

OFFICIAL PUBLICATION OF
THE MINISTRY OF HEALTH,
BRUNEI DARUSSALAM

Brunei International Medical Journal

Volume 14

21 November 2018 (13 Rabiulawal 1440H)

MID-TERM OUTCOMES OF OPERATIVE FIXATION OF TRAUMATIC PELVIC FRACTURES IN BRUNEI DARUSSALAM.

Lee Shi YEO¹, Toe Toe AUNG¹, Biju BENJAMIN², Dipo OLABUMUYI¹

¹Department of Orthopaedic Surgery, RIPAS Hospital, Bandar Seri Begawan, Brunei Darussalam.

²Department of Orthopaedic surgery, University College London Hospital, 235 Euston Rd, London NW1 2BU, United Kingdom.

ABSTRACT

Traumatic pelvic fractures are major bony injuries associated with long-term morbidity. We analysed the outcomes of operative repair of traumatic pelvic fractures secondary to road traffic accidents in our centre over a 11-years period. Majority of cases were B1 followed by C1 AO fracture pattern. Post-operative congruity was obtained in 95.2% of cases with a mean Majeed score of 92.4% at a minimum follow-up of four years. There was no statistically significant difference between the fracture groups and duration of hospital stay. Our results indicate that operative repair of traumatic pelvic fractures is associated with excellent outcome.

Keywords: Brunei, Fracture, Majeed score, Open fracture reduction, Pelvis, Road traffic accidents

Brunei Int Med J. 2018;14:161-166

Brunei International Medical Journal (BIMJ)

Official Publication of the Ministry of Health, Brunei Darussalam

EDITORIAL BOARD

Editor-in-Chief	William Chee Fui CHONG
Sub-Editors	Vui Heng CHONG Ketan PANDE
Editorial Board Members	Nazar LUQMAN Muhd Syafiq ABDULLAH Alice Moi Ling YONG Ahmad Yazid ABDUL WAHAB Jackson Chee Seng TAN Dipo OLABUMUYI Pemasiri Upali TELISINGHE Roselina YAAKUB Pengiran Khairol Asmee PENGIRAN SABTU Dayangku Siti Nur Ashikin PENGIRAN TENGAH

INTERNATIONAL EDITORIAL BOARD MEMBERS

Lawrence HO Khek Yu (Singapore)	Surinderpal S BIRRING (United Kingdom)
Emily Felicia Jan Ee SHEN (Singapore)	Leslie GOH (United Kingdom)
John YAP (United Kingdom)	Chuen Neng LEE (Singapore)
Christopher HAYWARD (Australia)	Jimmy SO (Singapore)
Jose F LAPENA (Philippines)	Simon Peter FROSTICK (United Kingdom)

Advisor

Wilfred PEH (Singapore)

Past Editors

Nagamuttu RAVINDRANATHAN
Kenneth Yuh Yen KOK

Proof reader

John WOLSTENHOLME (CfBT Brunei Darussalam)

Aim and Scope of Brunei International Medical Journal

The Brunei International Medical Journal (BIMJ) is a six monthly peer reviewed official publication of the Ministry of Health under the auspices of the Clinical Research Unit, Ministry of Health, Brunei Darussalam.

The BIMJ publishes articles ranging from original research papers, review articles, medical practice papers, special reports, audits, case reports, images of interest, education and technical/innovation papers, editorials, commentaries and letters to the Editor. Topics of interest include all subjects that relate to clinical practice and research in all branches of medicine, basic and clinical including topics related to allied health care fields. The BIMJ welcomes manuscripts from contributors, but usually solicits reviews articles and special reports. Proposals for review papers can be sent to the Managing Editor directly. Please refer to the contact information of the Editorial Office.

Instruction to authors

Manuscript submissions

All manuscripts should be sent to the Managing Editor, BIMJ, Ministry of Health, Brunei Darussalam; e-mail: editor-in-chief@bimjonline.com. Subsequent correspondence between the BIMJ and authors will, as far as possible via should be conducted via email quoting the reference number.

