Fragility Fractures of the Pelvis: Should they Be Fixed?

Fragilní zlomeniny pánve: mají být fixovány?

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SUMMARY

Due to the aging population, there is an increasing number of fragility fractures of the pelvis (FFP). They are the result of low energy trauma. The bone breaks but the ligaments remain intact. Immobilizing pain at the pubic region or at the sacrum is the main symptom. Conventional radiographs reveal pubic rami fractures, but lesions of the dorsal pelvis are hardly visible and easily overlooked. CT of the pelvis with multiplanar reconstructions show the real extension of the lesion. Most patients have a history of osteoporosis or other fragility fractures. The new classification distinguishes between four categories of different and increasing instability. FFP Type I are anterior lesions only, FFP Type II are non-displaced posterior lesions, FFP Type III are displaced unilateral posterior lesions and FFP Type IV are displaced bilateral posterior lesions. Subgroups discriminate between the localization of the dorsal instability. FFP Type I lesions are treated non-operatively. FFP Type II lesions are fixed in a percutaneous procedure when a trial of conservative treatment was not successful. FFP Type III lesions are treated with open reduction and internal fixation (ORIF). FFP Type IV lesions are treated with bilateral ORIF or with a bridging osteosynthesis. Iliosacral screw osteosynthesis is widely used, but has an elevated risk of screw loosening due to diminished bine mineral density. Transsacral bar osteosynthesis enable interfragmentary compression and does not have this danger of loosening. Bridging plate osteosynthesis is used as an additional fixation to iliosacral screw osteosynthesis. Lumbopelvic fixation is restricted to highly unstable lumbopelvic dissociations. More studies are needed to find the optimal treatment for each type of instability.

Key words: pelvis, fragility fracture, diagnosis, classification, treatment.

INTRODUCTION

With increasing age of our populations, the number of elderly persons is steadily growing. Among the aged, many are healthy, active and with high functional demands, other persons are sick, morbid or multimorbid and have limited physical activity. Both groups are at higher risk of suffering fractures due to low energy accidents. With higher age, the prevalence of age-related diseases increases. Among them, loss of bone mineral density and osteoporosis are widespread. Hip fractures, proximal humerus fractures, distal radius fractures and osteoporotic fractures of the vertebral column are typical locations of insufficiency fractures. Whereas the number of hip fractures in the US declined between 1996 and 2010 by 25.7%, geriatric acetabular fractures increased by 67%, subtrochanteric femur fractures increased by 42% and pelvis fractures by 24% (19). In this article, we focus on fragility fractures of the pelvis. Little is known about the specific morphology of these lesions and the loss of stability they induce. Furthermore, there are no widely accepted pathways for treatment. A new classification system throws light on four different categories of instability. In the subgroups, various locations of instability of the ventral or dorsal pelvic ring are described. Recommendations for treatment and specific fixation techniques are connected with the four categories of this classification (16).

Fragility fractures of the pelvis are different

When referring to pelvic ring fractures, we essentially have high energy trauma injuries in mind. Due to very strong ligaments and high bone density of sacrum and innominate bone, the pelvic ring of adolescents and adults only breaks under loads between 2,000 and 10,000 Newton. This occurs after high velocity traffic accidents, falls from great height or crush traumas. Most of the patients with a pelvic ring injury are severely injured, many severely injured have a pelvic ring injury. Typical patterns of dorsal pelvic ring disruptions are transforaminal fractures of the sacrum, pure iliosacral dislocations and crescent fractures. In open book lesions and vertical shear injuries, ligaments of the pelvic bottom are also torn. The pelvic ring explodes due to huge external traumatic forces. There is a high ratio of associated injuries of the soft tissues such as nerve damage, bladder or urethra rupture. Some patients are admitted in shock due to massive bleeding.

Fragility fractures of the pelvis (FFP) are different for what concerns trauma mechanism, fracture morphology and treatment algorithm. FFP are not caused by high energy trauma. Most of the patients suffer FFP after a fall from the standing or sitting position. Even bedridden patients may suffer from a FFP, while changed for personal hygiene from a supine to lateral position. In some patients, the trauma is even not memorable. The main symptom of the fractures is pain in the groin or pubic region; and dorsal pain at the sacrum or iliosacral joint. Most patients are immobilized by this pain, others are still able to walk short distances with walking aids. Hemodynamic instability is exceptional (6), there are no concomitant injuries.

As the ligaments in elderly patients are not affected by reduced strength, the bone breaks within an intact envelope of ligaments due to low energy injuries. There is an implosion instead of an explosion. Due to repetitive insults, FFP may change morphology over time, may undergo creeping progress from minor lesions to major instabilities. In chronic cases, also the ligaments of the symphysis pubis or sacroiliac joint may get involved and take part in a complex pattern of gross pelvic instability

Anamnesis and clinical picture

Most patients suffered from a minor trauma, typically from a fall from standing or sitting position. In some patients, the trauma event is not memorable. When exploring medical anamnesis, many patients have a history of osteoporosis or of another fragility fracture (hip, shoulder, distal radius, spine). Some patients have a long-term cortisone intake, others have been irradiated after operative treatment of a malignant tumor in the small pelvis (rectum, uterus, ovarium). In other cases, there is a fatigue fracture through a donor site of cancellous bone at the dorsal ilium, used for previous spine fusion (Fig. 1). Few patients are bedridden due to chronic diseases or dementia.

All patients have spontaneous pain in the pubic region or in the groin. Some express pain in the gluteal region, at the sacrum or the sacroiliac joint. Pain diminishes with bed rest but intensity increases while standing or walking. Major instability cannot be found, but pain exacerbates with lateral to medial compression on the iliac wings. Pain also intensifies with local pressure on the pubis or sacrum (7).

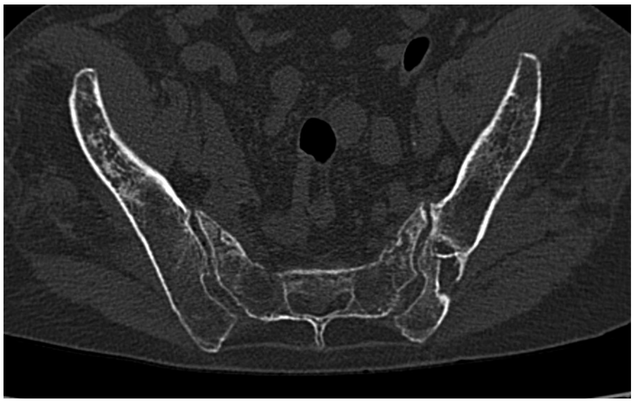

Fig. 1. Bilateral fracture of the sacral ala in a 79-year-old patient with previous lumbar spine fusion surgery. The site of bone harvesting is near to the left sacroiliac joint and to the left sacral fracture.

