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Should we take a Broader view when treating Fragility Fractures of the Posterior Pelvis? A Retrospective Cohort Study

Manuela Notzli[1], Laurenz Jaberg[2*], Ralph Zettl[2], Daniel Smolen[3], JoEllen Welter[2], Alexander Dullenkopf[2] and Florian Hess[2]

[1]*Department of Orthopedic Surgery, Schulthess Clinic, Zurich, Switzerland*

[2]*Department of Orthopedic Surgery and Traumatology, Cantonal Hospital Frauenfeld, Switzerland*

[3]*Alphaklinik, Zurich, Switzerland*

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***Corresponding author:** Laurenz Jaberg, Department of Orthopedic Surgery and Traumatology, Cantonal Hospital, Frauenfeld Pfaffenholzstrasse 4 8501 Frauenfeld, Switzerland

Abstract

Background: A classification system to treat fragility fractures of the pelvis (FFP) based on fracture type has been proposed. In practice, however, treatment can differ from recommendations. Our aims were to describe patient outcomes based on the approach used to treat FFP, to assess the consistency of our treatment with recommendations proposed by the classification system, and to identify risk factors potentially influencing treatment allocation.

Materials and Methods: Between January 2014 and June 2018, a total of 145 patients with an FFP I-IV were were treated. Seventy-seven patients (median age of 82 years; IQR, 73-87; range, 56-95) with posterior pelvic ring fractures (FFP II-IV) were included in our study. If surgery was necessary, either unilateral or bilateral lumbopelvic stabilization was performed with a minimally invasive approach. Treatment course, patient demographics, and factors potentially influencing outcomes (e.g., diabetes, chronic renal insufficiency, chronic steroid use, neurological disease) were analyzed. We measured the consistency rate between our treatment of Type III and IV fractures with the recommendations. We defined 'successful outcome' using three parameters (return to original residence, pain level, and fracture consolidation using CT scan) at the 6-month follow-up.

Results: Twenty-six patients underwent immediate posterior stabilization using minimally invasive lumbopelvic fixation, 18 had delayed surgical stabilization, and 33 were treated conservatively. The success rate for the cohort was 86%. Eight of the 11 failures (73%) were in the immediate surgery group. Conservative treatment succeeded in 62% (16/26) Type II, 29% (7/24) Type III, and 33% (9/27) Type VI fractures. Success by fracture type was: 88% in Type II, 75% in Type III, and 93% in Type IV. Success by treatment group was 69% (immediate surgery), 89% (delayed surgery), 97% (conservative); and the complication rate within the first six months was 34.6%, 27.8%, and 12.1%, respectively. Among those with Type III and IV fractures, 33% of patients were successfully treated conservatively. No risk factors were significantly different.

Conclusion: While the proposed classification system is useful for treating FFP, 33% of our patients with more complex and unstable fractures (Type III and IV) were treated conservatively, which differed from the recommended treatment courses.

Level of Evidence: 3

Keywords: Fragility fracture of the pelvis; Sacrum fracture; Osteoporosis; Geriatric patient

Abbreviations: ASA: American Society of Anesthesiologists; BMI: Body Mass Index; FFP: Fragility Fracture of the Pelvis; VAS: Visual Analog Scale

Introduction

Fragility fractures of the pelvis (FFP) are caused by mild trauma that would not usually be sufficient to fracture healthy bones [1-5]. The incidence of fragility fractures is on the rise, and an increase in life expectancy is one contributing factor [6-10]. Higher healthcare costs associated with sacral fractures, particularly in older patients [6,9], are primarily due to prolonged and intense pain, immobility, and loss of independence [11,12]. Especially problematic are severe secondary complications stemming from long-term immobilization, such as urinary tract infections, pneumonia, loss of muscle mass, and side effects of chronic use of pain medication [13].

The decision to treat a fracture surgically or conservatively is difficult. The most common approach to managing non-displaced FFP is conservative treatment with mobilization and analgesics

based on pain levels [4,5]. Problems can arise when conservative therapy fails, mainly due to the risk of complications associated with prolonged immobility. If surgery is needed, the least invasive method should be used, when feasible, to treat this vulnerable population [2].