Conditions

Submission of an article for consideration for publication implies the transfer of the copyright from the authors to the BIMJ upon acceptance. The final decision of acceptance rests with the Editor-in-Chief. All accepted papers become the permanent property of the BIMJ and may not be published elsewhere without written permission from the BIMJ.

Ethics

Ethical considerations will be taken into account in the assessment of papers that have experimental investigations of human or animal subjects. Authors should state clearly in the Materials and Methods section of the manuscript that institutional review board has approved the project. Those investigators without such review boards should ensure that the principles outlined in the Declaration of Helsinki have been followed.

Manuscript categories

Original articles

These include controlled trials, interventional studies, studies of screening and diagnostic tests, outcome studies, cost-effectiveness analyses, and large-scale epidemiological studies. Manuscript should include the following; introduction, materials and methods, results and conclusion. The objective should be stated clearly in the introduction. The text should not exceed 2500 words and references not more than 30.

Review articles

These are, in general, invited papers, but unsolicited reviews, if of good quality, may be considered. Reviews are systematic critical assessments of

literature and data sources pertaining to clinical topics, emphasising factors such as cause, diagnosis, prognosis, therapy, or prevention. Reviews should be made relevant to our local setting and preferably supported by local data. The text should not exceed 3000 words and references not more than 40.

Special Reports

This section usually consist of invited reports that have significant impact on healthcare practice and usually cover disease outbreaks, management guidelines or policy statement paper.

Audits

Audits of relevant topics generally follow the same format as original article and the text should not exceed 1,500 words and references not more than 20.

Case reports

Case reports should highlight interesting rare cases or provide good learning points. The text should not exceed 1000 words; the number of tables, figures, or both should not be more than two, and references should not be more than 15.

Education section

This section includes papers (i.e. how to interpret ECG or chest radiography) with particular aim of broadening knowledge or serve as revision materials. Papers will usually be invited but well written paper on relevant topics may be accepted. The text should not exceed 1500 words and should include not more than 15 figures illustration and references should not be more than 15.

Images of interest

These are papers presenting unique clinical encounters that are illustrated by photographs, radiographs, or other figures. Image of interest should include a brief description of the case and discussion with educational aspects. Alternatively, a mini quiz can be presented and answers will be posted in a different section of the publication. A maximum of

three relevant references should be included. Only images of high quality (at least 300dpi) will be acceptable.

Technical innovations

This section include papers looking at novel or new techniques that have been developed or introduced to the local setting. The text should not exceed 1000 words and should include not more than 10 figures illustration and references should not be more than 10.

Letters to the Editor

Letters discussing a recent article published in the BIMJ are welcome and should be sent to the Editorial Office by e-mail. The text should not exceed 250 words; have no more than one figure or table, and five references.

Criteria for manuscripts

Manuscripts submitted to the BIMJ should meet the following criteria: the content is original; the writing is clear; the study methods are appropriate; the data are valid; the conclusions are reasonable and supported by the data; the information is important; and the topic has general medical interest. Manuscripts will be accepted only if both their contents and style meet the standards required by the BIMJ.

Authorship information

Designate one corresponding author and provide a complete address, telephone and fax numbers, and e-mail address. The number of authors of each paper should not be more than twelve; a greater number requires justification. Authors may add a publishable footnote explaining order of authorship.

Group authorship

If authorship is attributed to a group (either solely or in addition to one or more individual authors), all members of the group must meet the full criteria and requirements for authorship described in the following paragraphs. One or more authors may take responsibility 'for' a group, in which case the other group members are not authors, but may be listed in an acknowledgement.

Authorship requirement

When the BIMJ accepts a paper for publication, authors will be asked to sign statements on (1) financial disclosure, (2) conflict of interest and (3) copyright transfer. The correspondence author may sign on behalf of co-authors.

Authorship criteria and responsibility

All authors must meet the following criteria: to have participated sufficiently in the work to take public responsibility for the content; to have made substantial contributions to the conception and de-

sign, and the analysis and interpretation of the data (where applicable); to have made substantial contributions to the writing or revision of the manuscript; and to have reviewed the final version of the submitted manuscript and approved it for publication. Authors will be asked to certify that their contribution represents valid work and that neither the manuscript nor one with substantially similar content under their authorship has been published or is being considered for publication elsewhere, except as described in an attachment. If requested, authors shall provide the data on which the manuscript is based for examination by the editors or their assignees.

