e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(11); 866-872

Original Research Article

Functional Outcome of Percutaneous Iliosacral Screw Fixation in Vertically Unstable Posterior Pelvis Fracture Dislocation

Neelavjyoti Deka[1], Paragjyoti Gogoi[2], Dhruba Narayan Borah[3], Aditi Das[4]

[1]Senior Resident, Department of Orthopaedics &Trauma, Gauhati Medical College & Hospital, Guwahati, Assam

[2]Associate Professor, Department of Orthopaedics &Trauma, Gauhati Medical College & Hospital, Guwahati, Assam

[3]Associate Professor, Department of Orthopaedics &Trauma, Dhubri Medical College & Hospital, Dhubri, Assam

[4]Assistant Professor, Department of Radiology, Gauhati Medical College & Hospital, Guwahati, Assam

Received: 25-08-2024 / Revised: 23-09-2024 / Accepted: 26-10-2024

Corresponding Author: Dr. Neelavjyoti Deka

Conflict of interest: Nil

Abstract:

Pelvic ring injury is a serious traumatic condition which needs urgent haemodynamic stabilisation of the patient and reconstruction of the pelvic ring. Depending upon the type of force vectors causing the injury, both the anterior fracture and symphyseal separation as well as the posterior Sacroiliac fracture dislocation warrant surgical fixation. However in certain cases, patients recover with only the posterior stabilisation supplemented by pelvic binders. Percutaneous fixation of the Sacroiliac disruption is always better than the open reduction and internal fixation as it is minimally invasive with little blood loss and less tissue damage. It may be associated with neurovascular complications if proper procedures and techniques are not followed. Per-operative C arm visualisation in various planes are mandatory for proper screw trajectories and to avoid complications. Usually 6.5 mm partially threaded Cannulated cancellous screws with washers are used for Sacroiliac dislocations, which require compression. A second screw may be added if needed into the S2 vertebral body. In sacral fractures, fully threaded Cannulated cancellous screws are used. Early reconstruction of the Pelvic ring helps in mobilising the patient, avoid complications like deep vein thrombosis, decubitus ulcers, infections and decreases the hospital stay duration. We are presenting in this study the functional outcome of 15 patients of Pelvic ring injury stabilized by Percutaneous Sacroiliac screws. Three patients also required anterior fixation of the symphyseal disruption. Rest are managed with posterior Sacroiliac fixation alone or few are supplemented by pelvic binders. Good to excellent functional recovery was recorded in majority of patients.

Keywords: Pelvic ring injury; Sacroiliac dislocation; Unstable Sacroiliac injury; Percutaneous Iliosacral Screw; Iliocortical density.

Introduction

Pelvis fractures are serious traumatic conditions threatening life and the limb. They comprises about 3-8% of all fractures and 2% of all orthopaedics hospital admissions with an incidence of 0.82 per 1,00,000 population [1]. They may be stable resulting from low energy trauma or unstable caused by high-energy trauma such as road traffic accidents, fall from height, fall of heavy objects etc. [2].

The unstable variety is usually accompanied by sacroiliac disruptions or sacral fractures as well as other long bone injuries and other systemic injuries [3].

The associated vascular, urological and neural injuries increase the morbidity considerably also the mortality that ranges from 10% to 50% [4]. Initial physiological stabilization according to the ATLS protocol is employed followed by surgical reconstruction of the pelvis ring. Surgical fixation of the unstable pelvis is helpful in early mobilization of the patient, good anatomical reduction of the fracture and disruption, shorter hospital stay and has better functional outcome compared to non-operative treatment [5]. Reconstruction of the pelvis ring can be obtained by minimally invasive Percutaneous Sacroiliac screws also. Apart from being less invasive, it has minimal blood loss and also has decreased post-operative infection rate compared to open surgeries [6].We are presenting here a study of percutaneous Sacroiliac screw fixation in vertically unstable posterior pelvic fracture dislocation done in a tertiary care hospital.

Materials and Method

A total of 15 patients who met the selection criteria were treated by this method and radiological and functional outcome were studied. Fractures which are vertically unstable unilateral or bilateral posterior Sacroiliac disruption, closed fractures, duration within three weeks and without any medical contraindications were selected for this study. Patients with open wounds or active infection at the fractured area, Morel-Lavallee lesion and horizontal sacral fractures were excluded. After stabilization of the patient by ATLS protocol and application of the Pelvic binders they were subjected for radiological evaluation. Antero-posterior, Inlet and Outlet view X-rays of the Pelvis were obtained as well as CT scan of the Pelvis with 3D reconstruction. Pre-operative blood parameters were obtained to assess the fitness for surgical intervention.