Although the incidence of sacrum fractures is increasing, reports on management strategies are limited, and evidence-based treatment guidelines reached by consensus are lacking. In 2013, Rommens & Hofmann [6] described a separate classification system for FFP since its fracture morphology differs from fractures in healthy bones caused by high energy trauma [1-3]. This classification system (Comprehensive Classification of Fragility Fractures of the Pelvic Ring) includes a broad spectrum of fracture morphologies caused by low energy trauma and permits international comparisons of such fractures. According to this classification system, Type II fractures ought to be treated conservatively, whereas Types III and IV with signs of instability should be stabilized surgically.

Despite the advances made with the establishment of these recommendations by Rommens & Hofmann, this system centers on the fracture type. Questions such as 'what degree of dislocation is relevant for treatment' and 'which types of fractures are truly unstable' remain unanswered. A multitude of factors could be considered when treating a mostly geriatric population, such as the array of comorbidities, degree of immobility, and pain level. However, including all potential risk factors into a treatment algorithm would not only be challenging, but it might also make defining standard procedures too complicated.

At our institution, we attempted to carry out the recommendations of Rommens et al. [14] when treating FFP cases. We found, however, that the everyday challenges in clinical practice did not always permit adherence to these recommendations. For example, some patients with Types III and IV fractures showing signs of instability refused surgery and were subsequently treated conservatively. Likewise, several patients with Type II fractures failed conservative treatment and eventually underwent surgery. These cases prompted us to question if the proposed classification system needs to be expanded slightly to include factors beyond just fracture type. The primary aim of our study was

i. To describe patient's outcomes based on the approach used to treat FFP. We also assessed

ii. The consistency of our treatment with recommendations proposed by the classification system. As an additional endpoint

iii. We looked at risk factors potentially influencing patient allocation to operative or conservative treatment.

Materials and Methods

Patient population

Between January 2014 and June 2018, a total of 145 patients with a fragility fracture of the pelvis (FFP I-IV) were admitted to our institution. The inclusion criteria for this study were as follows: (i) all adult patients aged 18 years and older who had a FFP of the posterior ring; (ii) a Type II, Type III, or Type IV fracture; (iii) and patients who underwent conservative or surgical treatment (immediate or delayed) of the FFP. Seventy-seven patients with a median age of 82 years (IQR 73-87, range 56-95) who had a fracture due to a low energy trauma were included. We excluded all patients who (i) were previously diagnosed with osteoporosis and had undergone antiresorptive therapy, (ii) had sacrum fractures caused by a malignant tumor with bone metastases, (iii) were undergoing revision surgery, or (iv) had a pelvic fracture due to a high energy trauma.

To assign the fracture type, we used the FFP classification [2]. In addition to baseline characteristics (e.g., gender, age, and BMI), the overall well-being of patients was scored using the ASA Physical Status Classification System. Likewise, we documented concomitant injuries and risk factors with the potential to influence bone healing, such as diabetes mellitus, chronic renal insufficiency [15], chronic steroid use [16,17], neurological disease, and pain levels (measured with visual analog scale (VAS)). To quantify bone quality and to estimate the extent of osteoporosis, the cortical thickness index was measured using x-ray images [18]. The length of hospitalization and operative time were also included in the analyses. This retrospective study was approved by the local ethics committee (01.5301(2013/2006/kap)012), and written consent was obtained from the participants.

General patient management

Patients admitted to the emergency department or seen for orthopedic consultation initially received a conventional radiograph. If the injury to the posterior pelvic ring was confirmed by x-ray or the patient complained of posterior compression pain, a CT scan was done to assess the fracture more precisely. Since most elderly patients are unable to mobilize adequately enough to return to their residence, all patients were admitted to the hospital.

During this initial hospitalization, our intention was to provide conservative treatment with pain medication and daily physiotherapy for five days, regardless of the patient's fracture type. If the pain level was under control and independent movement with an adequate degree of mobilization was possible, the patient was discharged from the hospital to either their residence or a rehabilitation clinic to improve mobility [5]. This decision about whether the pain was sufficiently under control was made directly by the patient or, in cases of dementia, by the surgeon. If the pain impeded mobilization, surgical stabilization of the pelvis was considered. Some patients refused this surgical option, while others chose to undergo early operative treatment. Surgery consisted of lumbopelvic stabilization with or without ventral stabilization of the pelvic ring. Depending on the fracture type, age and bone quality, dorsal lumbopelvic stabilization was done unilaterally or bilaterally, and with or without cement augmentation. Figure 1 illustrates the possible patient treatment regimes.

