



CODEN [USA]: IAJ PBB

ISSN: 2349-7750

**INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.1845557>Available online at: <http://www.iajps.com>

Review Article

**CAUSES, PREVALANCE AND TREATING PELVIC
FRACTURES FOR ELDERLY**

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Abstract:

Introduction: Many elderly individuals remain to be healthy and independent even at very old ages; others, on the other hand, suffer several serious age-related conditions, that limit their ability to move and be active. Osteoporosis is considered to be very common among the elderly and is characterized by a decreased of bone mineral density due to bone resorption. The result is the development of a bony structure, that is more susceptible in case of traumatic events. **Aim of work:** In this review, we will discuss the most recent evidence regarding optimal treatment of FFP and its influence on outcome. **Methodology:** We did a systematic search for Causes, prevalence and treating pelvic fractures for elderly in the emergency department using PubMed search engine (<http://www.ncbi.nlm.nih.gov/>) and Google Scholar search engine (<https://scholar.google.com>). All relevant studies were retrieved and discussed. We only included full articles. **Conclusions:** Fragility fractures of the pelvis (FFP) require our specific attention because their incidence is increasing dramatically and because they show a complicated prognosis in many cases. The characteristics of fragility fractures of the pelvis differ in many aspects from pelvic ring disruptions in adolescents and adults. They are the result of a low-energy trauma and does not need emergency treatment. Immobilizing pain in the low back, in the gluteal region, in the groin or at the pubic symphysis is the leading symptom. We discussed the new categorization system that comprises different degrees of instability, specific morphologies and localizations of fractures.

Key words: Causes, prevalence, management, pelvic fractures, elderly.

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Please cite this article in press Bandar Saeed Alanazi et al., *Causes, Prevalance and Treating Pelvic Fractures for Elderly.*, Indo Am. J. P. Sci, 2018; 05(12).

INTRODUCTION:

Due to the recent application of several prevention protocols, improved quality of life and medical care, we are observing an elevation in life expectancy rates in both developed and developing countries. In addition, there is a parallel steady decrease in birth rates, leading to significant increases in the counts of the elderly population. Many elderly individuals remain to be healthy and independent even at very old ages; others, on the other hand, suffer several serious age-related conditions, that limit their ability to move and be active.

Osteoporosis is considered to be very common among the elderly, and is characterized by a decreased of bone mineral density due to bone resorption [1]. The result is the development of a bony structure, which is more susceptible in case of traumatic events. Classical osteoporotic fractures include are intra and extracapsular hip fractures, vertebral compression fractures, proximal humerus and distal radius fractures. The fragility fracture of pelvis, also abbreviated as FFP, is another classical fracture, which is associated with low and very low bone strength [2].

On the other hand, the incidence and prevalence of hip fractures among the elderly has been decreasing since the 90s, the opposite is true for FFP [3]. Data from the US, Germany, the Netherlands and Finland unanimously show an increase of the incidence and prevalence of FFP, especially in the population above 80 years of age [4].

In this review, we will discuss the most recent evidence regarding optimal treatment of FFP and its influence on outcome.

METHODOLOGY:

We did a systematic search for Causes, prevalence and treating pelvic fractures for elderly in the emergency department using PubMed search engine (<http://www.ncbi.nlm.nih.gov/>) and Google Scholar search engine (<https://scholar.google.com>). All relevant studies were retrieved and discussed. We only included full articles.

The terms used in the search were: Causes, prevalence, management, pelvic fractures, and elderly.

Specific characteristics:

Pelvic ring disruptions among adolescents and young adults are always a consequence of high-energy trauma. They classically occur in motor vehicle accidents, crush traumas or falls from heights. Due to

huge amounts of blood loss, they can be serious and life-threatening ⁵. In some patients, there may be additional lesions of the intrapelvic structures like the urinary bladder, urethra, and peripheral nerves. The primary management of pelvic ring disruptions therefore includes to resuscitation and damage control protocols. Blood loss and instability are managed by applying external compression on the pelvic ring. This is done by several procedures, which are applied in different steps of the resuscitation.