After anesthesia, the patient is positioned Supine with a towel or blanket under the Pelvis to elevate it for proper C-arm view and placement of the percutaneous screw [7]. The entire lower abdomen is draped from nipple line and the involved leg drapped separately so that manual traction can be applied if required. Distal femoral skeletal traction through a pulley system attached to the operating table can also be employed when necessary [Figure 1].

Figure 1: Patient positioning and C-Arm Positioning

Initial AP radiograph is used to assess proper patient positioning.

The inlet and outlet views for each patient is determined. An ideal inlet image of the pelvis superimposes the upper-sacral vertebral bodies as concentric circles.

The ideal outlet image is defined as one where the superior aspect of the symphysis pubis is superimposed on the S2 vertebral body. In case of dysmorphic upper-sacral segments, the fluoroscope is adjusted to focus on the segment that will receive the SI screw. The lateral sacral view is obtained by adjusting the fluoroscope to superimpose the greater sciatic notches. On this image, the iliac cortical densities are identified and correlated with the preoperative CT scan and should be collinear with the alar slope [Figure 2].

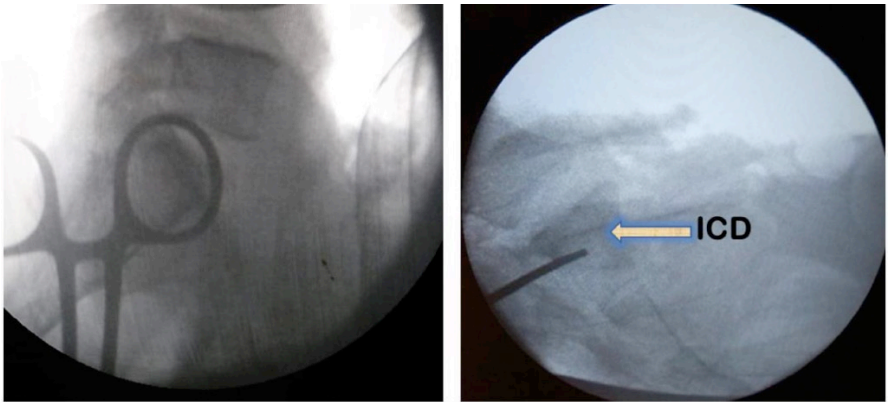

Figure 2: Iliocortical Density

Iliac cortical densities mark the alar locations according to the preoperative CT scan information. In a dysmorphic pelvis on the true lateral view of the sacrum, the alar slope may be more acute and nonlinear with the ICD. Screw orientation is directed from a posterior-caudal starting point with an anterior-cephalad directional aim. These screws rarely extend beyond midline because of the abnormal anatomy.

In the supine position the anterior superior iliac spine (ASIS) is palpated and a line from the ASIS perpendicular to the floor is drawn. A second line from the femoral shaft is extended proximally which intersects the first line and thus forms 4 quadrants. The starting zone for SI screw insertion is the posterosuperior quadrant. To identify the entry point on the lateral view of pelvis, the dorsal and ventral aspects of sacrum and the Iliocortical density (ICD) is identified [8]. It marks the superior border of the sacroiliac joint and the entry point is below this line and behind the anterior border of the sacrum [9]. Vertical displacement must be reduced before insertion of the guide wire. Traction is applied on the affected leg with hip in mild flexion and to reduce the fracture dislocation; abduction may be needed in case of Lateral compression injury and external rotation in Antero-posterior compression injuries. A Schanz pin in the ilium can be used as joystick to aid reduction. After achieving reduction, the guidewire is advanced through the ilium across the sacroiliac joint into the sacrum. The guide wire is advanced till the sacral foramina and the position is checked on the outlet view to make sure the guide wire is above the first sacral foramen.

Then inlet view is used to check for the anteroposterior position of the guide wire. The wire should lie between the anterior and posterior bony margins of the sacrum and below the iliac cortical density [Figure 3].