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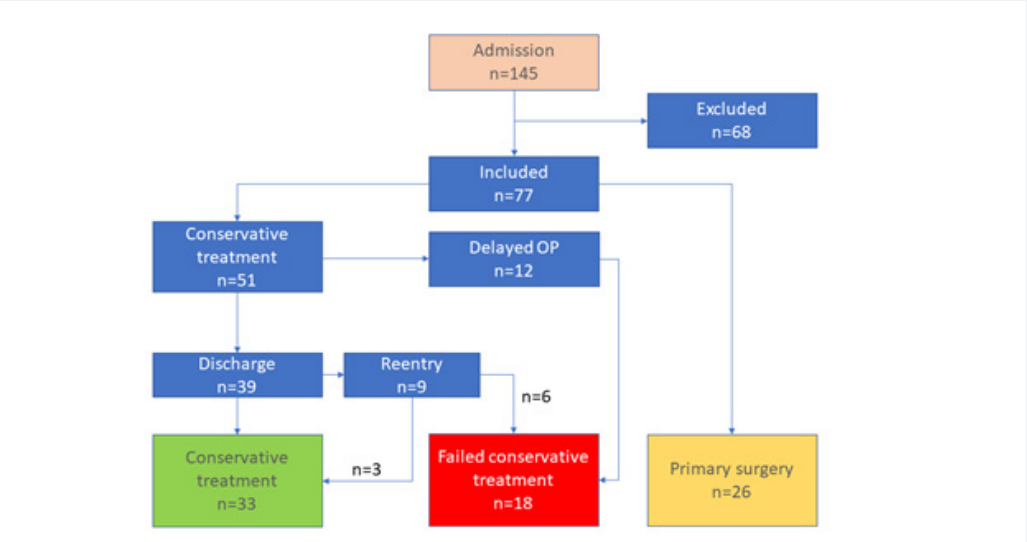

Figure 1: Flow diagram of treatment received.

Grouping

If the surgical procedure was done within the first five days after admission or within a maximum of 14 days after trauma, the patient was assigned to "immediate surgery group" [6,19,20]. The "delayed surgery group" consisted of patients who needed secondary stabilization for one of the following reasons: 1) surgery was done more than 14 days after trauma because conservative treatment failed, 2) the patient refused primary surgery, or 3) the injury occurred in a residential care facility and the patient was not initially admitted to the hospital by the primary care physician. The "conservative treatment group" included all patients with fractures that healed successfully without surgical intervention.

Surgical technique

All operations were performed by experienced orthopedic surgeons using a previously described technique [21]. Bilateral stabilizations were done by two surgeons. Stabilization was achieved by establishing a connection between the lumbar spine and the ilium (lumbopelvic stabilization). The CD Horizon® LongitudeTM System (Medtronic, Dublin, Ireland) was used for dorsal instrumentation.

Anesthesia

All procedures were performed under general anesthesia and with the patient in the prone position.

Surgical approach

Before skin incision, the posterior iliac crest and the pedicle were marked under fluoroscopy. For unilateral fractures, a longitudinal incision was made 3 centimeters paramedian to the midline, starting from the fourth lumbar vertebral body and continuing to the posterior iliac spine. In the case of bilateral lumbopelvic stabilization, identical skin incisions were done on both sides. The thoracolumbar fascia was visualized and split longitudinally. The sacrospinal muscle was bluntly dissected for partial exposure of the anterior and posterior border of the posterior iliac spine. The entry point for the iliac screw was located posteriorly and medially of the posterior iliac spine.

Screw placement

Using x-ray imaging, the pedicle (L4 or L5) and the entry point for the iliac screw were identified and then opened with a Jamshidi needle. In cases of degenerative scoliosis, previously consolidated vertebral body fractures of L5, or moderate-to-severe anterolisthesis, the lumbopelvic stabilization was extended up to the fourth vertebral body. The screws were then inserted with a guidewire. The position of the screws was checked at two levels by fluoroscopy. The iliac screw (7.5x55mm) was carefully inserted to prevent injury of the anterior corticalis since irritations of the thoracolumbar fascia can lead to chronic pain. Once the pedicle and iliac screws were correctly placed, the vertical connection rod was inserted medial to the sacrospinal muscle.

Rehabilitation

All patients underwent immediate, full-weight bearing mobilization within the first 24 hours after surgery. First radiographic images of the lumbar spine and pelvis were done after mobilization. For patients with cement augmented screws, a thoracic radiograph was done to exclude a cement embolus.