Financial disclosure or conflict of interest

Any affiliation with or involvement in any organisation or entity with a direct financial interest in the subject matter or materials discussed in the manuscript should be disclosed in an attachment. Any financial or material support should be identified in the manuscript.

Copyright transfer

In consideration of the action of the BIMJ in reviewing and editing a submission, the author/s will transfer, assign, or otherwise convey all copyright ownership to the Clinical Research Unit, RIPAS Hospital, Ministry of Health in the event that such work is published by the BIMJ.

Acknowledgements

Only persons who have made substantial contributions but who do not fulfill the authorship criteria should be acknowledged.

Accepted manuscripts

Authors will be informed of acceptances and accepted manuscripts will be sent for copyediting. During copyediting, there may be some changes made to accommodate the style of journal format. Attempts will be made to ensure that the overall meaning of the texts are not altered. Authors will be informed by email of the estimated time of publication. Authors may be requested to provide raw data, especially those presented in graph such as bar charts or figures so that presentations can be constructed following the format and style of the journal. Proofs will be sent to authors to check for any mistakes made during copyediting. Authors are usually given 72 hours to return the proof. No response will be taken as no further corrections required. Corrections should be kept to a minimum. Otherwise, it may cause delay in publication.

Offprint

Contributors will not be given any offprint of their published articles. Contributors can obtain an electronic reprint from the journal website.

DISCLAIMER

All articles published, including editorials and letters, represent the opinion of the contributors and do not reflect the official view or policy of the Clinical Research Unit, the Ministry of Health or the institutions with which the contributors are affiliated to unless this is clearly stated. The appearance of advertisement does not necessarily constitute endorsement by the Clinical Research Unit or Ministry of Health, Brunei Darussalam. Furthermore, the publisher cannot accept responsibility for the correctness or accuracy of the advertisers' text and/or claim or any opinion expressed.

MID-TERM OUTCOMES OF OPERATIVE FIXATION OF TRAUMATIC PELVIC FRACTURES IN BRUNEI DARUSSALAM.

Lee Shi YEO¹, Toe Toe AUNG¹, Biju BENJAMIN², Dipo OLABUMUYI¹

¹Department of Orthopaedic Surgery, RIPAS Hospital, Bandar Seri Begawan, Brunei Darussalam.

²Department of Orthopaedic surgery, University College London Hospital, 235 Euston Rd, London NW1 2BU, United Kingdom.

ABSTRACT

Traumatic pelvic fractures are major bony injuries associated with long-term morbidity. We analysed the outcomes of operative repair of traumatic pelvic fractures secondary to road traffic accidents in our centre over a 11-years period. Majority of cases were B1 followed by C1 AO fracture pattern. Post-operative congruity was obtained in 95.2% of cases with a mean Majeed score of 92.4% at a minimum follow-up of four years. There was no statistically significant difference between the fracture groups and duration of hospital stay. Our results indicate that operative repair of traumatic pelvic fractures is associated with excellent outcome.

Keywords: Brunei, Fracture, Majeed score, Open fracture reduction, Pelvis, Road traffic accidents

INTRODUCTION

Traumatic pelvic fractures are severe injuries, generally caused by high-energy impact trauma, most frequently from road traffic accidents. This is associated with a high prevalence of poor functional outcome and chronic pain. It has been shown that there is an increase in long-term complications from stable type A injuries to completely unstable type C injuries.¹ While assessing the prognosis of pelvic injuries, long-term results should be analysed. There are reports in literature which suggest that patient function improves over the first 18 months.² But other authors have described a plateau in functional improvement between 6 months and 1 year post injury.³

In Brunei Darussalam there is a rising incidence of road traffic accidents (RTA) casualties.⁴ But there is currently no data available on the pattern of pelvic fracture injuries and long-term operative repair outcomes. This study aimed to analyze the patients admitted with pelvic fractures following involvement in a road traffic accident, who were operated in Brunei Darussalam with emphasis on radiographic and functional outcomes, and post-operative complications.