The pelvic sheet and binder is usually used during the prehospital phase, when being transported to the hospital and within the ER. The pelvic C-clamp is used in the ER or operation theatres. External fixation is done only within the operation theatre. Other damage control measures include pelvic packing and arteriography with selective embolization. All of these measures are used to control the patients' hemodynamic instability, rather than the patients' osteoligamentar instability caused by the broken pelvic ring. Once the patient has been resuscitated, definitive surgical treatment can be performed. The target of treatment becomes different than in resuscitation: reconstruction of a symmetrical and stable pelvic ring, which enables quick mobilization and early rehabilitation [6].

FFPs, on the other hand, are the result of low-energy traumas like falls from a standing position. Their major clinical manifestations is the development of an intense pain within the pubic or inguinal region and/or at the low back or posterior pelvic ring, that leads to restricted mobility and thus limited every day activities [7]. Hemodynamic instability is rarely present. Due to the increasing rate of elderly individuals using antithrombotic drugs for the treatment different conditions (coronary bypass surgery, atrial fibrillation, strokes), there should be a high suspicion of persistent bleeding following FFP. It is, therefore, recommended to strictly monitor cardiopulmonary systems for at least one day following admission. If an active hemorrhage is suspected to be present, pelvic CT-scan with contrast is generally recommended. In cases of active arterial bleeding, arteriography and selective embolization seem to be the best therapeutic options. In other cases, no control procedures are necessary. Patients can be admitted in the normal ward and observed for a short duration before the decision of definitive treatment is made [8].

Another distinguishing characteristic of FFP is the presence of low density of bone mineral in the

sacrum and innominate bones. Because of to the decreased of bone strength, the bones usually become fragile. The term "fragility fracture" is defined by a fracture that is a result of an injury that would be not enough to fracture a normal bone and is caused by reduced compressive and/or torsional power of bone [9]. The reduction of bone mass in the sacrum follows a unique and consistent pattern.

Wagner et al. examined the density of bone mineral in the sacrum of ninety-two Europeans who were older than 65 years and had non-traumatized pelvis. They found the most significant reduction of bone mineral density to be present in areas that are lateral to the neuroforamina S1 and S2, sometimes with an additional area of very low density of bone mineral in the sacral bodies at the transition of S1-S2; or between S2 and S3. In these abovementioned areas, the measured Hounsfield Units may reach zero, meaning that the bony structure is totally resolved. These areas are known as "alar voids" [10]. These distinguishing patterns of bone mass in the sacrum of older individuals help understand the consistent pattern of fragility fractures of the sacrum. Linstrom et al. assessed unilateral and bilateral sacral ala fractures, which are either incompletely or completely connected to one another by an additional horizontal fracture component between S1 and S2 or between S2 and S3[11].

The pathophysiology of high-energy pelvic ring injuries does not change over time. The morphology of the fracture is cause by the amount and direction of the traumatizing force. Whether the treatment is conservative or operative, whether fracture fragments dislocate or not, whether healing of the bone is uneventful or nonunion develops, the original morphology of the fracture remains unaltered. However, this is not the case in FFP. We frequently find that the morphology of fractures changes from a fracture form with a lower instability degree to a fracture form with a higher instability degree. Additional fractures can happen, and a creeping implosion of the pelvic ring can take place.

Comprehensive classification:

Because of the previously mentioned special characteristics, many FFP cases do not meet the criteria of the diagnosis ¹². Therefore, a new comprehensive categorization system was developed to help diagnose and assess this group of fractures. This system gives a thorough framework to analyze these lesions and plan proper recommendations for treatment.

This system uses several criteria to categorize each case according to clinical manifestations. The first criterion, that leads to four different groups, is the "loss of stability" or " instability degree". Instability is invariably associated with pain and with immobility. It is the single most important criterion to make the decision on what type of treatment must be chosen. The second criterion, that gives rise to different subtypes in each group, is the instability localization within the posterior pelvic ring. The site of the fracture determines the type of surgical procedure, in cases where surgical intervention is needed.

FFP Type I is known as having an anterior pelvic fracture with the absence a posterior pelvic fracture. Most classically, it concerns superior and inferior pubic rami fractures. Pubic bone fractures and pubic symphysis instabilities can also be present. FFP type Ia is unilateral, while FFP Type Ib a bilateral. It is generally recommended that FFP cases undergo a pelvic CT so that the exact severity of the damage is not underestimated [13].

