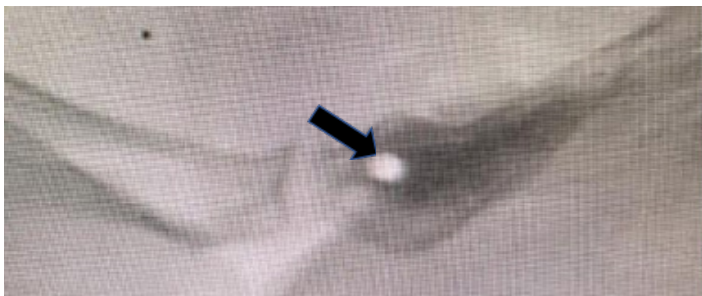


Figure 1: The Inlet view of the pelvis showing the Pubic Ramus anatomy as seen with the C-arm. Note the trocar placement and the Calcium Phosphate conforming to the fracture.

A procedure that is minimally invasive and easily performed utilizes an osteogenic material. The extensive research for an osteo-biologic for Fragility Fracture fixation has led to the use of Calcium Phosphate [7]. Studies have shown the incorporation of the Calcium Phosphate, as early as 4 weeks, into fracture site healing [8]. The Calcium Phosphate paste is prepared in the operating room there is no immediate set up time for its use, as the paste becomes hardened, only at body temperature. The paste is easily injected into the fracture pattern of the rami and easily conforms to the irregular shape of the bony anatomy. (Figure 2A, B) There is no need for open reduction or use of rigid internal fixation. Once the Calcium Phosphate hardens there is structural integrity added to the fracture.



Figure 2A: The Calcium Phosphate Conforms to the contour of the fracture.

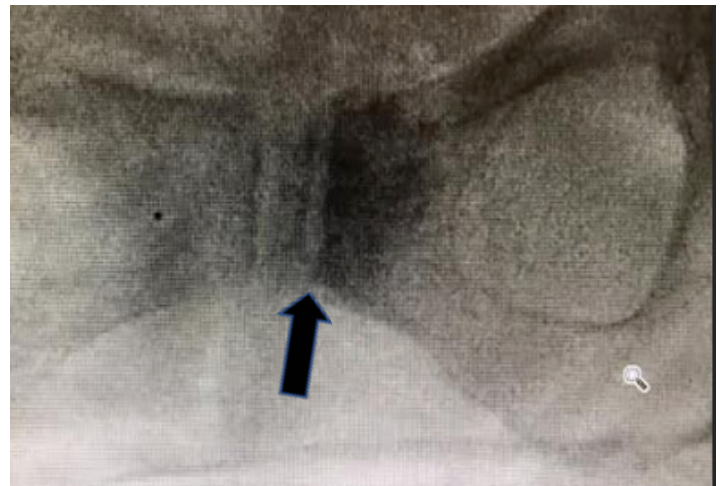


Figure 2B: The Calcium Phosphate Conforms to the contour of the fracture. Notice the trocar tract.

The use of Calcium Phosphate has been found to be helpful in management of various orthopedic conditions [9]. More recently, Calcium Phosphate has been used in the treatment of pelvic fracture conditions including fragility fractures of the pubic rami and sacrum [10]. The purpose of this study is to look at total surgery time (in room time and out room time) and to calculate surgical procedure time (surgery start and surgery stop) as well as surgery set up time. This information is helpful to the surgeon in scheduling surgical times for this procedure.

Methods

Over an eighteen-month period, 6/2018 -12/2019, we retrospectively reviewed the results of 45 cases of pelvic injuries consisting of fragility fractures. The study group included those

patients admitted to the hospital because of significant pain and limited mobility. X-rays of the pelvis as well as a CT scan were standard preoperative protocol. After medical clearance, all patients were taken to the operating room for treatment using a minimally invasive technique for fracture fixation. The criteria for surgical fixation were the presence of a pubic Fragility Fracture, a combination of a pubic rami fracture with an ipsilateral sacral fracture and an isolated bilateral sacral fracture. One patient had bilateral pubic rami fractures and one patient had a sacral fracture with a coccyx fracture. Calcium Phosphate was prepared on the back surgical table, during surgery set up, by mixing 2.8 cc of saline, 0.2 cc of Omnipaque and 5 cc of Calcium Phosphate. 5 cc of this mixture was injected into each ramus or sacrum under fluoroscopy control. Data consisting of Total OR Time (TOT), Total Surgical Time (TST) and Total Set up Time (TOT – TST = Total Set up Time) was recorded at surgery. This information comprises the rationale of this report.