Radiological work-up

At admission, all patients should receive three conventional radiographs: an anteroposterior pelvic overview, the pelvic inlet and the pelvic outlet view. Fractures of the superior and inferior pubic rami or the pubic bone are easily recognized on the ***anteroposterior view***. Due to low bone mineral density and superimposed bowel content is an accurate analysis of the dorsal pelvic ring not possible on this view. The *inlet view* best shows interruptions or morphological changes of the anterior cortex of the sacrum or rotation of the innominate bone. *The **outlet view*** gives the best information about the shape and symmetry of the sacrum, about form and location of the neuroforamina and sacroiliac joints. The three views serve as reference for later controls.

We recommend performing a computed tomography of the pelvis, when pubic fracture(s) have been diagnosed on conventional pelvic overviews. This avoids overlooking and underestimating lesions of the dorsal pelvic ring (10). Multiplanar reconstructions of the CT-data help to fully appreciate the fracture morphology in the dorsal pelvis. In coronal reconstructions, fractures of the lateral mass of the sacrum are sometimes better visible than in transverse sections. Horizontal sacral fractures are best recognized in sagittal reconstructions.

A NEW CLASSIFICATION OF FRAGILITY FRACTURES OF THE PELVIS (FFP)

The conventional radiographs and CT-data of 245 patients with fragility fractures of the pelvic ring, who had an in-patient treatment in our Department between 2007 and 2012 were retrospectively analyzed. All patients were older than 65 years. Patients with

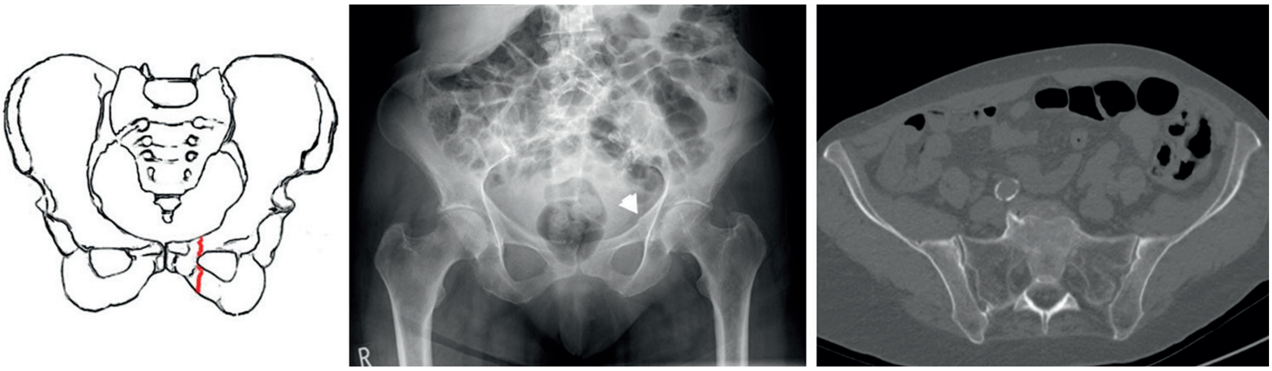

Fig. 2a. FFP Type Ia: unilateral anterior pelvic ring disruption.

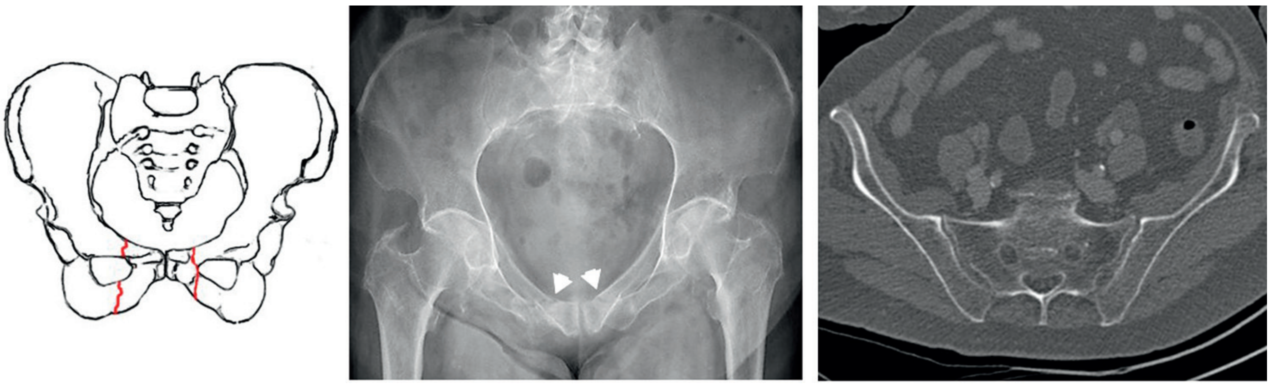

Fig. 2b. FFP Type Ib: bilateral anterior pelvic ring disruption.

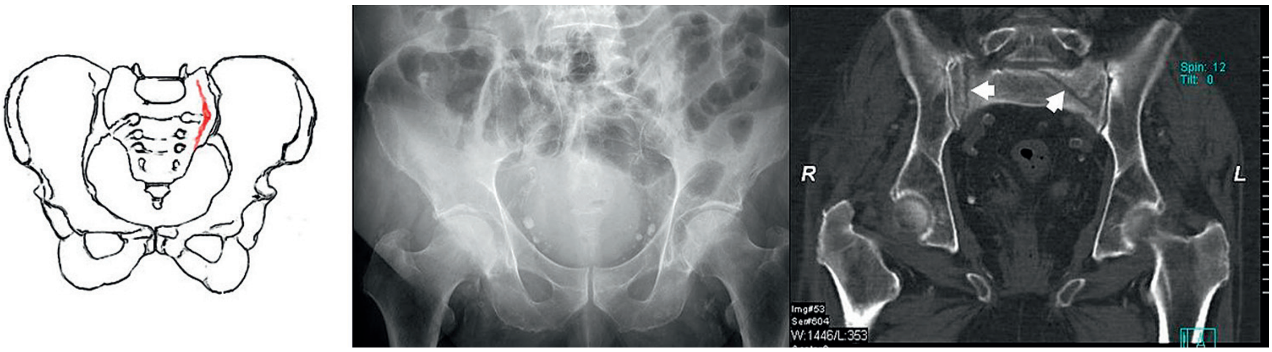

Fig. 3a. FFP Type IIa: dorsal non-displaced posterior injury only.

