



Modified Stoppa Approach versus Ilioinguinal Approach for Anterior Acetabular Fractures; A Systematic Review and Meta-Analysis

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▶ ABSTRACT

Introduction: Modified Stoppa approach was introduced as an alternative to ilioinguinal approach for management of anterior fractures of acetabulum in order to reduce complications of the latter. However, the efficacy of either approach over other is not well established. The aim of this meta-analysis is to compare the efficacy of modified stoppa and ilioinguinal approach in the management of acetabular fractures in terms of a) quality of reduction achieved b) complication rates c) functional outcomes d) operative time e) intra-operative blood loss.

Methods: Databases of PubMed, EMBASE and Cochrane registry of controlled trials were taken into consideration for studies on modified Stoppa approach versus Ilioinguinal approach group for the treatment of anterior acetabular fractures. Dichotomous variables were presented as risk ratios (RRs) /Odds Ratio (OR) with 95% confidence intervals (CIs), and continuous data was measured as mean differences, with 95% CIs.

Result: Four studies involving 375 patients were included in this meta-analysis. Out of those 375 patients, 192 were managed with ilioinguinal approach and 183 were managed with modified Stoppa approach. Anatomical reduction was significantly higher in Stoppa group ($p=0.052$, RR=1.19 (1.02, 1.37), $p=0.90$, I²=0%). The complication rate was significantly higher in the Ilioinguinal approach as compared with the Stoppa approach ($p=0.01$, RR 0.63 (0.44 to 0.91), $p=0.73$ (I²=0%). The operative time was significantly shorter with modified Stoppa approach (MD 48.79 (-80.29 to -17.30), $p=0.002$). No significant differences were found between the two groups in terms of their functional outcomes ($p=0.63$, RR 0.96 (-0.80 to 1.15), $p=0.56$, I²=0%) and blood loss (MD=-212.89 (-476.27 to 50.49) $p=0.06$, I²=71%).

Conclusion: Anterior acetabular fractures, if operated with the modified Stoppa approach were found to have better reduction and lower complication rates with less operative time, when compared to ilioinguinal approach. No significant difference in terms of blood loss was found in both the groups. Further higher quality randomized controlled trials are needed to verify our results.

Keywords: Acetabular fractures; Modified stoppa approach; Ilioinguinal approach; Quality of reduction; Functional outcomes; Intraoperative blood loss.

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Introduction

Acetabular fractures are one of the most difficult fractures to manage in orthopaedic surgery. Anatomic reduction of these fracture is necessary to get the optimal result. The ability to get reduction is highly dependent on the ability of surgeon to get good exposure of the surgical field, which in turn is affected by the chosen surgical approach. A good approach is not only just invaluable for obtaining good exposure but also allows anatomical reduction of fracture with a good control over the fracture fragments. It should also cause least possible amount of complications while trying to achieve the same. The ilioinguinal approach has been widely used for internal fixation of fractures of the pelvic ring and acetabulum [1, 2]. Multiple studies have proven its efficacy in approaching anterior acetabular fractures (anterior column fractures, anterior wall fractures, anterior column with posterior hemitransverse fractures, most fractures of both columns, partial transverse fractures, and T-type fractures) [3-5]. However, it is a laborious exposure with an inherent danger to the neurovascular structures (external iliac vessels and femoral nerve) due to their proximity to the surgical plane during the approach [6, 7]. In 1993, Hirvensalo, and later Cole described an extra peritoneal (“Stoppa”) approach through the rectus abdominis muscle as an alternative approach for internal fixation of fractures of the pelvic ring or acetabulum [8, 9]. This technique uses a single window to obtain an intra-pelvic overview of the operative field by maintaining the entire peritoneal sac and its contents, away from the fracture site with some added risk of vascular bleed from the corona mortis or the obturator vessels. However, there is lack of consensus in terms of better overall technique for tackling such fractures. Hence, this meta-analysis aims to compare modified Stoppa and ilioinguinal approach in the management of anterior acetabular fractures with respect to:

1. Quality of reduction obtained.
2. Complication rates.
3. Functional outcomes.
4. Operative time.
5. Intraoperative blood loss.

