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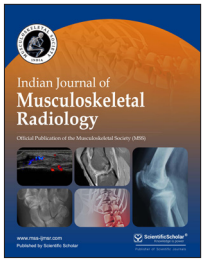

Original Article

Pelvic insufficiency fractures revisited

Ganesh Hegde[1], Srihari Giddaluru[2], Karthikeyan Parthasarathy Iyengar[3], Christine Azzopardi[1], Rajesh Botchu[1]

[1]Department of Musculoskeletal Radiology, Royal Orthopedic Hospital, Birmingham, West Midlands, United Kingdom, [2]Department of Surgery, Meenakshi Medical College and Hospital, Kanchipuram, Tamil Nadu, India, [3]Department of Orthopaedics, Southport and Ormskirk NHS Trust, Town lane, United Kingdom.

***Corresponding author:**
Rajesh Botchu,
Department of Musculoskeletal Radiology, Royal Orthopedic Hospital, Birmingham, West Midlands, United Kingdom.

drbrajesh@yahoo.com

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ABSTRACT

Objectives: There has been a significant increase in insufficiency fractures of the pelvis. Early diagnosis is essential to decrease morbidity and mortality. We describe the incidence of demographics of insufficiency fractures in different parts of the pelvis.

Material and Methods: A retrospective search of the radiology database for insufficiency fractures was performed at a tertiary orthopedic center. We analyzed the location of insufficiency fractures and demographics.

Results: There were 323 insufficiency fractures, with the majority being in the sacrum and pelvis. Insufficiency fractures of pubis, acetabulum and sacrum were in relatively older patients.

Conclusion: Early diagnosis and management are crucial.

Keywords: Insufficiency fracture, Pelvis, Demographics

INTRODUCTION

Insufficiency fractures result from low level trauma, which otherwise would not usually cause fractures and are defined by the World Health Organization as traumatic forces equivalent to falling from standing height or less.[1] Osteoporosis is the commonest predisposing condition for insufficiency fractures of the pelvis. Osteoporosis increases bone fragility and eventually propensity to fracture. It is estimated that osteoporosis is responsible for approximately 9 million fractures worldwide.[2] In the UK, the estimate of insufficiency fractures each year is approximately 300000, with huge medical and social care costs with approximately a cost of 2 billion pounds alone to manage hip fractures.[3,4] Apart from osteoporosis, other possible causes of fragility fracture include the use of steroids, age, sex, and family history of osteoporosis. The most common sites of insufficiency fractures are the spine, proximal femur, and distal radius with other common sites including the humerus, pelvis, and ribs.[5] It is important to diagnose insufficiency fractures to decrease morbidity and mortality. We describe the incidence and demographics of insufficiency fractures in different parts of the pelvis and believe this aspect has not been described in the literature.

MATERIAL AND METHODS

We undertook an epidemiological analysis of insufficiency fractures of the pelvis at a tertiary orthopedic center in the UK. We retrospectively searched the radiology database

for insufficiency fractures of the pelvis over 13 years. We recorded age, gender, location, and the number of fractures for each patient. The pelvis was divided into the sacrum, ilium, ischium, pubis (including superior and inferior pubic rami), acetabulum, femoral head, femoral neck, and subtrochanteric region. A consultant musculoskeletal radiologist with over 8 years of experience reviewed the images. The images included a combination of magnetic resonance imaging (MRI), computed tomography (CT), and radiographs though not all were available for review in all patients. MRI sequences included T1 and short tau inversion recovery (STIR) coronal and axial T1 and T2 fat suppressed or STIR. On MRI insufficiency fractures are seen as linear low signal on T1 and fluid sensitive sequences with osseous edema or hematoma. Insufficiency fractures are seen as areas of linear sclerosis on CT whereas on radiographs one can see disruption of the cortex or linear sclerosis. Simple descriptive statistical analysis was undertaken for demographics of insufficiency fractures of the pelvis.

RESULTS

In the past 13 years (2007–2020), there were a total of 323 insufficiency fractures of the pelvis at our hospital and the total number of MRIs performed during these years was 108664, with 12277 being pelvic MRIs. The number of insufficiency fractures as per individual locations in the pelvis with the mean age and gender distributions is shown in [Table 1]. The most common site for insufficiency fractures was sacrum and pubis [Figures 1-5]. The percentage of insufficiency fractures of the pelvis was 0.0293% out of all pelvic MRI's.