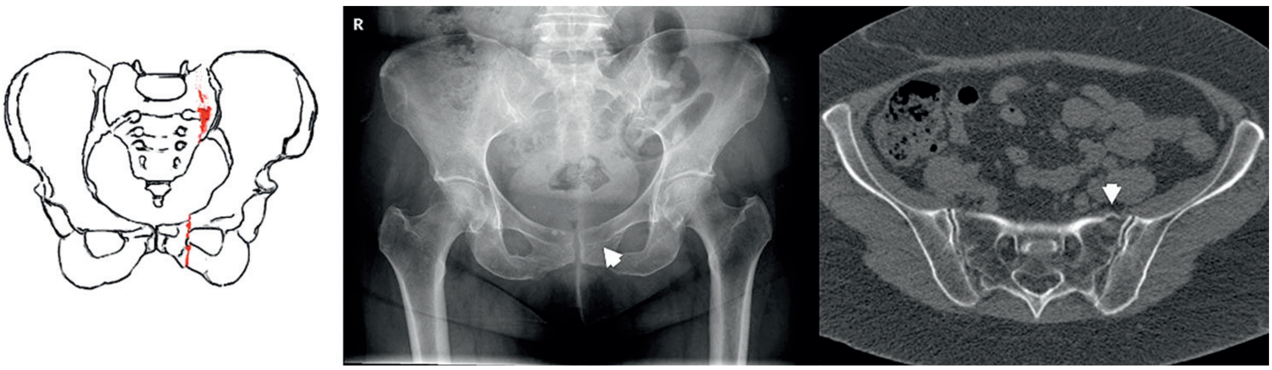

Fig. 3b. FFP Type IIb: sacral crush with anterior disruption.

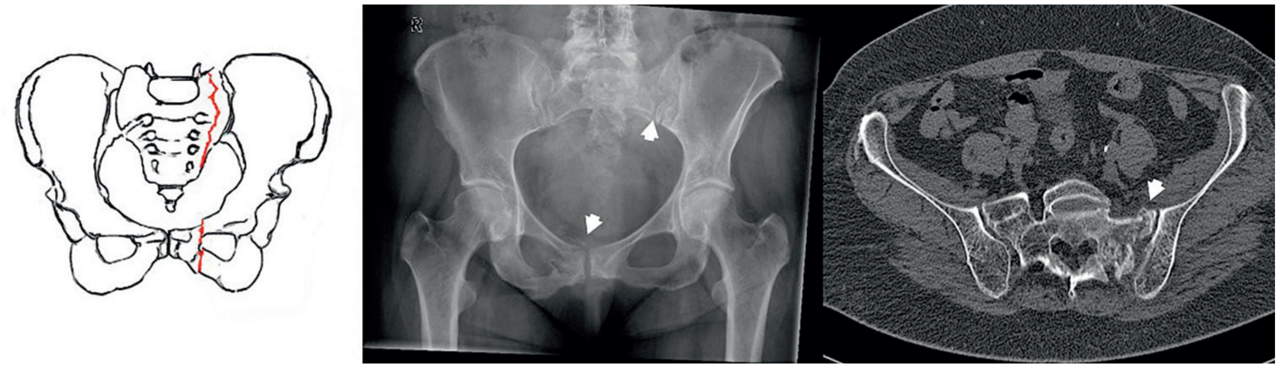

Fig. 3c. FFP Type IIc: non-displaced sacral, sacroiliac or iliac fracture with anterior disruption.

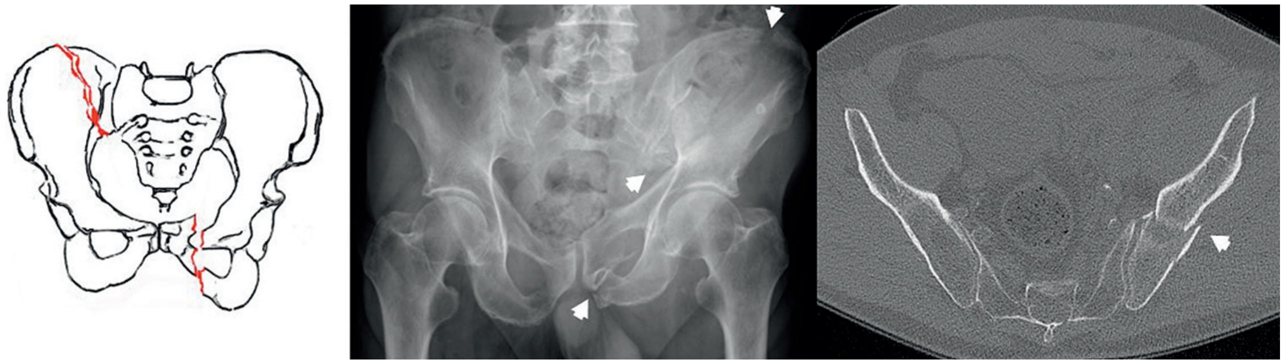

Fig. 4a. FFP Type IIIa: displaced unilateral ilium fracture and anterior disruption.

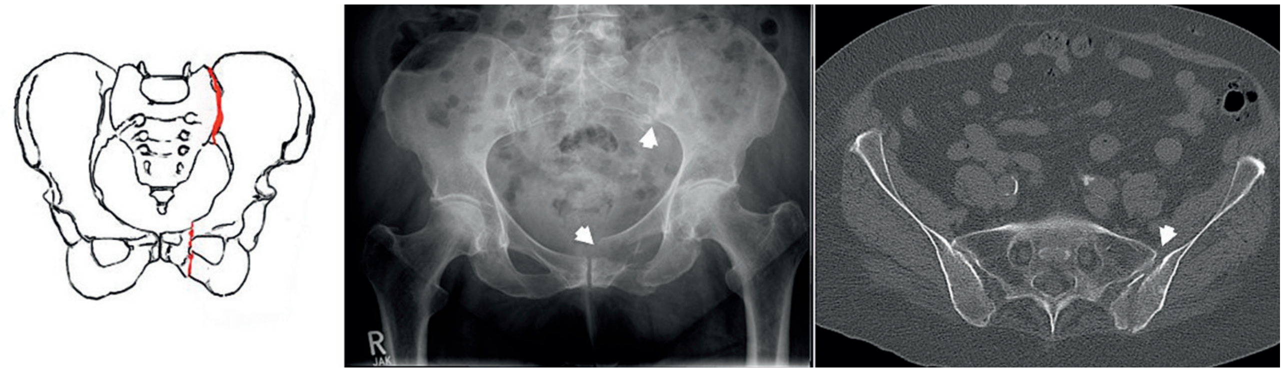

Fig. 4b. FFP Type IIIb: displaced unilateral sacroiliac disruption and anterior disruption.

acetabular fractures were excluded. The average age of the patients was 79.2 years. There were 198 females and 47 males, the gender distribution being 4.2 to 1.

The classification distinguishes four levels with increasing pelvic instability. The fractures are described as fragility fractures of the pelvis, abbreviated as FFP. Fragility better describes the origin of the fracture than stress, insufficiency fracture or osteoporosis (16).

FFP Type I are isolated anterior pelvic ring fractures, there is no posterior lesion. FFP Type Ia (Fig. 2a) is a unilateral and FFP Type Ib (Fig. 2b) a bilateral anterior lesion. FFP Type I constituted only 17.9% of all FFP in our series. Consequently, there was a posterior lesion in more than 80%. This data support the need of CT-evaluation of all low energy pelvic ring lesions!