Materials and Methods

This meta-analysis was conducted according to the guidelines of the preferred reporting items for systematic reviews and meta-analysis (PRISMA) and also the Cochrane handbook for systematic reviews of Interventions [10].

Literature Search Strategy

Cochrane Register of Controlled trials (The Cochrane library), PubMed (1946 to October 2015), and EMBASE (1980 to October 2015) databases were taken up for study. No language or publication

restrictions were applied. Articles in languages other than English were translated with the help of medically knowledgeable speakers. The following keywords were used for the searches: Acetabular fracture or acetabulum fracture, Ilioinguinal and Stoppa approaches. Reference lists of the published studies were checked to identify additional trials.

Eligibility Criteria

The literature was systematically reviewed according to the following criteria: (1) Target population of acetabular fracture requiring internal fixation. (2) Studies comparing the outcomes of modified stoppa approach with ilioinguinal approach and (3) One or more outcomes of interest.

Data Extraction

Study details using standardized extraction forms were independently extracted by the authors. Reviewers were not blinded to authors, journal, or any source of financial support. Disagreement was resolved by consensus or by the senior author. The primary outcome of interest was reduction quality. Secondary outcomes included in study were functional quality, complications rate, operative time and blood loss.

Assessment of Methodological Quality

The quality of included studies was assessed by Jadad scale [11]. Studies with 0-2 points were kept into low quality documents, and those with 3-5 points were considered high quality documents.

Assessment of Heterogeneity

Inconsistency between studies was formally tested with a standard x-square test. The I square (I^2 estimate) examined the percentage of total variation across studies resulting from heterogeneity rather than chance. Significance was set at 0.1 for the Q test. When using I square test, heterogeneity was interpreted as absent (I^2 : 0–25%), low (I^2 : 25.1%–50%), moderate (I^2 : 50.1%–75%), or high (I^2 : 75.1%–100%). All statistical analysis was performed by review manager 5.3 software. The Cochrane collaboration was used for graphic representation of the pooled data. Dichotomous variables were presented as risk ratios (RRs) with 95% confidence intervals (CIs), and continuous data were measured as mean differences, with 95% CIs.

Results

The study flow diagram is illustrated in Figure 1. Four studies involving 375 patients were included in the meta-analysis, with individual sample size ranging from 36 to 225 patients [12-15]. The literature screening process is listed in Figure 1. Of these 321 patients, 171 were managed with ilioinguinal approach and 150 were managed with Modified Stoppa approach. Table 1 summarizes the characteristics of the included studies. By using

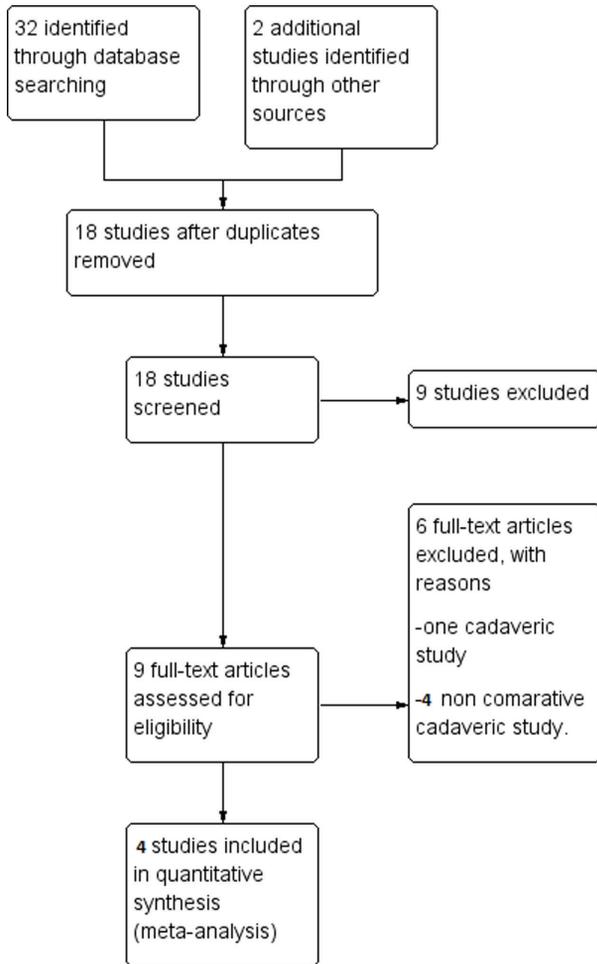


Fig. 1. Showing the literature screening process.