Results

From 6/2018 to 12/2019, 45 cases of patients admitted with fragility fractures of the pelvis were included in this study. The mechanism of injury was a simple fall, and no other major trauma was recorded. The breakdown of the fractures were 14 patients (10 female and 4 male) sustaining Right superior and Inferior pubic rami fractures, 14 Left Superior and Inferior pubic rami fractures (10 female and 4 male). 5 patients, all female, sustained Right Superior and Inferior pubic rami fractures with ipsilateral Sacral Alae fracture. 2 patients, all female, sustained Left Superior and Inferior pubic rami fractures and ipsilateral Sacral Alae fractures. There were 8 patients with Type IVb (5 females and 3 males) bilateral, isolated Sacral Ala fractures. 1 female had a Type IIa Sacral Alae fracture with a coccyx fracture. 1 female had a Type Ib bilateral anterior Superior and Inferior pubic rami fracture. Classification of the fracture types were 28 Type Ia, 1 Type Ib, 1 Type IIa, 7 Type IIb, and 8 IVb (Figure 3).

Figure 3: Breakdown of Fracture Classification and Times.

Fracture Classification	Total Operating Room Time	Total Surgery Time	Total Surgery Set Up time
Type Ia R (N=14)	61 minutes	30 minutes	31 minutes
Type Ia L (N=14)	57 minutes	37 minutes	29 minutes
Type Ib (N=1)	58 minutes	21 minutes	37 minutes
Type IIa (N=1)	60 minutes	40 minutes	20 minutes
Type IIb R (N=5)	69 minutes	37minutes	39 minutes
Type IIb L (N=2)	63 minutes	29 minutes	28 minutes
Type IV b (N=8)	73 minutes	26 minutes	47 minutes

Total Operating Room Time

The Total Operating Room time was calculated from the time the patient entered the room and the time the patient left the room. The times were averaged by total cases. The Type Ia cases with Right sided Superior and Inferior pubic rami fractures had an average Total Operating room time of 61 minutes (range 164 minutes to 34). The Type Ia cases with Left sided Superior and Inferior pubic rami fractures had an average Total Operating room time

of 57 minutes (range 78 minutes to 38 minutes). The fractures of Type IIb, 5 right with ipsilateral sacral fracture was 69 minutes (range 134-58) and 2 left was 63 minutes. The 8 Types IVb sacral fractures was 73 minutes (range 148-53). The total OR time for the 1 female with bilateral pubic rami fractures Type Ib was 58 minutes, and the 1 female patient with the sacrum and coccyx fractures Type IIa was 60 minutes.

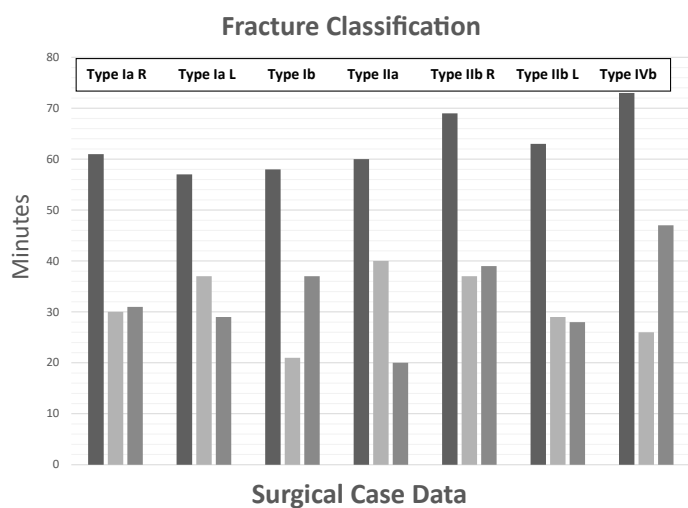
Total Surgery Time

The Total Surgical Time was calculated from the determined start of the procedure until the procedure stopped, usually at bandage application. Anesthesia is at the head of the table and in most cases, MAC anesthesia is suitable. The C-arm comes in from the right side of the operating room table with the viewer at the foot of the table. If the surgeon is right-handed, he should stand on the left side of the table, opposite the C-arm and facing the viewer at the end of the table. The surgery back table should be placed on the same side as the surgeon with the scrub nurse assisting by preparing the Calcium Phosphate for delivery. The Total Surgery Time for Type Ia right side was 30 minutes and 37 minutes for the left side. The surgical time for the one patient with a Type Ib fracture was 21 minutes. The one patient with Type IIa sacral and coccyx fractures was 40 minutes. Type IIb fractures was 37 minutes for the right-side pubic rami fractures with the ipsilateral sacral fracture. The left side was 29 minutes, The Type IVb sacral fractures had an average surgical time of 26 minutes.