FFP Type II lesions are non-displaced posterior lesions. FFP Type IIa (Fig. 3a) is a non-displaced posterior lesion without anterior instability, FFP Type IIb (Fig. 3b) is a crush lesion of the lateral mass of the sacrum with anterior disruption, and FFP Type IIc (Fig. 3c) is a non-displaced sacral, sacroiliac or iliac fracture with anterior disruption. FFP Type II lesions constituted 51.8%, being more than half of all FFP lesions in our series.

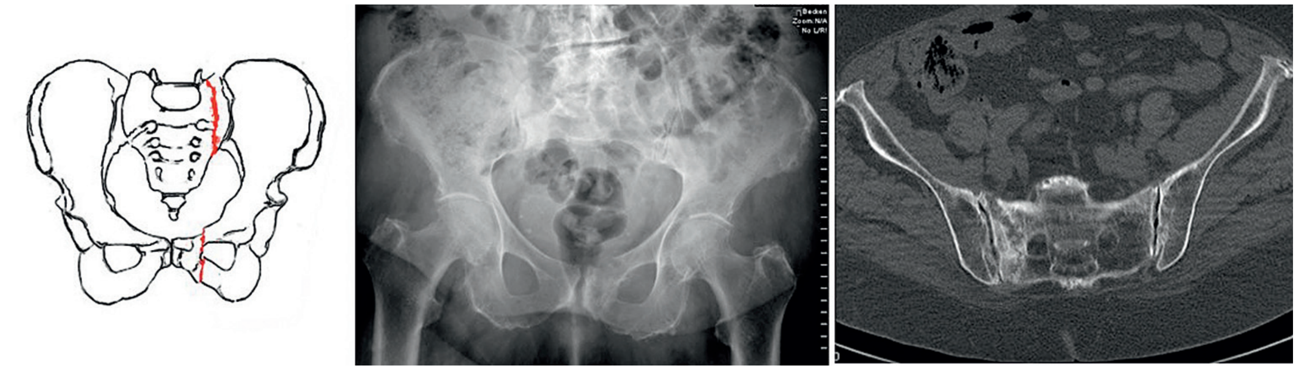

Fig. 4c. FFP Type IIIc: displaced unilateral sacral fracture together with anterior disruption.

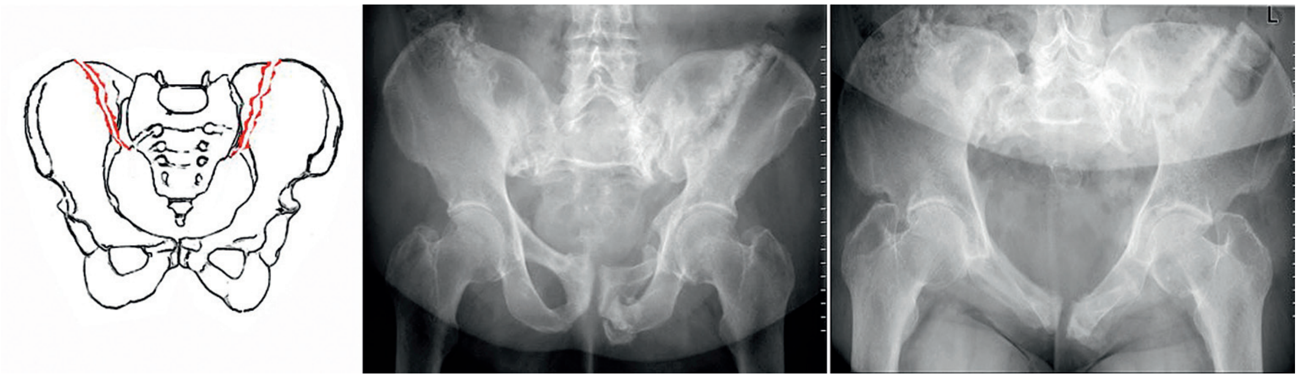

Fig. 5a. FFP Type IVa: bilateral iliac fractures or bilateral sacroiliac disruptions together with anterior disruption.

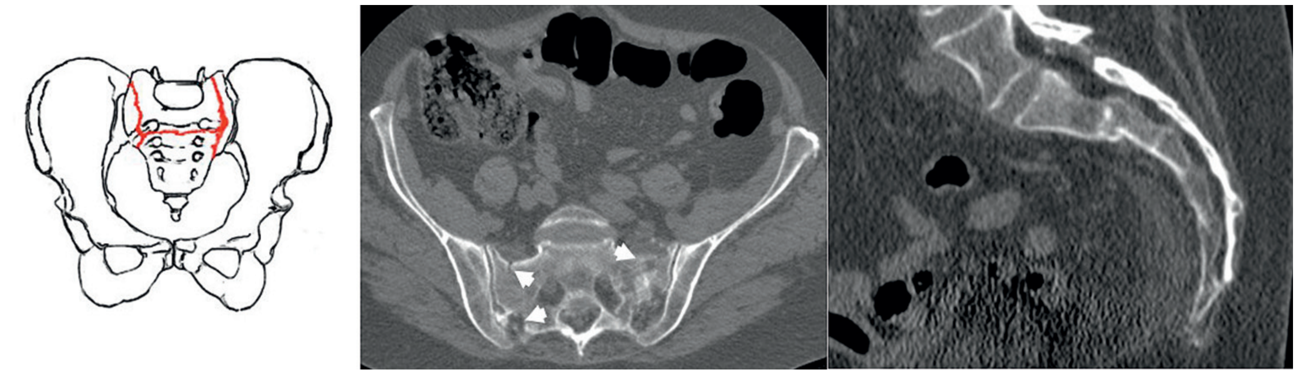

Fig. 5b. FFP Type IVb: spinopelvic dissociation together with anterior disruption.

FFP Type III lesions are displaced unilateral posterior injuries combined with a lesion of the anterior pelvic ring. A FFP Type IIIa (Fig. 4a) involves a displaced unilateral ilium fracture, FFP Type IIIb (Fig. 4b) is a displaced unilateral sacroiliac disruption and FFP Type IIIc (Fig. 4c) is a displaced unilateral sacral fracture. Displaced unilateral posterior lesions (FFP Type III) were 4.7 times less common than non--displaced dorsal lesions (FFP Type II).