Jadad scale quality assessment was done. Among four studies, one study was of higher quality and rest of three were of lower quality.

Reduction Quality

Three studies reported reduction quality

according to Matta’s criteria. Fractures achieving anatomical reduction were significantly higher in Stoppa group ($p=0.02$, RR=1.19 (1.02, 1.37); heterogeneity $X^2= 0.90$, $p=0.02$, $I^2=0\%$) (Figure 2, Showing reduction quality significantly higher in Stoppa group).

Functional Outcome

Three included studies reported on the comparable clinical outcomes. No significant differences were found between these two groups; RR 0.96 (0.80 to 1.15) ($p=0.83$, $I^2=0\%$) (Figure 3, showing no significant differences in functional outcome between two groups).

Complication Rate

All four studies provided details of the incidence of complications. The complication rate was significantly higher in the ilioinguinal approach compared with the Stoppa approach ($p=0.01$, RR 0.63 {0.44 to 0.91}) (Figure 4, Showing complication rate significantly higher in the ilioinguinal approach).

Operative Time

Three studies provided details of operative time. The operative time was significantly shorter with modified Stoppa approach (MD=-48.79 (-80.29 to -17.30), $p=0.002$). However the result should be interpreted with caution because of significant heterogeneity between the studies $p=0.0003$, $I^2=87\%$) (Figure 5, Showing operative time shorter with modified Stoppa approach).

Blood Loss

Only two studies provided details of blood loss. There was no significant difference between the two approaches in terms of blood loss (MD=-212.89 (-476.27 to 50.49) $p=0.06$, $I^2=71\%$).

Table 1. Characteristics of the included studies

Study	Study type	Mean age		Sample		Follow up (months)	Jaddad score
		Stoppa	Ilioinguinal	Stoppa	Ilioinguinal		
Ma et al. [15]	RCT	41 (33-65)	42 (31-62)	30	30	34	4
Elmadag et al.,[13]	Case control study	49.3	52.1	17	19	33	1
Hammad et al.,[12]	Retrospective chart review	32.14 (±13.53)	32.12 (±11.29)	21	33	12	1
Shazar et al.,[14]	Retrospective study	41.88 (±15.7)	41.4 (±15.4)	103	122	24	1