Outcome assessments

Follow-up visits with clinical and radiological assessments were done 6 weeks, 3 months, and 6 months postoperatively

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(primary or secondary pelvic stabilization) or after trauma for conservatively treated cases. To confirm fracture healing (and rule out non-union), all patients received a pelvic CT scan after 6 months. At the 6-month follow-up, data were collected for the following parameters: (i) the patient's residence, (ii) VAS scoring (0-10), and (iii) fracture healing. We classified a 'successfully treated' case as those patients meeting all of the following criteria:

Residential status

We determined that success was achieved when the patient was able to return to their previous residence or another independent living facility. This information was clinically relevant since it served as an indicator of the patient's ability to resume a similar pre-fracture lifestyle, with a comparable level of independence. The data were gathered from hospital discharge records.

Pain level

The VAS scoring (0-10), which was gathered during follow-up assessments, had to be at the level of pain-free (VAS = 0) or virtually pain-free (VAS = 1-2). This unidimensional measure of pain intensity (10 cm line) is routinely used at our institution before and after treatment to measure patient-reported outcomes. This subjective assessment is systematically documented in the medical records of each orthopedic patient.

Fracture consolidation

To measure bone healing, we used CT scan imagining confirming consolidation of the posterior pelvic fracture. Consolidation was defined as the appearance of new bone trabeculae in the fibrocartilaginous callus, which eventually becomes bony callus. This measurement of clinical outcomes in trauma patients with FFP is considered a standard method for objectively assessing bone repair. It is also used to determine if further action is needed to reach the final stage in bone healing.

Statistical Analysis

Descriptive statistics were used to analyze demographic and clinical characteristics. Fisher's exact test was used for categorical variables (gender, diabetes, renal disease, neurological disease, steroid intake, osteoporosis). Based on data distribution, either a Kruskal Wallis or one-way ANOVA tests were used to compare the three groups. When comparing two groups, the Wilcoxon rank sum test or t-test were used. The significance level was set at $p < 0.05$; however, a Bonferroni correction of 0.0167 was calculated for determining significance due to multiple group comparisons. The variables collected were age, gender, body mass index (BMI), ASA (American Society of Anesthesiologists) physical status score (1-6), comorbidities, fracture type, operation time, duration from trauma to surgery (days), length of hospitalization (days), unilateral or bilateral operation, complications, type of residence before and after treatment, pain level (VAS scores), and bone consolidation (measured with CT scans). All tests were conducted in IBM® SPSS® Statistics for Windows Version 21.0 (Armonk, NY).

Results

General Results

Table 1 presents an overview of the demographic and treatment-related data of the 77 patients included in the study. A significant difference in the age of the groups was detected, with a higher median age in the conservatively treated group. Of those patients who underwent surgery, the mean operation time for unilateral stabilization was 35.9 minutes (SD ± 13.7) and 64.2 minutes (SD ± 24.9) for bilateral procedures. There was no significant difference (p=0.10) in operation time between Groups 1 and 2. Potential risk factors that might have influenced the failure of conservative treatment are summarized in Table 2. No statistically significant differences were detected among the groups. According to our definition, 86% of all patients had successful outcomes at the 6-month assessment.

Table 1: Patient characteristics and treatment-related data according to the treatment group.

	Immediate surgery group	Delayed surgery group	Conservative treatment group	p-value [a]	p-value [b]
Number of patients	26	18	33	-	-
Age (years) [+]	73 (61-82)	79.5 (74-82)	85 (79-90)	0.0003	0.0092
Delay to surgery (days) [++]	4.9 (±3.6)	37.4 (±33.9)	-	-	-
Hospital stay (days) [++]	12 (± 3.3)	11 (± 4.1)	7 (± 3.3)	0.0001	0.0002
Body mass index (BMI) (Kg/m^2) [+]	24.5 (23.5-25.3)	23.25 (20.75-25.45)	25 (23.6-29.1)	0.0957	0.0437
American Society of Anaesthesiologists (ASA) physical status (1-6) [+]	2 (2-2)	2.5 (2-3)	2 (2-3)	0.0491	0.5356

[a]Compares all groups by Kruskal-Wallis or one-way ANOVA test.
[b]Comparison of Group 2 and Group 3 with T-Test or Wilcoxon rank sum. + Median (interquartile range), ++ Mean (standard deviation); Bonferroni correction p<0.0167

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Table 2: Potential risk factors for non-union according to the treatment group.