FFP Type IV lesions are defined as displaced bilateral posterior injuries. FFP Type IVa (Fig. 5a) have bilateral iliac fractures or bilateral sacroiliac disruptions. FFP Type IVb (Fig. 5b) is a spinopelvic dissociation characterized by a bilateral vertical fracture through the lateral mass of the sacrum with a horizontal fracture component connecting them (H-type sacral fracture). FFP Type IVc (Fig. 5c) is a combination of different posterior instabilities. Spinopelvic dissociations (FFP Type IVb) were present in 15.1% of all FFP, a surprisingly high number. Most of them were not detectable on conventional radiographs. This underlines the importance of CT with multiplanar CT-reconstructions: only in the sagittal views, the horizontal component of an H-type fracture of the sacrum can be

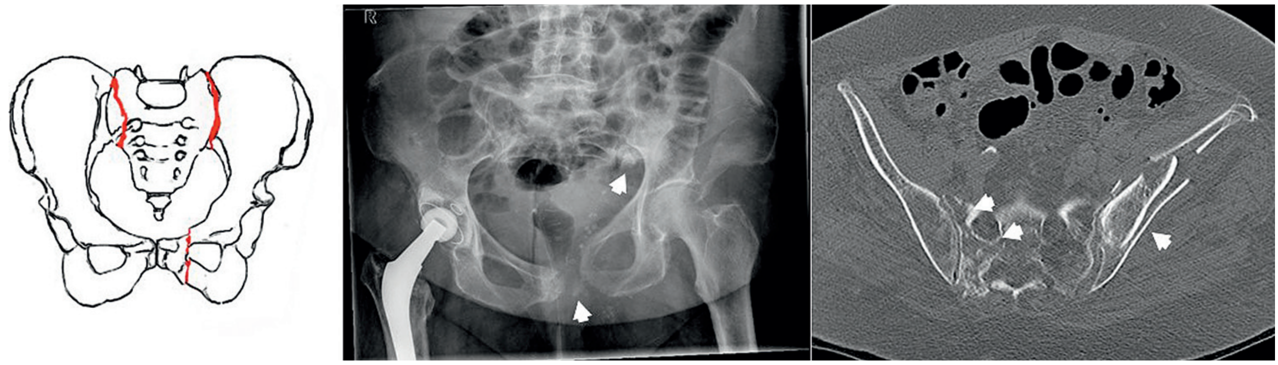

Fig. 5c. FFP Type IVc: combination of different posterior instabilities together with anterior disruption.

identified. Linstrom et al. described 108 patients with insufficiency fractures of the sacrum, of which the H-type pattern represented 61% (11).

FRAGILITY FRACTURES OF THE PELVIS: SHOULD THEY BE FIXED?

Most fragility fractures of the pelvis are treated conservatively. This because of different reasons: many fragility fractures of the pelvis are underestimated and the lesions of the dorsal pelvic ring not recognized. Conservative therapy with pain killers, anti-resorptive drugs; and careful mobilization is still considered as being the only valid method of treatment by most therapists and patients. Surgical stabilization is estimated as difficult, dangerous and too aggressive in this older patient population. Nevertheless, operative treatment has been described as successful in recent publications (4, 8, 12).

In our view, the management has to be individualized. Definitive treatment should depend on the clinical presentation of the patient at admission, his or her fracture type, comorbidities, functional status and functional demands. Primarily, all patients require bed rest and painkillers are administered. If not already done, diagnostic work-up of bone metabolism is performed and anti-resorptive drug therapy started. Anti-resorptive drugs are not prescribed sufficiently in patients, who suffered a fragility fracture. The orthopedic trauma surgeon, who treats the pelvic fragility fracture, plays an important role in initiating this anti-osteoporotic management (5). Biphosphonates are the drugs of choice. Parathyroid hormone is given additionally, it promotes fracture healing in FFP (23).

In FFP Type I lesions, treatment remains conservative. Careful mobilization is started after a short period of bed rest. Weight bearing as tolerated is allowed. Forced mobilization is avoided (1). Too early and aggressive mobilization may lead to additional trauma with more complex and more unstable fragility fracture types as a consequence. The patient is dismissed from the hospital when pain is under control and mobilization makes good progress. We recommend to see the patient regularly on an out-patient basis for clinical and radiographic control until radiographic evidence of fracture healing and relief of complaints. A high index of suspicion for creeping increase of instability must always be present. When pain intensity and pain frequency do not decrease or even increase after days or weeks, we recommended to repeat the CT-scan evaluation in order to rule out new fractures.

There is no evidence and no consensus on the treatment of FFP Type II lesions, which have a non-displaced posterior injury. Most typically, the dorsal fracture runs through the lateral mass of the sacrum. Bone density studies of the sacrum in elderly patients have exposed voids in the sacral ala (14, 21), (Fig. 6). Treatment starts with bed rest and pain killers. Due to intense anterior and posterior pain, FFP Type II patients can hardly be mobilized within the first days after admission. If no pain relief is observed within a week and mobilization remains impossible, surgical fixation should be considered. As the dorsal fractures are not displaced, a percutaneous procedure for internal fixation is possible (15). Alternatives are iliosacral screw osteosynthesis, sacroplasty, and transsacral bar fixation or bridging plate osteosynthesis (18).

Iliosacral screw osteosynthesis is widely used in Type B or C pelvic ring injuries after high energy trauma of

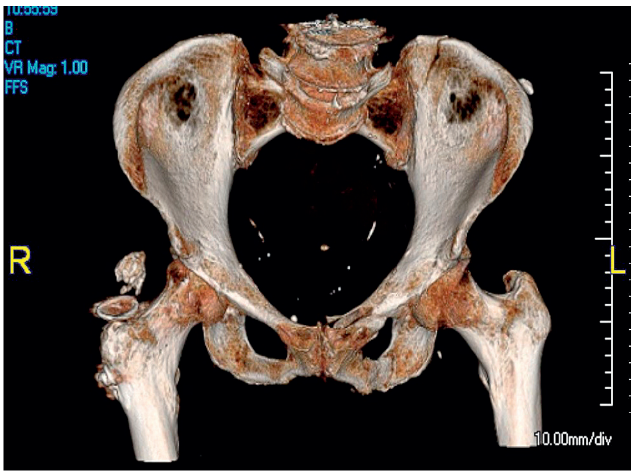

Fig. 6. Three-dimensional reconstruction of the pelvic ring in an 87-year-old female after a fall at home. The very low bone density in both sacral ala and in the center of the iliac wing is clearly visible.