DISCUSSION

In our study, there were 323 insufficiency fractures, with a third of them involving the pubis and pubic rami. Sacral insufficiency fractures accounted for half of the cohort. There were two insufficiency fractures in 65 patients and three insufficiency fractures in 8. There was a significant female predominance of 4:1 for sacral fractures whereas majority of the pubic fractures were seen in men. There was no significant difference in the average age between pubic and sacral fractures (72.4 years vs. 70 years). This was comparable to those with acetabular fractures. Insufficiency fractures of the femoral head, neck, and proximal femora were noted in the relatively younger cohort (61.3 years, 53.5 years, and 47.2 years). In the study reported by Cabarrus *et al*. over 50% of the insufficiency fractures involved the sacrum and almost a quarter had a concomitant fracture of the pubis and around 15% had a concomitant fracture of the acetabulum. On the contrary, 90% of those with pubic fractures had a concomitant fracture of the sacrum.[6] The findings of our study are in line with this, with approximately half of the fractures involving the pelvis.[7-9] In the elderly, there is an imbalance between bone formation and bone resorption, with the latter being more dominant resulting in low-density bone. There is a significant decrease in bone strength of over 20% due to bone resorption manifested as cortical porosity and this is 46% over 65 years. The protective effect of muscles is relatively decreased in the elderly too, which can predispose to fractures even under normal stress and result in restricted mobility.[10] Early diagnosis of these is essential to decrease morbidity and mortality.[11,12] Conditions such as osteoporosis, metabolic bone disease, corticosteroid, neurological, and post-radiotherapy can predispose to stress fractures. Stress and insufficiency fractures are more common in females. This has been attributed to osteoporosis, eating disorder, and amenorrhea, which result in nutritional deficiency. Bone loss after menopause and with age can increase the risk of fractures by 2% at the age of 50 to more than 25% at the age of 80.

There has been an increase in the incidence of insufficiency fractures in the elderly, with the majority being over 60 years with an increase in life expectancy being one of the reasons.[7,12] This is in contrast to the neck of femur fractures, which have declined over the last few years.[8,9] The annual incidence of insufficiency fractures of the pelvis ranges from 25 to 224/100000. More than 90% of these fractures are associated with osteoporosis.[13] Most insufficiency fractures of the pelvis are due to falls off a chair, bed, or standing position.[8,9]

Table 1: Demographics of insufficiency fractures according of location.

	Acetabula	Proximal femora	Femoral head	Femoral neck	Ilium	Pubis	Sacrum
Number of fractures	27	5	27	7	26	113	74
Age							
Maximum	87	84	86	68	84	90	90
Minimum	42	11	17	14	39	20	16
Average	68.2	47.2	61.3	53.5	66.2	72.4	70
Male	5	0	13	4	6	106	35
Female	22	5	14	3	20	7	139

These can be identified on radiographs, CTs, and MRIs. Radiographs are the first modality that's used for the evaluation of insufficiency fractures; however, these can be challenging in the evaluation of the posterior pelvis. Radiographs have a sensitivity of 35%.[11] Hence, cross-sectional imaging should be performed if clinically suspected. MR has a sensitivity of 100% and a specificity of around 85%. CT has a relatively lower sensitivity (85%) and specificity in comparison to MRI.[6-9,14,15]

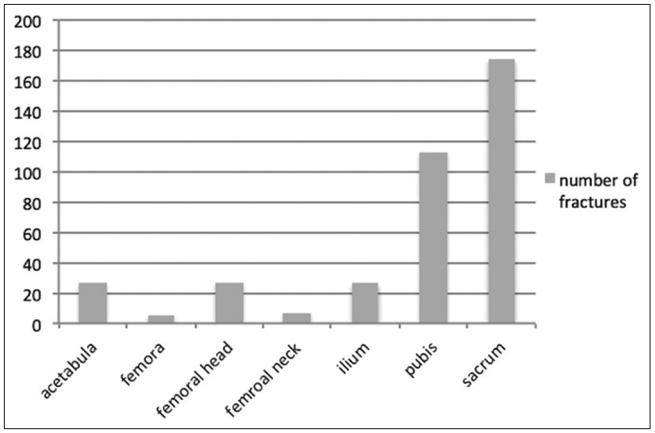

Figure 1: Number of fractures in different parts of the pelvis.

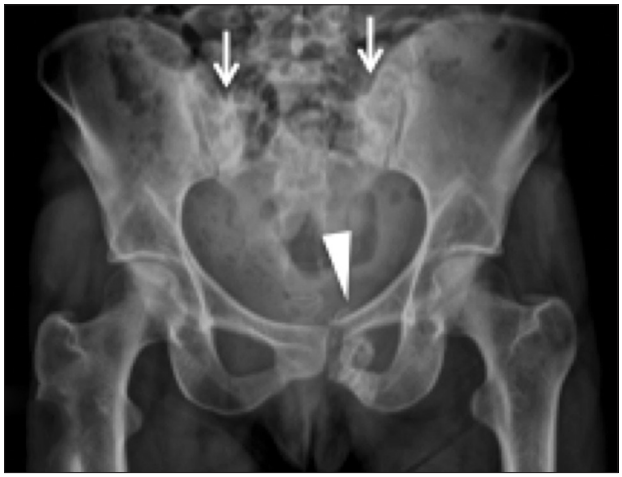

Figure 2: Anterior posterior radiographs of pelvis showing insufficiency fractures of both sacral ala (arrow) and left pubis (arrowhead).