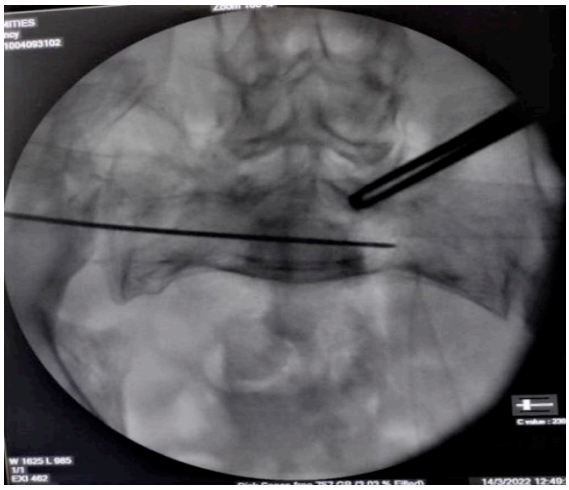

Figure 3: Guide wire position

The guide wire should be in the anterior half of sacral body in the inlet view and above the sacral foramen and below the superior aspect of sacrum in the outlet view. After confirming the guide wire position using inlet and outlet views cannulated drill bit is passed and screws inserted with washer [Figure 4].

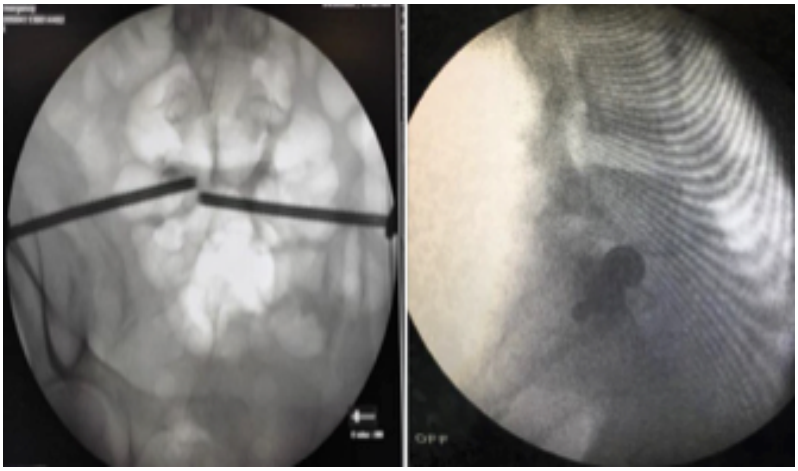

Figure 4: Screw Position in AP and Lateral View

Screw trajectory in Sacroiliac joint is perpendicular to sacroiliac joint from posteroinferior to anteriosuperior direction. And in Sacral fracture it is more or less horizontal.

Partially threaded 6.5 mm cannulated cancellous screw is used for Sacroiliac joint disruption and Denis zone 1 sacral fracture fully threaded 6.5 mm cannulated cancellous screw is used for Denis Zone 2 sacral fracture where compression is not required. In most cases a single screw is sufficient except for highly unstable dislocations where two screws may be inserted.

Patients were followed up at 2 weeks, 6 weeks, 12 weeks and at 6 months and 1year. During each visit, the radiographic assessment of sacroiliac joint is done by routine antero-posterior, inlet and outlet views. Implant is checked for any loosening, sign of infection and failure. Functional outcome of patient is assessed with pelvic outcome scale. After 3 months stress test of the Sacroiliac joint is also done.

Results

A total of 15 patients were fixed with Percutaneous Sacroiliac screws. The youngest patient in the study was 17 years old. The oldest patient in the study was 59 years. The mean age was 34.4 years. The maximum numbers of cases were observed between 21-30 years and equally in 41-50 years group. The male to female ratio was found to 1.14:1. The commonest mode of injury in the study was found to be road traffic accident (66.7%) while the mode of injury in 5 patients was due to fall from height. 3 patients had associated hemoperitoneum, 2 patients had bladder injury, 2 had L5 nerve root injury, 2 had spine injury, 1 maxillary fracture, 1 head injury, 1 humerus fracture, 1 both bone forearm fracture and 2 others had no associated injuries [Table 1]

Table 1: Demographic pattern of the Patients with different fixation combinations