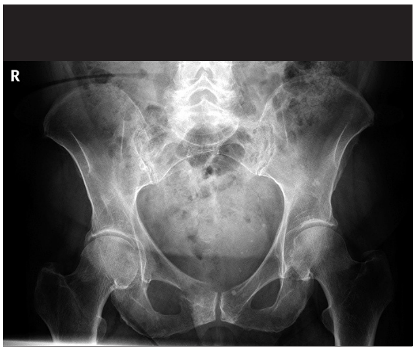

Fig. 7a

Fig. 7b

Fig. 7c

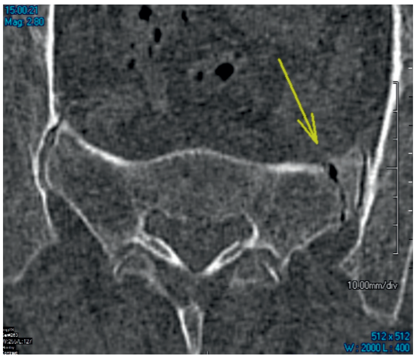

Fig. 7d

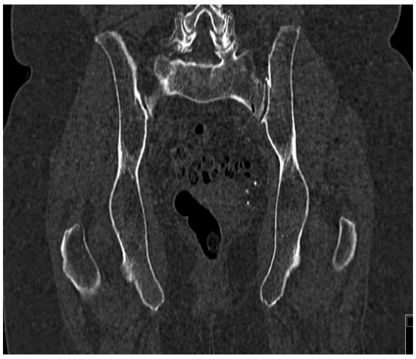

Fig. 7e

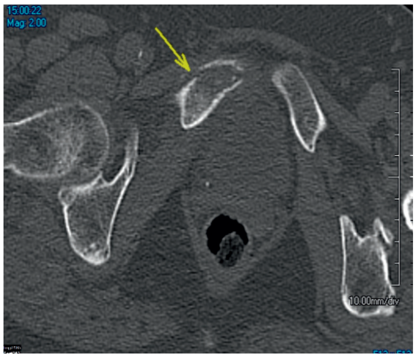

Fig. 7f

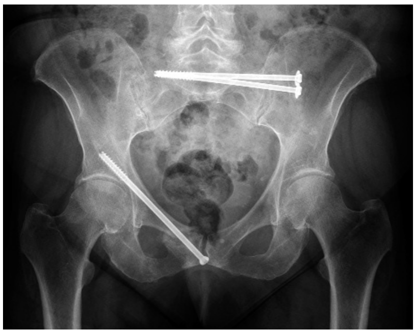

Fig. 7g

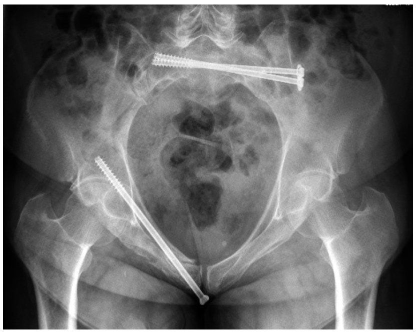

Fig. 7h

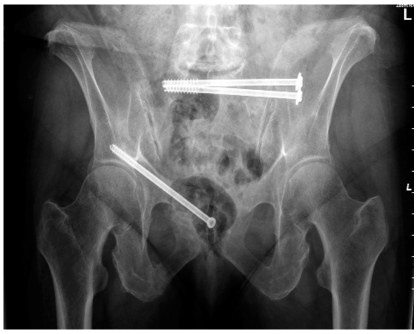

Fig. 7i

Fig. 7a. Seventy-five-year-old female with FFP Type IIc after a fall at home. Pelvic ap overview.
Fig. 7b. Pelvic inlet view.
Fig. 7c. Pelvic outlet view.
Fig. 7d. Transverse CT-cut through the sacrum shows the complete fracture in the left sacral ala.
Fig. 7e. Coronal CT-reconstruction through the sacrum.
Fig. 7f. Transverse CT-reconstruction shows the right pubic fracture.

Fig. 7g. The patient was primarily treated conservatively without success. After two weeks, percutaneous fixation of the sacral ala fracture with two long iliosacral screws was done. The right superior pubic ramus fracture was also fixed percutaneously with a retrograde transpubic screw. Pelvic ap overview 3 months after surgery.
Fig. 7h. Pelvic inlet view.
Fig. 7i. Pelvic outlet view.

adults. One or two large fragment cancellous screws are inserted into the body of S1 or one screw into the body of S1 and S2 each (Figs 7a–i). But screw osteosynthesis in osteoporotic bone has its limits. Due to lower holding power, there is a higher risk of screw loosening. Cement augmentation may provide a higher pull-out force. Surgical experience and information regarding long-term outcome are still limited (22).

Sacroplasty has been recommended for fixation of sacral insufficiency fractures. Bone cement is injected from dorsal into the fracture area through a long needle. The cement is distributed in the fracture gap and surrounding cancellous bone. There is quick pain relief and early mobilization is possible (3). Cement leakage is a described complication with possible neurological damage (2). As a sacral fragility fracture runs vertically,

Fig. 8a

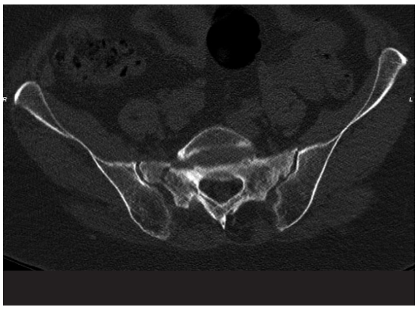

Fig. 8b

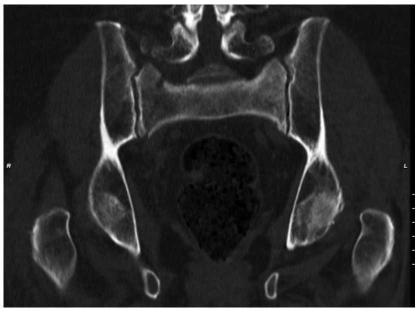

Fig. 8c

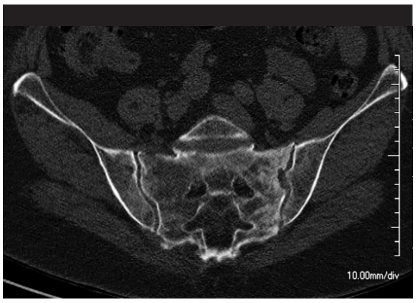

Fig. 8d

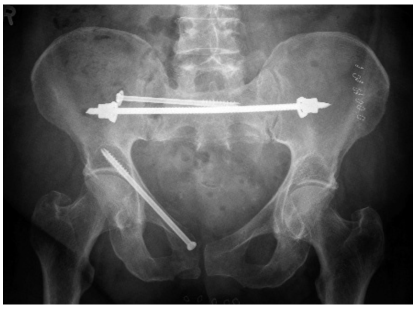

Fig. 8e

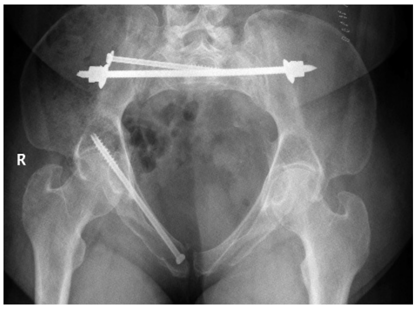

Fig. 8f

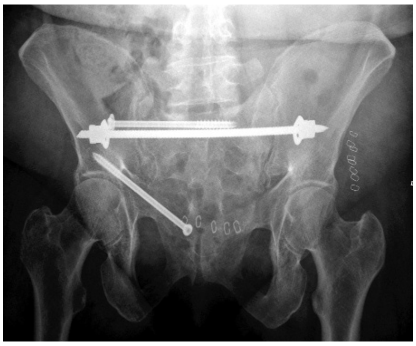

Fig. 8g

Fig. 8a. 68-year-old female with pain in the right groin and right gluteal region without history of fall. On the ap pelvic overview, there is a slightly displaced right pubic fracture.
Fig. 8b. Transverse CT-cut shows a complete fracture of the right sacral ala.
Fig. 8c. Coronal CT-cut confirms the fracture.
Fig. 8d. Coronal CT-cut though the sacrum confirms the right fracture, an irregular bone structure at the left sacral ala suggest there is also a fissure or fracture there. The lesion corresponds with a FFP Type IIc.
Fig. 8e. The dorsal instability was fixed with a transsacral bar and an additional iliosacral screw on the right side. The anterior instability was splinted with a large fragment retrograde transpubic screw. Pelvic ap overview.
Fig. 8f. Pelvic inlet view. In this view, the direct contact between the washers and the external cortex of the dorsal ilium is nicely visible.
Fig. 8g. Pelvic outlet view.