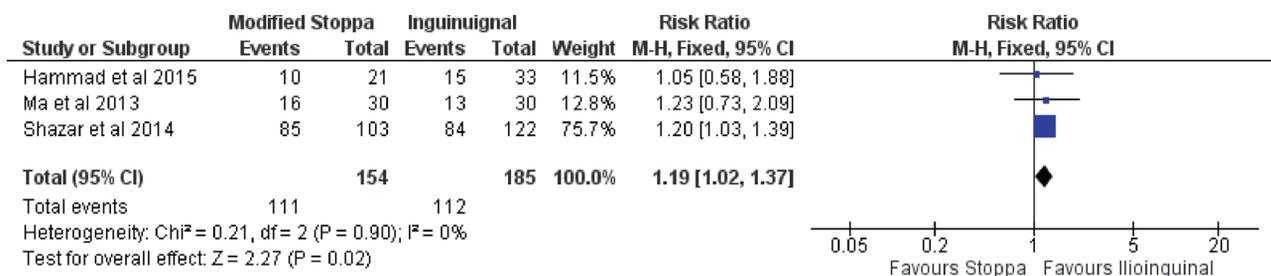


Fig 2. Showing reduction quality significantly higher in Stoppa group

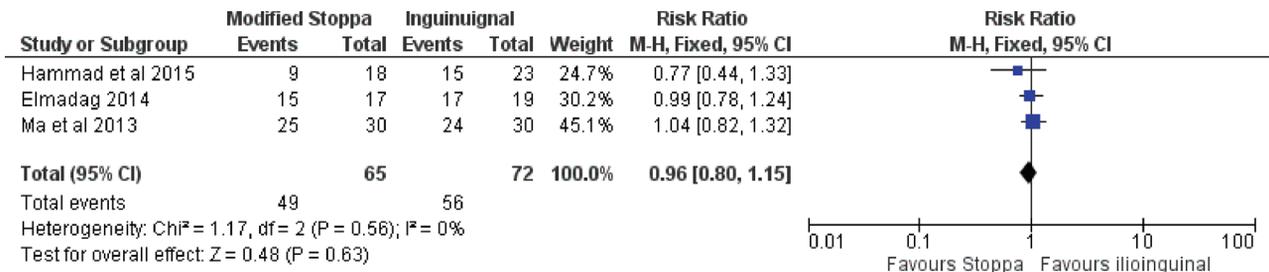


Fig 3. Showing no significant differences functional outcome between two groups.

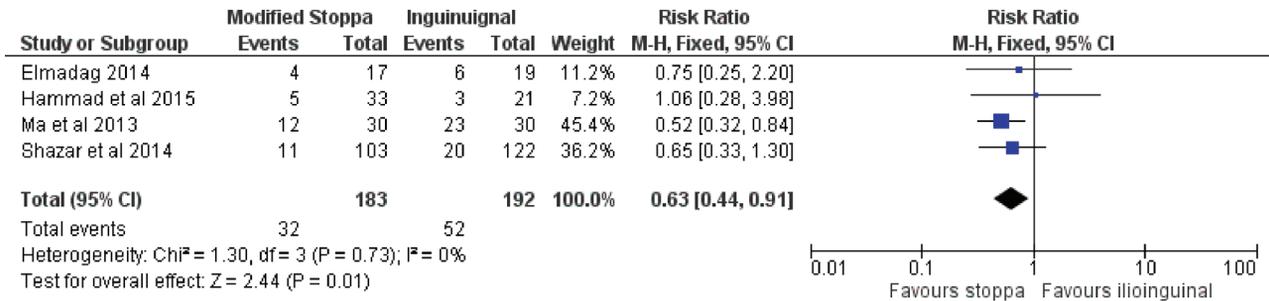


Fig 4. Showing complication rate significantly higher in the ilioinguinal approach.

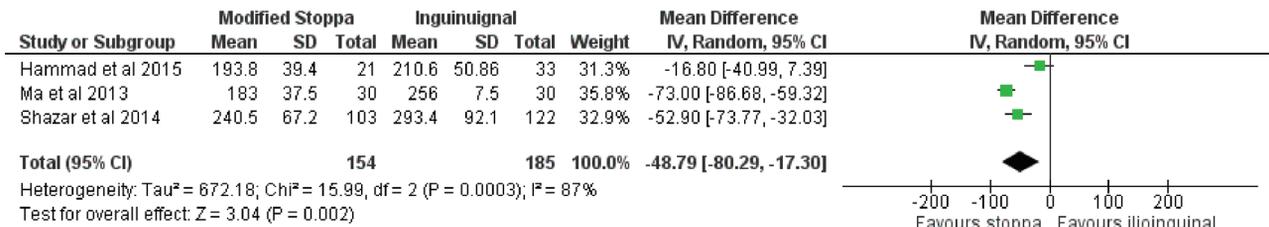


Fig 5. Showing operative time shorter with modified Stoppa approach.

Discussion

Ilioinguinal approach has remained the workhorse approach for fixation of anterior acetabular fractures (anterior column fractures, anterior wall fractures, anterior column with posterior hemitransverse fractures, most fractures of both columns, partial transverse fractures, and T-type fractures) since its description. However, it is time consuming, laborious and likely to cause blood loss in addition to posing inherent danger to external iliac vessels and femoral nerve. The combined view through the three windows in this approach permits only a limited view and assessment of the fracture thus often indirect reduction manoeuvres are required. In 1989 Stoppa described a midline approach to repair inguinal hernias using Dacron mesh. He achieved excellent exposure of the true pelvis with this approach [16]. This created an interest in using this approach for acetabular fracture fixation. Surgical incision landmarks and surgical steps of modified stoppa approaches are described in Figures 6 (Showing incision landmarks for Modified Stoppa approach) and 7 (Showing surgical exposure for modified Stoppa approach.). Recent studies have reported relatively less blood loss and less operative time with Stoppa approach [17]. This meta-analysis shows that the rates of achieving anatomical



Fig. 6. Showing incision landmarks for Modified Stoppa approach.