MRI demonstrates varying degrees of osseous and soft-tissue edema with a low signal fracture line. Soft-tissue edema is commonly seen in insufficiency fractures of the pubis and acetabulum. Insufficiency fractures can be undisplaced or displaced and resorption of fracture ends can be seen in chronic cases. The pattern of sacral fractures can involve the sacroiliac joint, sacral ala, and in some cases the neural foramina. Fractures of the anterior pelvis can involve the pubis, superior pubic ramus, and inferior pubic ramus. The superior pubic ramus fractures that are closer to the acetabulum are associated with relatively poorer functional outcomes.[16,17]

Insufficiency fractures can be classified into type 1 (involvement of anterior pelvis), type 2 (undisplaced posterior pelvis fractures), type 3 (displaced unilateral pelvis fractures), and type 4 (bilateral displaced pelvis fractures) majority (over 80%) of the fractures involved the posterior pelvis (sacrum and pubis).[7-10,17]

Pelvic insufficiency fractures have been associated with a significant increase in 1-year mortality following the fractures of around 23.8%. This increases with the complexity of insufficiency fracture ranging from 13.3% to 27.4%. Hoch and colleagues had reported a 2-year mortality rate of 41% in non-operative and 18% in operative patients with pelvic insufficiency fractures. Immobilization is a frequent consequence of insufficiency fractures which is associated with respiratory, cardiovascular problems as well as thrombosis.[13]

These can be managed by a combination of analgesia, anabolic treatment, and cement augmentation (sacroplasty and acetabuloplasty).[7,12,14] The presence of normal fatty marrow within the bones is the key to differential insufficiency fracture from pathological fractures. Chemical shift imaging might help to differentiate these too.

Our study has few limitations. Ours was a retrospective study looking at MRI of the pelvis done for all indications, not specifically for pelvic pain. Second our center is a non-trauma orthopedic center; thus we might have had less referrals from patients with a history of minimal trauma such as trivial fall, which are responsible for a considerable number of insufficiency fractures.

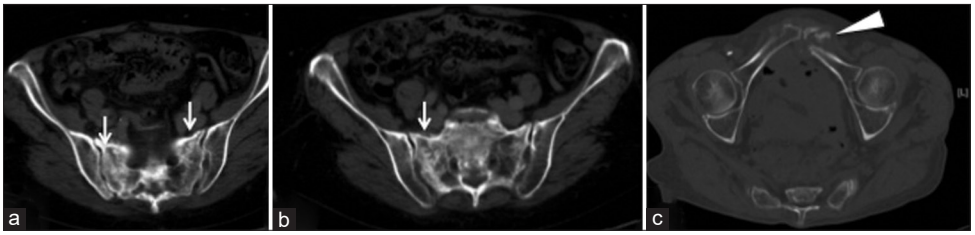

Figure 3: Axial computed tomography showing insufficiency fractures of both sacral ala (arrow) and left pubis (arrow head).

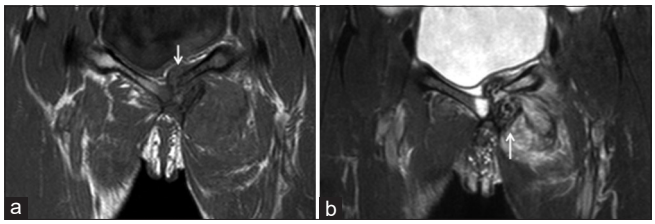

Figure 4: Coronal T1 (a) and short tau inversion recovery (b) showing insufficiency fracture of left pubis with marked osseous edema and hematoma (arrow).

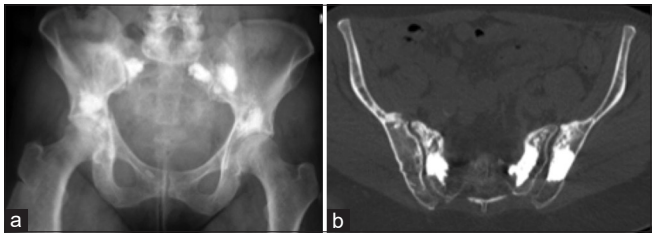

Figure 5: Anterior posterior radiograph (a) and axial computed tomography (b) showing bilateral sacroplasty and acetabuloplasty and left ilioplasty.

CONCLUSION

Insufficiency fractures of the pelvis can result in increased morbidity and mortality. Early diagnosis and management are crucial. We describe the demographics of different pelvis insufficiency fractures.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Nil.

Conflicts of interest

There are no conflict of interest.

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