axial loading will induce shearing forces. The injected cement will hinder fracture healing. We therefore hypothesize that many of these patients will be prone to treatment failure on the long term. Internal fixation of the sacrum may then become more demanding or even impossible due to the cement block. Therefore, the authors do not recommend sacroplasty for the treatment of FFP.

Transsacral bar osteosynthesis uses the concept of interfragmentary compression. A solid bar with a diameter of 6 millimeters is placed horizontally in the coronal plane from one ilium through the body of S1 to the opposite ilium. Washers and nuts are placed over the ends of the bar on each side. By tightening the nuts, a compressive force, which is perpendicular to the plane of the sacral fracture, is created. The procedure can be performed percutaneous (12). Transsacral bar osteosynthesis bears the same risks as sacroiliac screw placement: perforation of the anterior cortex of the sacrum, damage to the cauda equine, nerve roots and vessels. In contrast to iliosacral screw osteosynthesis, there is no risk of loosening as the holding power of the implant is not depending on the strength of the cancellous bone in the sacrum but on the strength of the cortical bone at the dorsal ilium. An additional S1 screw further enhances stability and neutralizes rotational loads (Figs 8a–g).

In **bridging plate osteosynthesis**, a pre-contoured long plate connects both dorsal iliac crests at the level of the posterior inferior iliac spines. Long screws are inserted into the dorsal ilium parallel to the iliosacral joint through the plate holes on each side. The plate construct bridges the fracture area, but does not compress the fracture side. This technique of osteosynthesis less suitable for the stabilization of sacral insufficiency fractures on its own, it can be used in addition to iliosacral screw osteosynthesis.

Additional to dorsal stabilization, anterior pelvic ring fixation is mandatory "to close the broken ring". Non-displaced superior pubic rami fractures are

Fig. 9a

Fig. 9b

Fig. 9c

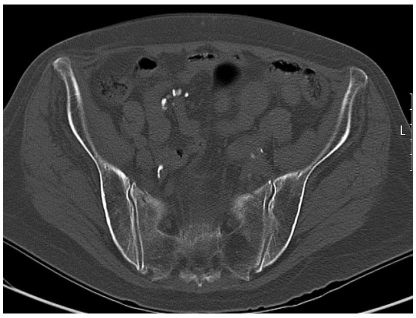

Fig. 9d

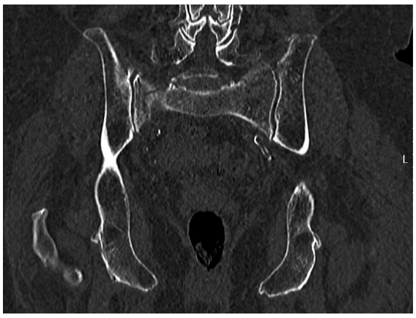

Fig. 9e

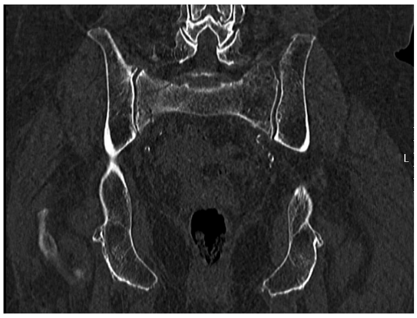

Fig. 9f

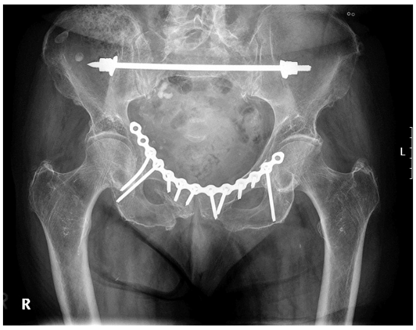

Fig. 9g

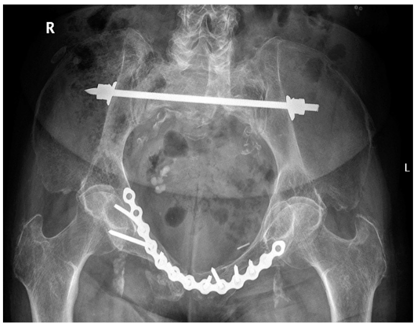

Fig. 9h

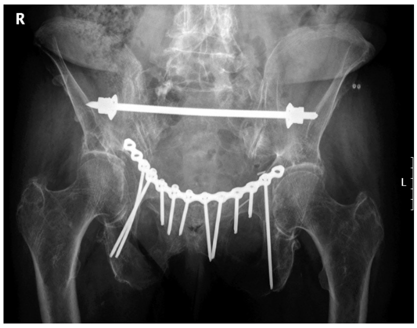

Fig. 9i

Fig. 9a. Eighty-five-year-old female with a FFP Type IIc which was treated conservatively for more than three weeks. The pelvic ap overview shows an marked displacement of the right superior pubic ramus.
Fig. 9b. Pelvic inlet view. An internal rotation of the right innominate bone is visible. The anterior cortex of the right sacral ala seems interrupted.
Fig. 9c. Pelvic outlet view.
Fig. 9d. Transverse CT-cut through the sacrum showing a cortical rupture of the right and left sacral ala.
Fig. 9e. Coronal CT-cut through the sacrum showing a complete fracture on the right sacral ala and an incomplete on the left.
Fig. 9f. Coronal CT-cut near to the cut of Fig. 9e. The interruption of the sacral ala on the left is better visible.
Fig. 9g. Dorsal stabilization with transsacral bar. Open reduction and internal fixation of the displaced right superior pubic ramus fracture with a long plate. The marginal screws have a long trajectory medial to the acetabulum into the posterior column, preventing implant loosening. Pelvic ap overview three months after surgery.
Fig. 9h. Pelvic inlet view. Direct contact between the washers and the external cortex of the dorsal ilium is nicely visible.
Fig. 9i. Pelvic outlet view.