Modified Stoppa approach;- transverse incision over 1 inch above the symphysis pubis and for the lateral window, an incision over the iliac crest, starting 1 inch posterior to the ASIS, along the iliac crest posteriorly.

reduction by modified Stoppa approach are higher than those achieved by the ilioinguinal approach. The modified Stoppa approach allows adequate reduction of the articular fragment impacted into the weight bearing dome area. It is also suitable for cancellous bone grafting, addition of bone substitute material, fixation of the fractures without lateral

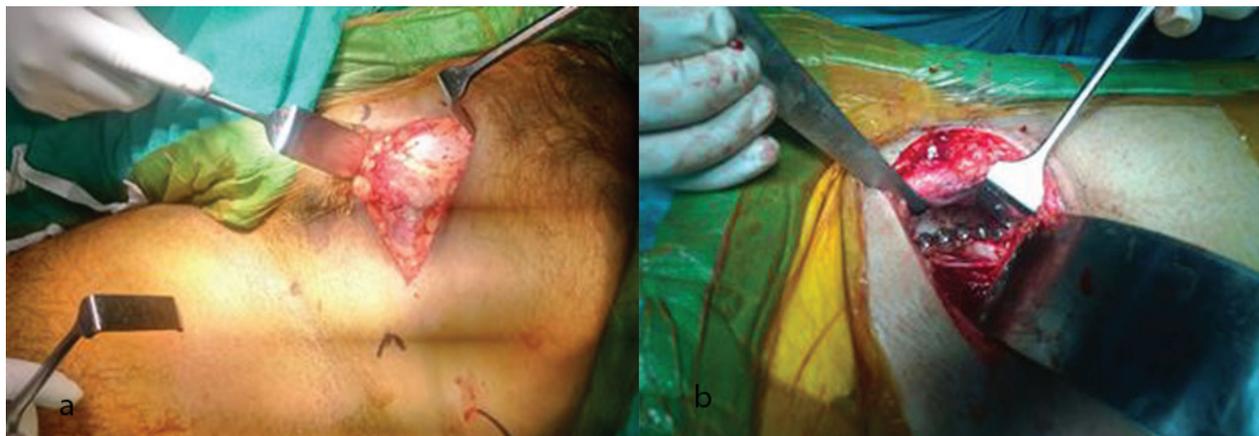


Fig. 7. Showing surgical exposure for modified Stoppa approach.

- a) Superficial exposure: Subcutaneous tissues, rectus fascia, rectus abdominus muscle and transversalis fascia are incised or split over the symphysis pubis for superficial exposure.
 b) Deep exposure: The insertion of the rectus abdominus muscle, the iliopectineal fascia and the iliopsoas muscle released and elevated for adequate exposure of true pelvic brim.

extra pelvic exposures and without dislocating the joint. Many authors have reported large series of patients operated by the modified Stoppa approach. Hirvensalo *et al.* used modified Stoppa approach in 164 cases of pelvic and acetabular surgery, of which 138 (84.1%) had anatomic reduction, 9% were graded as fair and 7% were graded as poor. They found that 80% of patients achieved a Harris hip score of 75 or greater on clinical examination and functional outcome scoring [18]. Sagi *et al.* described 50 cases, of which 92% had an excellent or good reduction of acetabular fractures. However, the use of lateral window was required in 60% of their cases to achieve reduction of high anterior column fracture and place fixation or insertion of posterior column lag screws, while Anderson *et al.* reported an 82% anatomic reduction rate [19, 20]. However, the inclusion criteria vary among different studies. Shazar *et al.*, [14] reported that main and statistically significant difference in the achieved reduction rates was in the both-column fracture type for which anatomic reductions were achieved in 54.2% of the patients in the ilioinguinal group and 79.4% of the patients in the modified Stoppa group. They believed that a major benefit in the modified Stoppa approach resulted from the enhanced ability to reduce and fix the posterior column component of the fracture, and the quadrilateral plate component. The ability to add a posterior column buttress plate, underneath the pelvic brim, assists the anatomic reduction of the posterior column and quadrilateral plate obviating medial displacement. The Kocher-Langenbeck approach was added only when the posterior wall component needed to be addressed. The single midline approach allows access to the entire pelvic ring, so that both sided fractures can be approached through a single incision. The anatomic reduction and proper stabilization of fractures allow early beginning of mobilization, rehabilitation and effective functional recovery