	Immediate surgery group	Delayed surgery group	Conservative treatment group	*p-value* [a]	*p-value* [b]
Gender (female)	22 (85%)	17 (88%)	29 (89%)	0.608	0.645
Diabetes	1 (4%)	2 (11%)	7 (22%)	0.129	0.292
Renal disease	4 (22%)	13 (26%)	9 (28%)	0.042	0.746
Neurological disease	3 (12%)	4 (22%)	3 (9%)	0.385	0.234
Chronic steroid intake	0	2 (11%)	2 (6%)	0.213	0.612
Osteoporosis	12 (46%)	9 (50%)	17 (52%)	0.169	0.643

[a] Compares all groups by Fisher's exact test. [b] Comparison of Group 2 and Group 3 (Fisher's exact test), Bonferroni correction p<0.0167

Fracture types and comparison with the classification system

A detailed list of the fracture types in each treatment group is given in Table 3, and the distribution per group is illustrated in Figure 2. A significant difference in the distribution of the fractures among the groups was detected (p=0.007). At the 6-month assessment, successfully treated fracture types were as follows: 85% (22/26) Type II, 92% (22/24) Type III, and 81% (22/27) of Type IV. Eight of the 26 Type II fractures were successfully treated with surgery (6 in the immediate surgery group and 2 in the delayed surgery group). Thirty-three percent (8/24) of Type III fractures healed after conservative treatment and 14 had success with surgery (11 in Group 1 and 3 in Group 2). Lastly, 9 of 27 (33%) Type IV fractures healed after conservative treatment, while 13 (5 in immediate surgery group and 8 in delayed surgery group) had success after surgery. Therefore, 17 of 51 Type III or IV fractures successfully healed after conservative treatment, which represents a 33% deviation from the recommendations.

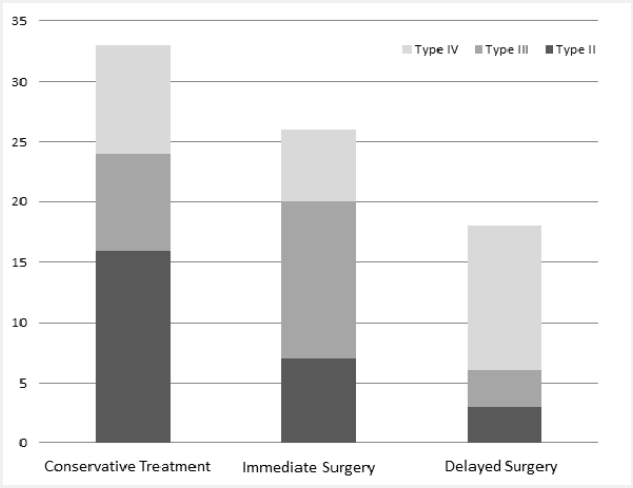

Figure 2: Distribution of fracture types according to treatment received.

Table 3: Fracture types according to the treatment group.

Fracture Type	Immediate surgery group	Delayed surgery group	Conservative treatment group	Total
IIa	-	-	1	1
IIb	3	1	15	19
IIc	4	2	-	6
IIIa	-	-	2	2
IIIb	-	-	-	0
IIIc	13	3	6	22
IVa	-	-	-	0
IVb	4	3	3	10
IVc	2	9	6	17

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Immediate surgery group

General description of treatment group

A total of 26 patients were unable to be sufficiently mobilized within the first five days and underwent immediate stabilization. Most of the patients had Type III fractures (n=13). Due to poor bone quality in 19 patients, cement augmented screws were used. In one patient with osteoporosis, the fracture of the anterior pelvic ring included the anterior rim of the acetabulum. For this reason, additional open reduction and internal fixation (ORIF) of the ventral pelvis was necessary. A single iliosacral screw was used in one patient with a contralateral transforaminal sacrum fracture, and a triangular stabilization was applied in one patient with a Type IIIc fracture.

Outcome measures of success

Of the 26 patients undergoing immediate surgery, 85% were successful. (i) Residential status: A total of 6 patients were directly discharged to their residence, 15 patients were admitted to a rehabilitation clinic, and 4 patients were temporarily or permanently referred to a nursing home. During the 6-month follow-up, all surviving patients (n=23) except one reached their preoperative level of mobility and went back to their previous residence. One patient never regained enough mobility to return home; she remained in a nursing home. (ii) Pain level: Sixteen patients were entirely pain-free (VAS 0) and 8 patients complained of slight pain (VAS 1 n=3, VAS 3 n=5). Of this latter group, implant removal was done after 6 months in 6 patients. (iii) Bone consolidation: All posterior pelvis fractures healed within 6 months.