splinted with a cannulated large fragment screw. It is inserted retrograde through a small skin incision near the pubic bone, fits inside the superior pubic ramus, passes the acetabulum medially and superiorly and ends in the body of the ilium (Figs 7g–i and Figs 8e–g). Displaced pubic ramus fracture are reduced by closed manipulation, alternatively open reduction is achieved through a small suprapubic midline incision. A symphysis pubis instability or a fracture very near to the joint is fixed with a bridging angular stable plate. A long plate enhances stability and avoids loosening. At its margins, it contains long screws going into the

Fig. 10a

Fig. 10b

Fig. 10c

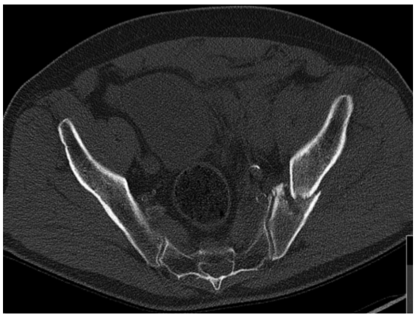

Fig. 10d

Fig. 10e

Fig. 10f

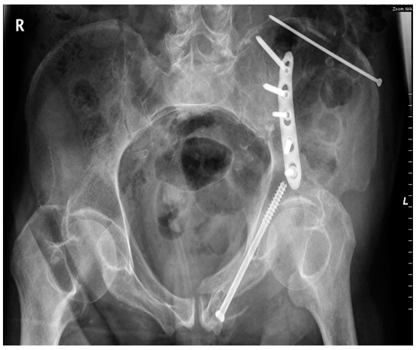

Fig. 10g

Fig. 10h

Fig. 10a. Seventy-eight-year-old male with Alzheimer disease and recurrent falls at home. Pelvic ap overview shows a FFP Type IIIa with fracture of the left ilium beginning at the inner curve of the innominate bone and going up to most proximal curve of the iliac crest. There also is a displaced fracture of the left superior and inferior pubic ramus.
Fig. 10b. Pelvic inlet view.
Fig. 10c. Pelvic outlet view.
Fig. 10d. Transverse CT-cut showing the complete fracture of the left ilium.
Fig. 10e. Coronal CT-cut showing the fracture near to the sacroiliac joint with slight internal rotation of the left innominate bone.
Fig. 10f. The ilium fracture has been fixed through the first window of the ilioinguinal approach. A large fragment angular stable plate has been placed along the pelvic brim. At the iliac crest, a long small fragment lag screw has been used. The anterior pelvic ring is splinted with a retrograde large fragment transpubic screw. Pelvic ap overview one month postoperatively.
Fig. 10g. Pelvic inlet view.
Fig. 10h. Pelvic outlet view.

infra-acetabular corridor towards the posterior columns (Figs 9a–i).

External fixation is not the ideal solution for stabilization of the anterior pelvic ring in the elderly. There is an elevated risk of pin loosening, wound breakdown and pin track infection. Recently, **internal fixators** have been presented as an alternative to external fixators. A long and thick screw is placed in the left and right anterior inferior iliac spine in the direction of the posterior superior iliac spine. The screws are connected with a long curved plate or solid bar, which is inserted subcutaneously. Lateral cutaneous femoral nerve palsies and heterotopic ossification have been described (20). A second operation for metal removal is needed. We therefore prefer conventional plate and screw fixation instead of internal fixators.

Fragility fractures of the pelvis from the type III and IV have displaced posterior ring lesions. These patients are not able to ambulate anymore. For reduction and fixation, an open surgical approach is needed (17). After reduction, the same techniques as for the stabilization of non-displaced sacral fractures are used.

In transiliac instabilities, the fracture runs from the inner curve of the ilium towards proximally and laterally. An **angular stable plate osteosynthesis** is our treatment of choice. As in other skeletal regions, angular stable plates have higher pull-out forces, therefore there is a lower risk of loosening. The angular stable plate is placed parallel to the iliosacral joint along the inner curve of the innominate bone. The proximal screws are directed parallel to the sacroiliac joint, the distal screws in the sagittal plane or slightly towards lateral (Figs 10a–g). At the iliac crest, the fracture is stabilized with one or several long lag screws, which are drilled between the inner and outer cortex of the crest.

In case of bilateral dorsal instability, internal fixation should be done on both sides.. The same techniques as in unilateral instabilities are used. Alternatively, a bridging osteosynthesis is used. In bilateral fractures of the lateral mass of the sacrum, a transsacral positioning bar is inserted. Iliosacral screws are placed additionally on both sides to neutralize rotational forces. (Fig. 8e). Iliosacral screws as the only measure of stabilization are not reliable due to the elevated risk of loosening.

Transsacral bar osteosynthesis can also be used in H-type fracture patterns. Lumbopelvic fixation is preserved for lumbopelvic dissociations with gross instability or for patients, in which the transsacral corridor S1 is not available for the insertion of a transsacral positioning bar, due to sacral dysmorphism. In lumbopelvic fixation, pedicular screws are placed bilaterally in the L4 and L5 pedicles and in the dorsal ilium. The screw in the ilium is very long and directed towards the anterior inferior iliac spine. It can measure more than 70 mm of length. The screws are connected with a bar on each side, the two bars are connected with a transverse connector (13). Newly, a less invasive technique of fixation has been described (9). Lumbopelvic fixation prevents further intrusion of the lumbosacral segment into the pelvic ring. To obtain interfragmentary compression, the combination of a lumbopelvic fixation with an iliosacral screw or a transsacral positioning bar osteosynthesis is also possible.

Aftertreatment

In case of non-operative or operative management, physiotherapy must be adapted to the functional status of the patient before the fragility fracture occurred. Too aggressive mobilization may lead to additional pelvic fragility fractures with enhanced instability. Due to this, some patients, who were treated conservatively, may need operative treatment

We recommend relative bed rest for six weeks for patients, which have been treated operatively. Short transfers and sitting in a wheelchair are allowed, but long standing and walking with full weight bearing must be avoided. When conventional radiographs after six weeks confirm ongoing bone healing without implant migration, and the subjective feeling of the patient is good, weight bearing as tolerated is allowed. Full weight bearing without walking aids should be pursued after three months. Active physiotherapy is further needed to improve the general condition and mobility of the patient.

CONCLUSION

Fragility fractures of the pelvic ring are a new entity. The represent a wide variation of lesions with different degrees of instability. More than three quarters have unilateral or bilateral fractures of the dorsal pelvic ring. We recommend a CT scan of the pelvis to avoid underestimation of the instability. A comprehensive classification system, based on morphology and degree of instability, is presented. Type I lesions can be treated conservatively with painkillers and mobilization as tolerated. Type II lesions are stabilized with a percutaneous procedure, when conservative treatment is not successful. Type III and IV lesions need open reduction and internal fixation. Iliosacral screw osteosynthesis, bridging plate osteosynthesis, transsacral bar osteosynthesis, angle stable plating and lumbopelvic fixation are alternative options. They can be used in combination. As experience with operative treatment and long-term outcome of these lesions is still limited, more clinical and biomechanical studies are needed to identify the optimal treatment regimens for the different categories of instability.

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