FFP Type II, on the other hand, is a non-displaced fracture of the posterior pelvic ring. This group is responsible for more than half of FFP cases. FFP Type IIa is the presence on injury in posterior pelvic ring injury, FFP Type IIb is known to have a crush of the sacral ala in combination with the presence of a fracture of the anterior pelvic ring, FFP Type IIc is the presence of a fracture of the sacral ala, sacroiliac joint or posterior ilium together with a fracture of the anterior pelvic ring. The stability of FFP Type II is overall less than FFP Type I.

FFP Type III is a displaced unilateral fracture of the posterior pelvic ring. FFP Type IIIa is characterized by having a displaced fracture of the ilium, FFP Type IIIb is characterized by having a fracture-dislocation of the sacroiliac joint and FFP Type IIIC is characterized by having a displaced sacrum fracture. The posterior pelvic ring fractures are always combined with another fracture or instability of the anterior pelvic ring.

FFP Type IV is sacrum a bilateral displaced fracture of the posterior pelvic ring. FFP Type IVa is displaced a posterior bilateral ilium fracture, FFP Type IVb is a bilateral fracture of the sacral ala with the presence or absence of a horizontal fracture, and FFP Type IVc is the combination of posterior pelvic ring instabilities. Bilateral fragility fractures of the sacrum (FFP Type IVb) are usually, but not necessarily combined with anterior pelvic ring

fractures. They are likely to be a consequence of an evolving process: because of subsequent falls or predisposed by continuous repetitive smaller traumas, more bone structures become damaged, leading to more advanced fractures and higher instability. Complete destruction of the pelvic ring represents the end of this evolving process.

Diagnostic examinations:

Patients usually present with immobilizing relatively mild pain within the inguinal region and/or in the lower back or posterior pelvic ring. Classically, there is history of prior low-energy trauma like a fall. Many patients are not able to remember the trauma. Other patients can have a history of chronic corticosteroids use, irradiation of the pelvic ring following malignancies, immobilization for long durations because of having comorbidity. Most patients are elderly women and are diagnosed with osteoporosis; and many of them had already had prior fractures like hip fractures, a compression fracture at the thoracolumbar spine, a proximal humerus or distal radius fracture.

Radiological imaging should start with a pelvic overview. When the fracture of the anterior pelvic ring is found, it is generally advised to enhance the X-ray results with a pelvic inlet and outlet view. Cortical interruptions and fracture displacements can usually be better visualized through oblique views. However, conventional pelvic views are usually insufficient to evaluate the posterior pelvic ring¹⁴. Missing a fracture within the posterior pelvic ring can cause underestimation of the present instability, and thus, may cause inaccurate recommendations for treatment.

CT-scan of the pelvis is an essential modality to provide a thorough analysis of the presence, localization and configuration of the posterior and anterior pelvic ring fracture. It allows for correct categorization of the disease and thus, an accurate prediction of instability. MRI imaging and technetium bone scan are considered to have extremely high sensitivity for the diagnosis of bone bruise and higher activity. They can assess posterior pelvic ring pain, when a fracture is not detected with conventional X-rays or CT images[15].

Treatment objectives:

Once a diagnosis of FFP has been made and the categorization of the disease has been determined, the decision of proper management and treatment plans must be taken. The targets of management are not always similar to adolescents and younger adults.

The main target is to give back the best possible mobility along with the highest degree of independence in the elderly individuals. This can only be achieved by proper pain relief along with early mobilization. Anatomical reduction of the fracture and the restoration and maintenance of the symmetry of the pelvic are considered less important.

When surgical interventions are needed, surgery must be as less invasive as possible for these elderly patients. Long-duration, invasive surgeries that are associated with huge blood loss can imply high stress for the cardiovascular system and might cause serious complications like hypothermia and coagulopathy. Moreover, they are correlated with longer recovery time and higher risk of having wound healing problems and infection. Therefore, percutaneous surgeries are considered better whenever they can achieve sufficient stability and early mobilization¹⁶. Conservative treatment can be followed, and includes admission to the hospital for a short duration, strict monitoring of hemodynamic status for at least one day, providing pain relief using analgesics and mobilization as tolerated by the patient. Mobilization physical exercises can be initiated from the first day with exercises in bed. They are then followed by sitting at the edge of the bed, standing and short transfers. Observing the intensity of the pain with visual analogue scores can aid in confirming a sufficient control of pain while exercising and mobilization. The duration of the mobilization is defined by the patient, and exercises must never be forced on the patients as this can carry a high risk of worsening instability by developing new fractures [17].