SL NO	AGE	SEX	MOI	ASSOC INJURY	TILE CLASS	TIME DELAY	HOSP STAY	OPERATING TIME	PROCEDURE	COMPLICATIONS	FOLLOW UP	RESULT
1	17	F	RTA	HUMERUS #	C2	8	13	105 MINUTES	SI SCREW FIXATION WITH SYMPHYSEAL SCREW	NIL	10 MONTHS	EXC
2	37	M	FFH	MAXILLARY #	C2	3	6	43 MINUTES	SI SCREW FIXATION	NIL	7 MONTHS	GOOD
3	18	F	RTA	HEAD INJURY	C2	6	9	93 MINTUES	BILATERAL SI SCREW FIXATION	NIL	9 MONTHS	EXC
4	33	M	FFH	BLADDER INJURY	C2	11	16	62 MINUTES	S1 S2 SCREW FIXATION WITH PELVIC EX FIXATOR	NIL	7 MONTHS	EXC
5	26	M	RTA	HEMOPERITONEUM	C1	5	10	40 MINUTES	SI SCREW FIXATION	NIL	10 MONTHS	EXC
6	24	M	RTA	#BBFA	C1	3	8	72 MINUTES	BILATERAL SI SCREW FIXATION	NIL	8 MONTHS	GOOD
7	45	M	FFH	SPINE #	C3	3	7	119 MINUTES	SYMPHYSEAL PLATING WITH SI SCREWFIXATION	NIL	8 MONTHS	EXC
8	49	F	RTA	# DER	C1	2	5	68 MINUTES	S1 S2 SCREW FIXATION	NIL	9 MONTHS	GOOD
9	21	M	RTA	L5 NERVE ROOT PALSY	C2	6	9	39 MINUTES	SI SCREW FIXATION	NIL	7 MONTHS	FAIR
10	44	F	RTA	HEMOPERITONEUM	C3	8	11	74 MINUTES	BILATERAL SI SCREW FIXATION	S1 PARAESTHESIA	6 MONTHS	GOOD
11	53	M	RTA	BLADDER INJURY	C1	10	13	41 MINUTES	SI SCREW FIXATION	NIL	6 MONTHS	EXC
12	42	F	RTA	NIL	C2	3	6	123 MINUTES	SYMPHYSEAL PLATING WITH SI SCREWFIXATION	NIL	10 MONTHS	EXC
13	28	M	FFH	L5 NERVE ROOT PALSY	C2	5	8	111 MINUTES	SYMPHYSEAL PLATING WITH SI SCREWFIXATION	NIL	7 MONTHS	EXC
14	59	F	RTA	HEMOPERITONEUM	C2	7	10	34 MINUTES	SI SCREW FIXATION	NIL	8 MONTHS	EXC
15	20	F	FFH	NIL	C1	3	6	37 MINUTES	SI SCREW FIXATION	NIL	6 MONTHS	GOOD

Tile C2 was the most common class of fracture in our study (53.3 %) followed by tile C1 (33.3 %) and C3 (13.3 %).

The most common surgical procedure adopted in our study was single sacroiliac screw fixation (40%) followed by bilateral sacroiliac screw fixation (20%) and anterior symphyseal plating with bilateral SI screw fixation (20%). The average time delay between injury and surgery was 5.53 days (range 2-11days). The average surgical time was 70.73 minutes (range 34-119 mins) and hospital stay was 9.13 days (5-16days). The average duration of follow up was 7.86 months. One patient had post-operative S1 nerve root palsy which recovered within a month.

According to Majeed scoring, 9 patients (60%) had excellent functional outcome, one had fair and rest five had good functional outcome [Figure 5].

Figure 5: A 42 year old woman underwent percutaneous SI screw fixation and symphyseal plating and had excellent outcome

Discussion

Percutaneous Sacroiliac screw fixation under image guidance is a minimally invasive technique for fixation of Pelvic ring injuries involving the posterior ring. It is a good procedure with reproducible results. We studied the literature for and found similar comparable results with other studies. Road traffic accidents and fall from height comprises the majority of the cases.

Patient positioning is very important as it influences the surgery. The Iliosacral screw can be applied both in the prone position and supine position. The prone position gives the advantage of unimpeded guide wire positioning and drilling. However, if any anterior fixation procedure is required then the patient must be repositioned. Moreover, the C-arm positioning may sometimes be difficult as it must be totally opposite to that of the normal views. In the supine position, the screw trajectory may be difficult to obtain because of the OT table. Therefore the pelvis has to be lifted a little bit by putting towels or folded bed sheets so that guide wire can be put properly. The useful C-arm views must be checked beforehand [8,9]. The Iliosacral screw can be partially or fully threaded depending upon the association of sacral fractures. In cases of Sacroiliac dislocation, the partially threaded screws are used as compression is required; but if there is associated sacral fractures then the fully threaded screws were used. Second Sacroiliac screw into the Sacral 2 vertebral body may be needed to reinforce the first one. This screw is parallel to the first one but inferior and posterior. Since the trajectory of the screw is postero-lateral to anterio-medial it should not cross the midline to

avoid injury to the vital vascular structures. Intraoperative fluoroscopy instead of static C-arm images should be done at the final stage of tightening of the screw [10]