Total Surgery Set Up Time

The Surgery Set Up Time includes patient positioning on the operating room table, anesthesia delivery, C-arm placement, prepping, draping and removal of the patient from the operating room table. The Type Ia cases with Right sided Superior and Inferior pubic rami fractures had an average Total Surgery Set Up Time of 31 minutes. The Type Ia cases with Left sided Superior and Inferior pubic rami fractures had an average of 29 minutes. The fractures of Type IIb, 5 right with ipsilateral sacral fracture was 39 minutes and 2 left was 28 minutes. The 8 Types IVb sacral fractures was 47 minutes. The Total Set Up Time for the 1 female with bilateral pubic rami fractures Type Ib was 37 minutes, and the 1 female patient with the Type IIa sacrum and coccyx fractures was 20 minutes.

The Surgery Set Up Time is representative of the surgical team's efforts in preparing for the procedure to start and arrive at a successful conclusion. The Total Surgery Time is the surgeon's responsibility to initiate and complete the consented procedure in an efficient and timely manner. The surgeon must be prepared to complete the procedure by having all the necessary personnel, equipment, and Calcium Phosphate appropriately prepared. The Total Operating Room Time is the combined effort of all the members of the surgical team (Figure 4). When scheduling this procedure as Internal fixation of superior and inferior pubic rami fractures standard booking time is 1 hour. Total Surgery Time should be calculated at 30 minutes (Graph 1).



Graph 1



Figure 4: Total Operating Time is dependent upon an efficient Operating Room Team.

Discussion

The purpose of this report was to look at the surgical time required to complete a new surgical technique to treat Fragility Fractures of the pelvis. Due to the increasing incidence of these unique pubic rami fractures, in an aging population, new surgical challenge has presented themselves [11]. Osteoporotic bone produces fracture patterns that are different from a younger population and does not maintain reduction or hold rigid internal fixation. The curvilinear anatomic configuration and tubular structure make it difficult to place linear screws in various fracture patterns. Hardware loosening and infections are serious complications that in most cases require further surgery [12]. Calcium Phosphate treatment for these fractures provides a delivery system that accommodates

comminuted fracture patterns, minimally invasive, and supplies a supportive endothermic material adding stability to the fracture site. Stabilizing the fracture site decreases pain and increases mobility. The Calcium Phosphate becomes incorporated into the fracture callous and does not need to be removed [13].

This report demonstrated surgical times for the fixation of Fragility Fractures with Calcium Phosphate. The largest group of fracture types identified for treatment was Type Ia (14 right pubic rami fractures and 14 left). This fracture type has been suggested to be treated non-operatively [14]. The ease of management with delivery of Calcium Phosphate allows treatment in this group. Total Operating Room time was one hour. Types IIb, which include an ipsilateral sacral ala fracture, was again found to take 60 minutes. The Total Set Up Time for Type Ia was 30 minutes. The Total Surgery Time for Type Ia was 30 minutes. Essentially the Total Surgery time is 1 hour with Set Up Time and Surgery Time 30 minutes each. The combined Total Operating Room Time for Type IIb fractures, which include the ipsilateral sacral fracture, was 1 hour. These cases require moving the patient off the operating room table and replacing the patient back on the table after flipping the patient for reposition. These cases usually start with the patient prone for treatment of the sacrum and then repositioning the patient to treat the anterior pubic ring. Total Surgery Time was less than 1 hour. The 8 bilateral sacral fragility fractures Type IVb was 47 minutes. These patients were positioned prone. The times as reported demonstrate procedures representative of the minimally invasive treatment of pubic rami fractures and are well within the range of times in the literature [15].

Conclusion

Based on this study, Surgical Times for treatment of Fragility Fractures of the pelvis were divided into 3 separate intervals. Calcium Phosphate treatment is minimally invasive and easily performed. All fracture Types are amendable for this treatment. Surgeons' familiar with pelvic bone anatomy should have confidence in performing this procedure and the time per procedure should act as a scheduling guide. A knowledge of radiographic anatomy of the pelvis in various projections is imperative for success of this procedure. The inlet view is key for trocar placement within the confines of the Superior and Inferior rami. The fracture pattern of comminution demonstrated on the CT scan will help identify areas of extravasation of Calcium Phosphate expected with filling of the fracture. One aspect of importance in learning the surgical procedure, to help manage Total Surgical Time, is a cadaver lab.