Complications

The overall complication rate within the first six months was 34.6% in the immediate surgery group. One patient died one day after surgery due to cardiac insufficiency, and one patient died within the first 6 months. Three patients received antibiotics for a urinary tract infection, and two patients developed nosocomial pneumonia. One patient with a Type IIIc fracture had a secondary dislocation of the anterior pelvic ring and was surgically stabilized two months after primary dorsal stabilization with plating. A concomitant symphyseal disruption was diagnosed during treatment in one patient and resulted in a secondary plating 5 days after lumbopelvic stabilization. This same patient developed a postoperative mechanical ileus and needed surgical intervention. One patient had a non-union of the anterior pelvic ring after 6 months, but no further surgery was necessary.

Delayed surgery group

General description of treatment group

Two patients refused primary surgery and 16 were initially mobilized under pain medication, but improvements in mobility and pain were insufficient. Most of the fractures (n=12) were Type IV. In a total of 15 patients, the screws were cement augmented. In one patient (Type III fracture), an additional ventral ORIF including the anterior pelvic ring and the acetabulum was necessary.

Outcome measures of success

Of the eighteen patients who underwent delayed surgery, 72% were successful. (i) Residential status: A total of 14 patients were referred to a rehabilitation clinic and 4 patients were discharged to their residence. At the 6-month follow-up visit, all patients (n=16) except one reached their preoperative level of mobility and went back to their residence. One patient could not achieve adequate mobility to return home and remained in a nursing home. (ii) Pain level: Fifteen patients were completely pain-free (VAS 0) and 2 patients complained of slight pain (VAS 2). Three patients underwent implant removal after 6 months. (iii) Bone consolidation: All posterior pelvis fractures healed within 6 months.

Complications

The overall complication rate within the first 6 months was 27.8% in the delayed surgery group. Two patients developed a urinary tract infection during hospitalization. Vascular revision surgery was necessary for a patient with a Type IVc fracture 5 days after additional anterior pelvic ring plating due to postoperative closure of the external iliacal vessels. One patient died 8 weeks after surgery due to cardiac insufficiency (Figure 3). At the 6-month follow-up, one patient with a Type III fracture presented with a non-union of the anterior pelvic ring fracture with persistent pain but refused revision surgery. Implant removal resulting from local irrigation had to be done after 6 months in 3 patients.

Conservative treatment group

General description of treatment group

A total of 33 patients were treated conservatively, 16 of which had Type II fractures (Figure 4). Operative treatment was recommended to 5 patients who had immobilizing pain, but they all refused (Type II, n=2; Type III, n=2; Type IV, n=1).

Outcome measures of success

Of the 33 patients treated conservatively, 94% were successful. (i) Residential status: A total of 11 patients were directly discharged to their residence, 8 patients were admitted to a rehabilitation clinic, and 14 patients were temporarily or permanently referred to a nursing home. Three of the five patients who refused lumbopelvic stabilization were readmitted to the hospital with persistent pain 17-23 days after discharge, yet they still refused surgery. At the 6-month follow-up visit, all patients (n=33) reached their preoperative level of mobility and went back to their former residence. (ii) Pain level: Twenty-seven patients were pain-free (VAS 0), and 6 patients reported slight pain (VAS 1-2). (iii) Bone consolidation: All posterior pelvis fractures healed within 6 months.

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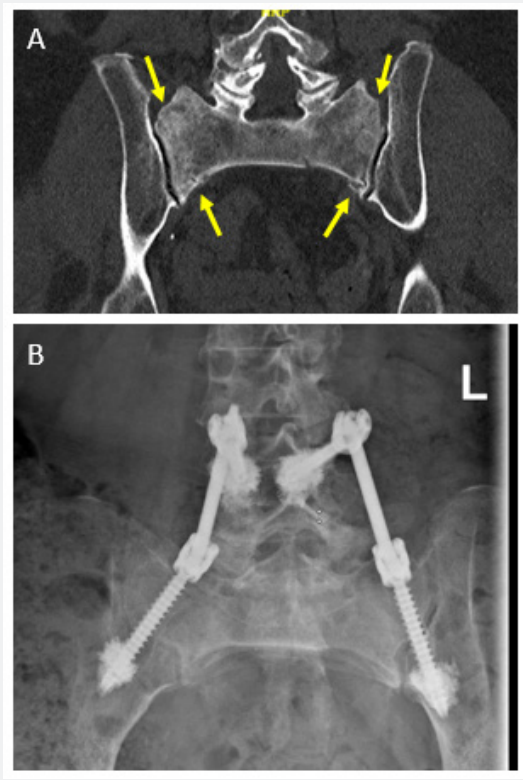

Figure 3: Type IVc fracture in a 72-year-old female. (A) Preoperative CT scan, (B) postoperative X-ray after bilateral cemented lumbopelvic stabilization.