Anterior fracture or symphyseal disruption can be managed by different methods. Minimally displaced ones can be left with posterior fixation alone. Symphyseal plates, percutaneous iliopubic screws for rami fractures, or supracetabular external fixation can be combined with posterior Iliosacral screws [10, 11,12,13]. In our study also most of the cases were managed by single Sacroiliac screw fixation (40%) and only in 20% cases anterior Symphyseal plating was done. S. A. Khaled et al (2014) found the mean elapsed time between injury and surgery was 10 days. The mean time elapsed between injury and surgery in our study was 5.53 days. Similarly Osterhoff et al (2011) in their study stated the mean time elapsed as 2 days [11]. The average operating time in our study was 70.73 minutes. The mean operating time in the study of Osterhoff et al in (2011) was 16 ± 7 min/screw [11], in the study by Henrik Eckardt et al in 2017 was 79 min [13] , Florian Gras et al in (2010) was 62 mins [14], Shuler TE et al in their study in 1995 was 52 mins [15]. Operating time is also depended on the expertise of the C-arm technician since the whole procedure demands accurate placement of the screws avoiding the vital structures.

In our study the average duration of stay in the hospital was 9.13 days. In the study by Schweitzer et al (2008) the mean duration of hospital stay was 43 days [12], in the study by Eric W. van den Bosch et al (2002) it was 19.2 days [16], Florian Gras et al (2010) was17 days [14] and in the study by Shresta D et al (2015) the mean duration of hospital stay was 11 days [17]. This variability can be explained by the association of various other system injuries and the time required for their management.

During the course of follow up in our study, one case had postoperative S1 nerve paraesthesia which resolved within 1 month. S. A. Khaled et al (2014) in their study reported no postoperative neurologic injuries or vascular injuries, however, mentioned breakage, non-unions, or thromboembolic complications [10]. Schweitzer al (2008) in their study reported that 2 patients had transitory postoperative neurological deficit, 5 patients presented with hardware failure. 15 patients developed sacroiliac osteoarthritis during follow-up [12]. Screw malposition is the most commonly reported reason for reintervention. Post-operative CT scan is helpful if the patients complain of any paraesthesia, weakness, etc [11,16]. Osterhoff, G et al (2011) in their study reported that one patient presented with nonunion, 13 months after surgery [11] Henrik Eckardt et al (2017) in their study reported that 2 patients suffered from perioperative complications. One patient had transient arterial bleeding from gluteal muscle during insertion of one posterior screw. One patient developed ischial pain after the screw insertion with computer tomographic evidence of intra-foraminal screw placement and remission of the symptoms after immediate screw removal [13]

We used Majeed scoring system for functional evaluation of our patients [18]. Most of the cases in our study had excellent functional outcome (60%) during the course of follow up. They were utilised in other studies as well. In the study by S. A. Khaled et al in (2014) the Majeed score was excellent in 72.20%, good in 13.89%, fair in 8.33% and poor in 5.56% [10]. Similarly, in the study by Shresta D et al in (2015) the score was excellent in 47.60%, good in 28.57%, fair in 19.05% and poor in 4.70% [17]. In the study by Schweitzer et al (2008) the score was excellent in 11%, good in 22.05%, fair in 5.82%and poor in 2.94% [12]

Conclusion

Unstable Pelvic fractures are one of the most challenging fractures an orthopaedic surgeon can come across is and hence its management and techniques of safe surgical fixation are demanding. Constant dedication to improvement is needed and should be the goal of pelvic surgeons. Percutaneous ilio-sacral screw fixation with C arm guidance is safe and minimally invasive technique for sacro-iliac joint injury and sacral fracture. A detailed 3 dimensional orientation of the anatomy of the pelvis with clear images and accurate interpretation of X-rays, CT scans and per operative C arm images are pre-requisites that have to be fulfilled to avoid malpositioning of screws and iatrogenic neurovascular injuries.

Declaration

All Authors contributed equally to the study. No funding was received from any source. Written consent was taken from the patients for the study.