MATERIALS AND METHODS

Patients

This was a retrospective cohort study of all traumatic pelvic fracture cases that were operated on from 2005 to 2016 at Raja Isteri Pengiran Anak Saleha (RIPAS) Hospital in Brunei Darussalam, which was carried out as part of our departmental audit into pelvic fractures management and outcomes.

Correspondence: Mr. Dipo Olabumuyi, FRCS(Ed), Department of Orthopaedic Surgery, RIPAS Hospital, Bandar Seri Begawan BA1710, Brunei Darussalam.

Telephone number: +6738670993; Fax Number: +6732424274; Email: dolabumuyi@yahoo.com

Inclusion criteria were all cases of isolated traumatic pelvic fractures operated between this period at RIPAS Hospital. Patients with traumatic pelvic fractures and other associated injuries requiring prolonged treatment and hospital stay were excluded. Cases were identified from the operating theatre registry. In total, there were 26 cases of traumatic pelvic fractures following road traffic accidents that were operated on during the study period. However eight patients had other associated injuries that required prolonged hospital stay and treatment, hence they were excluded. Thus only 18 patients were included in the final analysis. Case records, radiographs and CT films of these 18 cases were analyzed. Demographic data, duration of hospital stay, days to surgery, and days to ambulation were the data extracted from the clinical notes. Pelvic fractures were classified according to the AO system and then clinically evaluated for functional outcomes.⁵

Operative approach and repair

All Type B fractures were reduced through Pfannenstiel incision with fixation carried out using AO 3.5 mm reconstruction plates and fixed superiorly or anteriorly over the pubic symphysis as previously described.⁶

Fractures of the pubic rami, or wing of the iliac bones were fixed according to the fracture patterns. Open reduction and AO 3.5mm reconstruction plate fixation were carried out for these injuries using the "appropriate windows" of the ilioinguinal approach for the injury as dictated by the fracture pattern.⁷

Type C unstable posterior fractures through sacroiliac joint (SIJ) were treated with open reduction using the posterior window of the ilioinguinal approach to access the SIJ anteriorly, taking care to preserve the lumbosacral nerve trunk. Appropriate sized 3 or 4 holes AO reconstruction plates were used to secure the reduction. Cases of SIJ joint

disruption with moderate displacement were fixed percutaneously under image intensifier control, with AO 7.3 mm cancellous screws with washers. Parallel shorter plate (AO third tubular plate) were used to increase stability of the construct if required.⁸⁻¹⁰

Outcome measures

Patients were followed up with clinical examinations and radiographs for an average of 48 months after surgery. Post-operative radiographs were analyzed by two surgeons independently (TTA and DO) for congruency. We used the Majeed scores to assess the functional outcome.¹¹ The Majeed scores is a pelvic fracture specific functional assessment tool with a maximum of 100 points for patients working before injury or 80 points for patients not working before injury. The score items were pain (30%), return to work (20%), sitting disturbances (10%), sexual impairments (4%) and walking ability (36%). Walking ability was subdivided into use of walking aids (12%), analysis of unaided gait (12%), and the walking distance (12%). Patient who worked before injury were graded into excellent, good, fair and poor with score values of >85, 70–84, 55–69 and <55, respectively. Patients who did not work before injury were graded as excellent with a score >70, good with a score of 55–69, fair with a score of 45–54 and poor with a score <45.

Statistics

Continuous data were presented as mean and range, while nominal data were presented as percentage. Descriptive statistical analysis was carried out among the variables. We also used one-way analysis of variance (ANOVA) to explore for differences among the different types of fractures. A p value of <0.05 was proof of statistical significance.

RESULTS

The follow-up period ranges from 2 to 13 years. The mean age of the group was 34

Table 1: Fracture patterns and Inpatient statistics.