of the patients. In their series of 41 cases with at least one year follow up, wherein 23 patients were operated using ilioinguinal approach and 18 patients were operated using Stoppa approach, Hammad *et al.* suggested the advantage of Stoppa approach over and above the ilioinguinal approach for obtaining reduction in both column fractures where a direct buttressing of the quadrilateral plate was required [12]. On the other hand, the ilioinguinal approach, which probably has an upper hand in obtaining reduction in anterior wall fractures with a more transverse fracture line through use of its middle window [12]. Shazar *et al.*, [14] observed absence of a learning curve effect with Stoppa approach as compared to ilioinguinal approach when performed by experienced surgeons. They attributed this to the fact that Stoppa approach is less extensive in a way that it does not require an incision into the inguinal canal. In our analysis, modified stoppa approach is associated with a significantly lower complication rate. Complications such as hernia, thrombosis, neurovascular injuries and hematoma are seen at the rate of approximately 10% in the Ilioinguinal approach. The lymphatic veins with the neurovascular band and the preparation of the funicular structures add an extra risk resulting increased intraoperative time is needed. This may also lead to consequent scar formation or fibrosis on important structures. Most complications of the Ilioinguinal approach are particularly related to the soft tissues of the middle window, while in the newer approach dissection of tissues in this window is avoided, thus potentially minimizing risks of iatrogenic injury to the inguinal canal, femoral nerve and external Iliac vessels. As compared to the classical Ilioinguinal approach, this approach decreases the risk of scar tissue formation and heterotrophic ossification.

Operative time may have an effect on the general condition of the patients as well as on the incidence of complications. Using a less traumatic

surgical approach with minimal operative time in the reduction and stabilization of pelvic ring and acetabular fractures is very significant in the management of severely polytraumatised patients. The modified Stoppa approach has a significantly lower operating time. This approach, when executed correctly provides clear acetabular access, including access to the pubic body, superior ramus and pubic root, the Ilium above and below the pectineal line, the quadrilateral plate, and the medial aspect of the posterior column, sciatic buttress and anterior sacroiliac joint. This approach can also be used in the surgical treatment of both pelvic ring and acetabular fractures, which is important in management of polytrauma patients following high energy trauma.

The limitations of the modified Stoppa approach are that there may be difficulties in reduction and internal fixation of posterior column fractures while impossibility of visualization of the femoral head, labrum, and articular surface of the acetabulum resulting inadequate debridement of the joint. To approach posterior column fractures, Vikmanis *et al.*, [21] used to perform further dissection to the quadrilateral surface; the obturator neurovascular bundle was identified and protected with a retractor. They used individual canalized screws or additional plates for fixation and support of quadrilateral plate. Disadvantages of this approach are risk of peritoneal injury, corona mortis injury and possibility of a postoperative hernia along with adductor weakness. There are several limitations of this meta-analysis study. First, the number of studies included in this

analysis is very small and it includes only a single randomised controlled trial. Also, the majority of these studies are of low quality and involve only a small number of patients. Therefore, it is difficult to conclude convincingly from this study about direct comparison between these two different approaches for managing anterior acetabular fractures.

Conclusion

Acetabular fractures mostly anterior, operated with the modified Stoppa approach achieve better anatomic reduction and low complication rate as compared to ilioinguinal approach. There is no significant difference in intra-operative blood loss between the two groups. Further high quality randomized controlled trials are needed to verify the results.

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Conflict of Interest: None declared.

Compliance with ethical statements: Ethical committee clearance is not applicable for this manuscript.

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