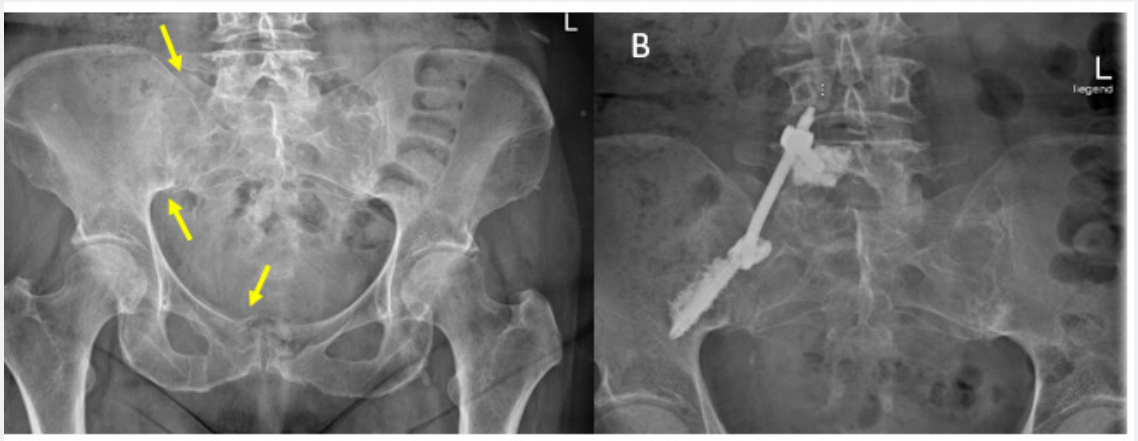

Figure 4: Type IIc fracture in a 78-year-old female. (A) Preoperative Xray, (B) postoperative x-ray after unilateral cemented lumbopelvic stabilization.

Complications

The overall complication rate within the first 6 months was 12.1% in the conservative treatment group. Three urinary tract infections and one case of pneumonia occurred during hospitalization. Although 3 patients were readmitted due to persistent immobilizing pain between 17 to 23 days after discharge, they refused to have surgery. None of the patients died within the first 6 months.

Discussion

We assessed treatment strategies among patients with fragility fractures of the pelvis by comparing patient characteristics and

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outcomes. The fracture types varied among the groups, which was expected. However, the distribution differed from what would have been expected had we followed the existing classification system. Up to 55% of patients who were successfully treated conservatively had Type III or IV fractures. We were not able to identify statistically significant risk factors that may have influenced the outcomes except that the median age of the conservatively treated group was higher than the two surgical groups. Higher complication rates occurred in the surgical groups.

According to the literature, one significant risk factor for pelvic ring fractures is osteoporosis [22,23]. Burge et al. [24] reported that pelvic ring fractures in the elderly accounted for 7% of all osteoporosis-associated fractures. The incidence of these fractures has increased dramatically in the past few decades [7], which is likely due to increased life expectancy and improved diagnostic methods [25]. The highest incidence of FFP occurs in the ninth decade of life [26], and women are more frequently affected [25,27,28], which is consistent with our experience treating these cases. Despite this increasing trend, decision-making about how to treat such fractures remains a challenge due, in part, to a scarcity of empirical evidence [19,29]. When we compared our results to other reports in the medical literature, we found a lower amount of posterior ring involvement, with only 53.1% of all fractures classified as Type II or higher. This difference, however, might be due to our diagnostic strategy. Only patients with posterior compression pain or possible involvement of the posterior pelvic ring on the a.p. x-ray of the pelvis received a CT scan for verification.