Fracture Pattern with numbers	Days to surgery	Days to ambulation	Total inpatient days	
B1: 7	8	19	26	
B2: 1	18	54	62	
C1: 5	14	21	25	
C2: 2	10	24	29	
C3: 3	18	23	41	
	SS	df	MS	p
Days to surgery between B and C patterns	86.0444	1	86.0444	F = 4.29685 p = 0.054695
Total inpatient days between B and C patterns	78.1723	1	78.1723	F = 1.478

years (Age range 20 to 55 years). Majority of the patients were male (83.3%) with a male to female ratio of 5:1. Majority were Malays (88.9%) with one Chinese and one foreign Philippine national. Based on the AO system of pelvic fracture classification, there were 7 cases of B1 injuries, 1 case of B2 fracture, 5 cases of C1 Fractures, 3 cases of C3 fractures and 2 cases of C2 fractures (Table 1). There were no cases of type A pelvic fractures in our series.

Operative management

All 8 cases of type B fractures were reduced and fixed using two AO 3.5 mm reconstruction plates, one fixed superiorly and the second fixed anteriorly over the pubic symphysis. Six cases of type C unstable fractures, posterior fractures through sacroiliac joint (SIJ) were fixed via open reduction using appropriate sized 3 or 4 holes AO reconstruction plates to secure the reduction. Two cases of SIJ joint disruption with moderate displacement were fixed percutaneously under image intensifier control, with AO 7.3 mm cancellous screws with washers. Two cases of type C pelvic injuries with associated U-shaped fracture of the sacrum had both anterior pelvic ring fixations as stated above, followed by posterior injury fixation through a midline incision from L4 to rima ani. The deep preparation elevates both erector spinae from lumbar spine, sacrum, and iliac crests on both sides. Laminectomy and nerve roots decom-

pression were done for trapped nerve roots. With adequate reduction of fracture fragments, tension band plating of the posterior sacrum and iliac crest using long contoured AO 3.5 mm straight reconstruction plate spanning the posterior sacrum and both iliac crests were carried out. A second parallel shorter plate (AO third tubular plate) was needed to increase the stability of the construct at S3 level in one case.

Fracture types and length of hospital stay

In our series it was observed that B2 fracture patients had prolonged in-hospital stay ranging from 26 to 62 days, and most days to ambulation ranging from 19 to 54 days (Table 1). This was followed by the C3 pattern of injury with overall in-hospital stay ranging from 25 to 41 days and days to ambulation ranging from 21 to 24 days. However there was no statistically significant difference between the various fracture patterns (AO Type B versus AO Type C fractures) in the total length of hospital stay (Table 1).

Post-operative radiograph congruency, functional outcome and complications

The mean follow-up was 48 months. Figure 1 showed the post-operative radiograph congruency with good reduction achieved in 95.2% of the cases. The overall the Majeed score achieved was 92.4%, indicating excellent post-operative functional outcome for all patients. When this was broken down into the sub-

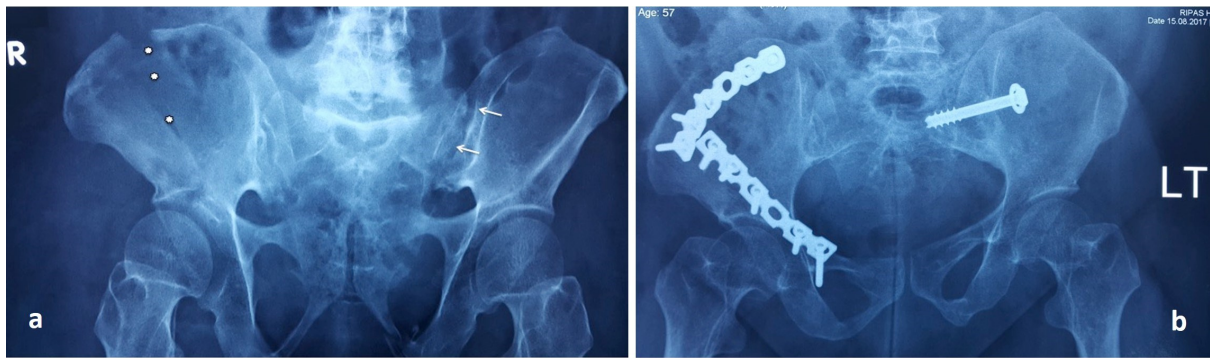


Figure 1: Fracture pelvis pre and post op radiographs demonstrating congruent reduction.

groups of fractures, Type B attained a score of 97% and Type C, 92%. There was only one post-operative complication of loosening of the SIJ plate.