References:

1. Animesh Agarwal. Pelvic Ring Injuries. Chapter 49. In: Paul Tornetta III, William M. Ricci, Robert F. Ostrum, Margaret M. McQueen, Charles M. Court-Brown editors. Rockwood and Greens Fractures in Adults, 9Th Edition. Volume 2. International edition. Wolters Kulwer. 2020. page: 1964-1965
2. Guyton JL, Perez EA. Fractures of acetabulum and pelvis. Chapter 56. In: Canale ST, Beaty JH, editors. Campbell's operative orthopaedics.12th edition. Volume 3. Philadelphia: Elsevier; 2007. Page. 2799-2800
3. Bryceland JK, Keating JF. Laparotomy and unstable pelvic fractures. Injury. 2008 Aug 1; 39(8):853-7.

4. James L. Guyton, Edward A. Perez. Fractures of Acetabulum and Pelvis. Chapter 56 In: Frederick M. Azar, James H. Beaty, S. Terry Canale editors. Campbell's Operative Orthopaedics, 13th edition. Volume 3. International Edition. Elsevier 2017. Page no 2895
5. Burgess AR, Eastridge BJ, Young JW, Ellison TS, ELLISON Jr PS, Poka A, Bathon GH, Brumback RJ. Pelvic ring disruptions: effective classification system and treatment protocols. Journal of Trauma and Acute Care Surgery. 1990 Jul 1; 30(7):848-56.
6. Routt MC, Nork SE, Mills WJ. High-energy pelvic ring disruptions. Orthopedic Clinics. 2002 Jan 1; 33(1):59-72.
7. Routt Jr ML, Kregor PJ, Simonian PT, Mayo KA. Early results of percutaneous iliosacral screws placed with the patient in the supine position. Journal of orthopaedic trauma. 1995 Jun 1; 9(3):207-14.
8. Iorio JA, Jakoi AM, Rehman S. Percutaneous sacroiliac screw fixation of the posterior pelvic ring. Orthopedic Clinics. 2015 Oct 1;46(4):511-21
9. Frederick M, James H, Terry Canale S, Campbell's operative orthopaedics,Philadelphia, Thirteenth Edition.
10. Khaled SA, Soliman O, Wahed MA. Functional outcome of unstable pelvic ring injuries after iliosacral screw fixation: single versus two screw fixation. European Journal of Trauma and Emergency Surgery. 2015 Aug; 41(4):387-92.
11. Osterhoff G, Ossendorf C, Wanner GA, Simmen HP, Werner CM. Percutaneous iliosacral screw fixation in S1 and S2 for posterior pelvic ring injuries: technique and perioperative complications. Archives of orthopaedic and trauma surgery. 2011 Jun; 131(6):809-13.
12. Schweitzer D, Zylberberg A, Córdova M, Gonzalez J. Closed reduction and iliosacral percutaneous fixation of unstable pelvic ring fractures. Injury. 2008 Aug 1; 39(8):869-74.
13. Eckardt H, Egger A, Hasler RM, Zech CJ, Vach W, Suhm N, Morgenstern M, Saxer F. Good functional outcome in patients suffering fragility fractures of the pelvis treated with percutaneous screw stabilisation: assessment of complications and factors influencing failure. Injury. 2017 Dec 1; 48(12):2717-23.
14. Gras F, Marintschev I, Wilharm A, Klos K, Mückley T, Hofmann GO. 2D-fluoroscopic navigated percutaneous screw fixation of pelvic ring njuries-a case series. BMC musculoskeletal disorders. 2010 Dec; 11(1):1-0.
15. Shuler TE, Boone DC, Gruen GS, Peitzman AB. Percutaneous iliosacral screw fixation: early treatment for unstable posterior pelvic ring disruptions. Journal of Trauma and Acute Care Surgery. 1995 Mar 1; 38(3):453-8.
16. Van den Bosch EW, van Zwienen CM, van Vugt AB. Fluoroscopic positioning of sacroiliac screws in 88 patients. Journal of Trauma and Acute Care Surgery. 2002 Jul 1; 53(1):44-8.
17. Shrestha D, Dhoju D, Shrestha R, Sharma V. Percutaneous ilio-sacral screw fixation in supine position under fluoroscopy guidance. Kathmandu University Medical Journal. 2015 Oct 20; 13(1):56-60.
18. S A Majeed. Grading the outcome of pelvic fractures. J Bone Joint Surg Br. 1989 Mar; 71(2):304-6.