References

1. Kannus P, Palvanen M, Niemi S, et al. Epidemiology of osteoporotic pelvic fractures in elderly people in Finland sharp increase in 1970-1997 and alarming projections for the new millennium. *Osteoporos Int.* 2000; 11: 443-448.
2. Kannus P, Parkkari J, Niemi S, et al. Low-trauma pelvic fractures in elderly Finns in 1970-2013. *Calcif Tissue Int.* 2015; 97: 577-580.

3. Andrich S, Haastert B, Neuhaus E, et al. Epidemiology of pelvic fractures in Germany considerably high incidence rates among older people. *PLoS One*. 2015; 10.
4. Nanninga GL, de Leur K, Panneman MJM, et al. Increasing rates of pelvic fractures among older adults: the Netherlands 1986-2011. *Age Ageing*. 2014; 43: 648-653.
5. Suneja NMD, Kong RMBS, Tracey OCBA, et al. Epidemiology of Fragility Pubic Ramus Fractures in the United States. *Geriatr Orthop Surg Rehabil*. 2022; 13: 21514593221097274.
6. Nanninga GL, de Leur K, Panneman MJM, et al. Increasing rates of pelvic fractures among older adults The Netherlands 1986-2011. *Age Ageing*. 2014; 43: 648-653.
7. Oberkircher L, Ruchholtz S, Rommens PM, et al. Osteoporotic pelvic fractures. *Dtsch Arztebl Int*. 2018; 115: 70-80.
8. Maier GS, Kolbow K, Lazovic D, et al. Risk factors for pelvic insufficiency fractures and outcome after conservative therapy. *Arch Gerontol Geriatr*. 2016; 67: 80-85.
9. Tile M. Pelvic ring fractures should they be fixed. *J Bone Joint Surg Br*. 1988; 70B: 1-12.
10. Rommens PM, Hofmann A. Comprehensive classification of fragility fractures of the pelvic ring recommendations for surgical treatment. *Injury*. 2013; 44: 1733-1744.
11. Rommens PM, Hofmann A. Comprehensive classification of fragility fractures of the pelvic ring recommendations for surgical treatment. *Injury*. 2013; 44: 1733-1744.
12. Filip A, Veliceasa B, Puha B, et al. Pain Intensity and Degree of Disability after Fragility Fractures of the Pelvis. *Medicina Kaunas*. 2022; 58: 477.
13. Ray j. Calcium Phosphate Treatment for Acute Pubic Rami Fractures of the Pelvis A new approach to Surgical Internal Fixation. *Journal of Trauma & Treatment*. 2020; 9: 2.
14. Knaack D, Goad MEP, Aiolova M, et al. Resorbable Calcium Phosphate Bone Substitute. 1 ETEX Corporation Cambridge Massachusetts 02139 2 Institut National Polytechnique de Toulouse Toulouse. *J Biomed Mater Res*. 1998; 43: 399-409.
15. Ray J. Minimally Invasive Surgery for Anterior Pubic Rami Fractures Under Fluoro-Navigation Using the Medtronic O Arm System and Calcium Phosphate for Internal Fixation. *J of Orthopedic and Bone Disorders*. 2021; 5: 2.
16. Bloemers FW, Stahl Jens-Peter, Sarkar M, et al. Bone Substitution and Augmentation in Trauma Surgery with a Resorbable Calcium Phosphate Bone Cement. *European Journal of Trauma*. 2004; 1.
17. Rommens PM, Graafen, M, Mehling I, et al. Minimal-invasive stabilization of anterior pelvic ring fractures with retrograde trans pubic screws. *Injury*. 2020; 51: 340-346.
18. Filip A, Veliceasa B, Puha B, et al. Pain Intensity and Degree of Disability after Fragility Fractures of the Pelvis. *Medicina Kaunas*. 2022; 58: 477.
19. Sarkar M, Wachter N, Patka P, et al. First Histological Observations on the Incorporation of a Novel Calcium Phosphate Bone Substitute Material in Human Cancellous Bone. *J Biomed Mater Res*. 2001; 58: 329-334.
20. Russell, TA, Leighton RK. Phosphate Cement for Defect Augmentation in Tibial Plateau Comparison of Autogenous Bone Graft and Endothermic Calcium. *J Bone Joint Surg Am*. 2008; 90: 2057-2061.
21. Kovacevic D, Fox AJ, Bedi A. Calcium-Phosphate Matrix With or Without TGF- β 3 Improves Tendon-Bone Healing After Rotator Cuff Repair. *Am J Sports Med*. 2011; 39: 811.