Another difficulty when treating these patients is the multitude of comorbidities [30] and increased perioperative risk [20], which was demonstrated by the higher complication rates in the immediate surgery and delayed surgery group. Furthermore, we observed lower success rates in the two surgical groups when compared to the conservatively treated group. When possible, surgery should be avoided when conservative treatment can achieve a similar outcome. Despite the recommendations of Rommens et al. [29] to surgically treat Type III and IV fractures, approximately one-third of our patients with FFP III and IV fractures were treated conservatively. Due to the more advanced age and the shorter hospitalization of the conservatively treated group, these patients were more likely to be discharged to a rehabilitation clinic for temporary care. This treatment course is consistent with the standard of care offered in Switzerland; it is not an indicator of a poorer health status of this patient group compared to the other groups. Although we analyzed other factors that might have influenced treatment outcomes (e.g., gender, diabetes, osteoporosis [3], renal and neurologic disease, chronic use of steroids [31]), none were statistically significant. This does not mean, however, that they were not clinically relevant. Our inability to detect a difference may have been the result of relatively small group sizes.

When surgical treatment is indicated, lumbopelvic stabilization has advantages as a minimally invasive technique. The operating time is usually short, and if two surgeons operate simultaneously in bilateral cases, the extended time can be minimized. Blood loss remains low with minor surgical incisions, which is hemodynamically beneficial [29]. Lumbopelvic stabilization aids in establishing early bone stabilization and direct mobilization of the patients [32-34], which can help prevent complications stemming from immobility. In general, we did not perform a triangular fixation with lumbopelvic stabilization and a cement-augmented sacroiliac (SI) screw because the clinical benefits of the additional SI screw are not clear, especially in osteoporotic bones. One or two cement-augmented SI screws seldom achieve enough mechanical stability. They often loosen on the ileum side, particularly in cases of poor bone quality [14,35]. Alternatively, transsacral bar osteosynthesis or internal fixator (rods) could be performed to stabilize the posterior pelvis [29]. While most techniques can be done as a minimally invasive procedure, it is unclear if they can achieve the same level of stability as the lumbopelvic technique, especially in severely osteoporotic bones.

Another important consideration when performing surgical interventions is that posterior pelvic ring fixation may not close the ring if it is also broken anteriorly. Some authors recommend anterior stabilization for displaced anterior pelvic fractures [2,19,36,37]. However, in our study population, dorsal support was often enough to facilitate mobilization and reduce pain. Two of our patients also needed anterior stabilization because of the worsening dislocation of the anterior pelvic ring. For all other patients, complete fracture healing was confirmed using CT scan imaging six months after surgery. In cases of considerable dislocation of the anterior pelvic ring in Type III or IV fractures, an additional anterior stabilization is recommended [29]. When treating obese patients with severe osteoporosis or patients with complete disruption of the pelvic ring, additional anterior pelvic ring stabilization may be needed to prevent non-unions.

One limitation of this retrospective study was the potential for bias in treatment allocation. In addition, not all patients were initially assessed at the orthopedic clinic, which may have led to delays in treatment. Furthermore, the selection of a 5-day time frame for patient mobilization was not based on previously published recommendations. Some patients might have avoided surgery if the time frame was extended. Nonetheless, this period seemed to be adequate for our population since most patients who chose the surgical option did so within this period, mostly due to intolerable discomfort and immobilization. Furthermore, the 14-day time frame between the immediate and delayed surgery groups was chosen simply to establish a cutoff point between primary surgery and failed conservative treatment - it was not based on evidence in the medical literature. Regarding the clinical outcome, pain medication was not standardized during or after hospitalization, and no pain scores were evaluated before hospital

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discharge. Lastly, the median age of patient the immediate surgery group was slightly younger (73 years) than several averages (79-81 years) reported in the medical literature [38-40]. When selecting a treatment course, we considered several factors, including the patient's age. However, the determining factors were the level of pain and mobility. We do not believe there was selection bias towards surgical treatment in younger patients, but with any retrospective analysis, this possibility is higher than with a prospective study.

Conclusion

The establishment of universal treatment algorithms based solely on a given fracture type is difficult, especially since geriatric patients contend with a multitude of risk factors that influence treatment options and outcomes. Rommens et al. created a useful classification system, yet it is somewhat limited by its focus on the fracture type. We found that some patients (33%) with Type III and IV fractures healed after conservative treatment. Consequently, we propose conservative treatment for approximately five days from the point of trauma, regardless of the fracture type, because we believe this allows adequate time to assess the need for more invasive treatment.

Given our favorable results despite some inconsistencies with the classification system, and the increasing incidence of fragility fractures of the pelvis, further investigation of other potential confounders is warranted. Only then can we develop comprehensive guidelines based on evidence gathered from a broader perspective.

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