In addition to the short-term conservative treatment, bone metabolism should be assessed with correcting detected deficiencies. The general status of the patient must be assessed and corrected, if this is possible. The ideal management and treatment of these patients must be planned by a multidisciplinary team of orthopedics, trauma surgeons, geriatricians, pain therapists and physiotherapists [18]. Conservative treatment is generally recommended for the treatment of FFP Type I and FFP Type II lesions. Whereas a good prognosis can be expected in FFP Type I, conservative treatment might be more important in FFP Type II because of the presence of the posterior pelvic ring fracture. It must be known within 1 week if conservative treatment is successful. If pain intensity does not improve or even worsen, or when mobilization seems to be difficult, surgical procedures must also be considered as a valid management option. In addition, x-rays and CT

pelvis scans can be done again to exclude the presence of further displacements or rule out the presence of an additional fracture. If the former is present, surgical interventions become crucial for treatment.

On the other hand, FFP Type III and FFP Type IV lesions require surgical interventions. It cannot be assumed that these displaced fractures will heal spontaneously. Chronic immobilization will result in the development of complications like pneumonia, urinary tract infections, and muscle atrophy or pressure ulcers. Percutaneous operations are usually preferred over open reduction and internal fixation, when sufficient stability can be achieved.

Multiple less invasive procedures for the internal fixation of both the anterior and posterior pelvic rings in patients with FFP have been recently developed. These procedures use multiple stabilization principles. However, no enough evidence is present in the literature to demonstrate the superiority of one technique over the other. Only case series studies have been published, which generally recommend the use of the described procedure. Although more clinical and biomechanical work is still required to detect ideal stabilization procedures for different types of FFP, the currently developed procedure clearly shows a shift from open reduction and internal fixation towards closed internal fixation (using bridging and splinting).

Sacroplasty is a procedure that is derived from vertebroplasty and kyphoplasty. During this procedure, small amounts of cement are injected to the area of the fracture. No further implants need to be inserted. Through inter-dentation of the cement with the trabecular bone, restoration of stability is achieved, and the pain relief becomes significant. Contradictory results have been found in different studies. Some authors suggest the use of this technique for fractures that are visible on MRI but not on CT. On the other hand, other authors perform sacroplasty in complete fractures of the sacral ala, which are clearly visible on CT images¹⁹. It still remains unclear which subtypes of FFP will most profit from sacroplasty. In some cases, the injected cement may prevent the healing of the fracture and become an obstacle for the iliosacral screw osteosynthesis, when additional stabilization of the fracture is needed. Iliosacral screw osteosynthesis is a well-accepted procedure for the stabilization of sacral fractures and sacroiliac dislocations following high energy pelvic trauma.

The most important limitations of iliosacral screw osteosynthesis in FFP are the low rate of bone stock for screw anchorage. As we previously mentioned, there is a continuous reduction in bone mass in the sacral ala and sacral body among the elderly. Due to lower screw anchorage, there is a higher chance of screw loosening with recurrent instability of the posterior pelvic ring [20]. To improve screw anchorage in the trabecular bone of the upper sacrum, cement augmentation of the iliosacral screws has been described [21]. The procedure is generally different from sacroplasty, where the cement is applied on the fracture gap. In these cases, the cement could be applied on the sacral body through multiple screw perforations near to the screw tip. This application of cement is usually done under fluoroscopic control. Strict care should be applied to prevent the leakage of cement into the sacral canal, the neuroforamina or through the anterior sacral cortex.

CONCLUSIONS:

Fragility fractures of the pelvis (FFP) require our specific attention because their incidence is increasing dramatically and because they show a complicated prognosis in many cases. The characteristics of fragility fractures of the pelvis differ in many aspects from pelvic ring disruptions in adolescents and adults. They are the result of a low-energy trauma and does not need emergency treatment. Immobilizing pain in the low back, in the gluteal region, in the groin or at the pubic symphysis is the leading symptom. We discussed the new categorization system that comprises different degrees of instability, specific morphologies and localizations of fractures. When surgical intervention is needed, the surgery should be as less invasive as possible. Different techniques for stabilization of the posterior and anterior pelvic ring have been used, which use the principles of compression, bridging and splinting. Literature data do not deliver sufficient evidence until now, to answer the question which procedure(s) are the most beneficial for the patients with fragility fractures of the pelvis. More clinical and biomechanical work is needed to shed light on the optimal management of this emerging pathology.

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