DISCUSSION

Traumatic pelvic fractures with disruption of the pelvic ring are commonly caused by high impact energy commonly encountered in RTAs.¹² All 18 cases in our series were the result of RTAs. The incidence of pelvic fractures in trauma patients involved in RTAs has been reported to vary between 3% to 8% with instability of the pelvic ring seen in 13% to 17% of cases.¹³ Because of the high impact energy involved, other associated injuries to the head, chest and abdomen are often present and about 14.2% of these patients with haemodynamic instability and pelvic fractures will succumb to their injuries.¹²

There are growing evidences that operative repair with external fixation devices will stabilise and tamponade open pelvic fractures and hence reduce venous and bony bleeding. However, external frame does not permit early mobilisation without causing displacement of the fragments, especially those with vertical instability (Figure 1a). External fixators can be used in emergency situation to stabilise patients in the acute phase with formal open reduction and plate fixation carried out about 5-7 days post trauma when the patient general status allowed.

The classification of type B injuries includes anterior posterior compression injuries ("open book" injuries: B1, B3) and lateral compression injuries (B2). The latter seem to be less unstable and therefore potentially have a better long-term result with fewer patients complaining of pain.^{1,14} Mardanpour et al in an analysis of 27 patients with type B injuries, reported an overall Majeed score of 81%, indicating good and excellent functional results of all cases treated with open reduction and internal fixation.¹³ But only 48% of these patients were completely pain-free at follow-up. After B1 injuries, the overall functional result was graded excellent and good in 70–90%, when symphyseal plating was performed.¹⁵ Thus the results of our small series is comparable to the larger series published internationally.

In Type C unstable fractures, the outcome of operative fixation is less satisfactory, although approximately an excellent or good overall functional result can still be expected in 70–80% of cases.¹⁵ In terms of chronic symptoms, 30–50% of these patients may still complain of significant persistent pain and have sexual or urogenital disturbances.

The commonest injuries requiring fixation in our series were Types B1 and C3. It has been previously shown that a residual displacement of >5mm at the posterior pelvis is associated with poor clinical outcomes^{16,17}. Therefore, it is very useful to evaluate the

posterior pelvic ring at follow up by both conventional x-rays and CT scans. In our limited series, we were able to attain congruent reduction in 95.2% of the cases. Overall, our patients were able to achieve a Majeed score 92.4% in long-term functional outcome assessment.

Our results also indicate that among the fracture patterns, those with B2 and C3 fractures spent more days before mobilization and therefore more days in the hospital, but there was no statistically significant difference among the various fracture patterns.

Study limitations

There are several limitations in this study and the obvious ones are both retrospective design of the study and the small sample size of the cohort. Like most retrospective studies, searching and retrieving data poses a major challenge, in particular with missing data. However, in design of the study, we only aimed at collecting data field which were mostly recorded in the notes such as age, gender, length of stay, time to surgery, operative details etc. Furthermore, from 2013 onwards, with the introduction of Bru-HIMs national patients electronic medical record database, retrieving data was a lot easier. With regards to the small sample size, Brunei Darussalam is a small country of about 400,000 population. Hence this is likely to impact on the number of cases we see although RIPAS Hospital is the main tertiary referral centre of trauma and all cases would have been captured in our records and database.

CONCLUSION

The majority of pelvic fractures seen in our series following RTA were type B and C fractures. Open surgical reduction and fixation with plates and screws of type B and C pelvic fractures were associated with excellent functional outcome as indicated by an overall Majeed score of more than 92%, which is

comparable to those reported in current literature. However these type of pelvic fracture injuries and their operative management are associated with prolonged in-hospital stay and delayed mobilization.

DISCLOSURE

All authors have contributed to the manuscript equally. None of the authors have direct or financial conflicts of interest.

REFERENCES:

- 1: Pohlemann T, Gänsslen A, Schellwald O, Culemann U, Tscherner H. Outcome after pelvic ring injuries. *Injury.* 1996; 27:31-38.
- 2: Majeed SA. External fixation of the injured pelvis – the functional outcome. *J. Bone Jt Surg.* 1990; 72(4):612-614.
- 3: Kreder H. Fractures of the pelvis and acetabulum. In: Tile M, Helfet DL, Kellam JF, editors. *Outcomes after pelvic ring injuries in adults.* 3rd ed. Philadelphia: Lippincott; 2003:409-416.
- 4: Azian Othman. Rise in road deaths. *Borneo Bulletin.* March 23, 2018. [Accessed on 15 May 2018]. Available at <https://borneobulletin.com.bn/rise-in-road-deaths/>
- 5: Müller E. Editor. *Comprehensive Classification of Pelvis and Acetabulum Fractures.* Bern: Switzerland, Maurice E. Müller Foundation; 1995.
- 6: Van Loon P, Kuhn S, Hofmann A, Hessman MH, Rommens PM. Radiological analysis, operative management and functional outcome of open book pelvic lesions: A 13-year cohort study. *Injury.* 2011; 42(10):1012-1019.
- 7: Leung KS, Chien P, Shen WY, So WS. Operative treatment of unstable pelvic fractures. *Injury.* 1992; 23(1):31-37.
- 8: Hunt N, Jennings A, Smith M. Current management of U-shaped sacral fractures or spinopelvic dissociation. *Injury.* 2002; 33(2):123-126.
- 9: Schroeder GD, Savage JW, Patel AA, Stover MD. Spinopelvic Fixation in complex sacral fractures. *JBJS Rev.* 2015;24:3(3). pii: 01874474-201503030-00005. doi: 10.2106/JBJS.RVW.N.00007.
- 10: Tile M, Helfet DL, Kellam, JF, Vrahas M. *Fractures of the Pelvis and Acetabulum—Principles and Methods of Management.* 4th ed. Davos: AO Foundation; New York Stuttgart: Thieme; 2015:vol2.

- 11: Majeed SA. Grading the outcome of pelvic fracture. *J Bone Joint Surg Br.* 1989; 71(2):304-306.
 - 12: Giannoudis PV, Grotz MRW, Tzioupis C, Dinopoulos H, Wells GE, Bouamra O, Lecky F. Prevalence of pelvic fractures, associated injuries, and Mortality: The United Kingdom Perspective. *J Trauma.* 2007;63:875-883. [Accessed on 15 May 2018]. Pdf available at [http://www.ubccriticalcaremedicine.ca/academic/jc_article/Pelvic%20Fracture%20\(May-21-09\).pdf](http://www.ubccriticalcaremedicine.ca/academic/jc_article/Pelvic%20Fracture%20(May-21-09).pdf)
 - 13: Mardanpour K, Rahbar M. The outcome of surgically treated traumatic unstable pelvic ring fractures by open reduction and internal fixation. *J Inj Violence Res.* 2013; 5(2):77-83. [Accessed on 15 May 2018]. Pdf available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3683417/pdf/jivr-05-77.pdf>
 - 14: Lindahl J, Hirvensalo E, Bostman O, Santavirta S. Failure of reduction with an external fixator in the management of injuries of the pelvic ring. Long-term evaluation of 110 patients. *J Bone Joint Surg Br.* 1999; 81(6):955-962.
 - 15: Gänsslen A, Lindahl J. Evaluation tools and outcomes after osteosynthesis of unstable type B and C Pelvic ring Injuries. *Acta Chir Orthop Traumatol Cech.* 2013; 80(5):305-320.
 - 16: Dujardin FH, Hossenbaccus M, Duparc F, Biga N, Thomine JM. Long-term functional prognosis of posterior injuries in high-energy pelvic disruption. *J Orthop Trauma.* 1998; 12(3):145-150; discussion 150-151.
 - 17: Copeland C, Bosse M, McCarthy M, Mackenzie E, Guzinski G, et.al. Effect of trauma and pelvic fracture on female genitourinary, sexual and reproductive function. *J. Orthop. Trauma.* 1997; 11(2):73-81.
-