ADVANTAGES OF MODIFIED STOPPA APPROACH VERSUS ILIOINGUINAL APPROACH IN TREATING ACETABULAR INJURY

BY

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A dissertation submitted in fulfillment of the requirement for the degree of Master of Orthopaedic Surgery

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ABSTRACT

This is a comparative cross-sectional study. Study population will be all patient treated surgically via anterior approach in Hospital Tuanku Jaafar Seremban from January 2014 till June 2017. Total of 52 subjects with 26 in each arm; the modified stoppa approach and the ilioinguinal approach. The surgery was done by either one of the two certified pelvic surgeons. All patients had radiograph of AP, Inlet, Outlet and Judet view of the pelvis. A CT with 3D reconstruction was also obtained for each patient. The outcome observed are the duration of surgery and the estimated blood loss intra-operatively. Total of 52 patients with majority of age group of 21-30 years old and male predominance. Most common type of fracture sustained is Associated type with 55.8%. There was significant reduction in the estimated blood loss in Modified stoppa approach. Also, significant reduction in Estimated Blood Loss and Duration of surgery in modified stoppa approach for Associated type of injury.

APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Master of Orthopaedic Surgery

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DECLARATION

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LIST OF ABBREVIATIONS

AAOS	American Academy of Orthopaedic Surgeons
AAST	American Association of Surgery and Trauma
CBC	Complete Blood Count
CT	Computed Tomography
EBL	Estimated Blood Loss
MIN	Duration of surgery in minutes
SSSL	Safe Surgery Saves Lives

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Acetabular fracture is currently one of the most challenging injuries to operate on. This is due to the complexity of the fracture itself and the location of the acetabulum in the pelvic cavity with its surrounding structures. Currently, the management of this injury has become a subspecialty in the orthopaedic fraternity, it's technically demanding and require specialized units. A comprehensive knowledge and high amount of skill is required to manage it. Currently the main mechanism of injury is by motor vehicle accident. Occasionally in the elderly, acetabular injury by low energy trauma can be seen.

In earlier days, acetabular injury is often not treated surgically. Conservative treatment is the main management. Thus, this will lead to morbidity towards the patient and poor outcome. Thomson et al 1951 reported that outcome of minor posterior fracture or a single large posterior fracture which is reduce by closed method did well (Letournel & Judet, 1964). But more complex injuries or those with unstable fracture after a closed manual reduction did less well. They noted that if instability or incongruity of the joint can be avoided with open reduction, the outcome will be better in term of incidence of arthritis. It is also noted that the overall outcome depends on the fracture pattern and early diagnosis. Steward in 1954 also discussed 128 cases, in which 33 of them receive surgical treatment and they concluded that in the absence of instability, immobilization of the fracture is not needed (Alton & Gee, 2014). Rowe in 1961 had published a case series of 93 case fracture of acetabulum, in which 23 cases showed that if there is anatomical reduction and congruence of the weight bearing dome is achieved, the outcome will be better (Korovessis, Stamatakis, Sidiropoulos, Baikousis, & Piperos, 2000).

Judet and Letournel in 1964 described in their paper regarding the now widely used classification of acetabular fracture. In the same paper, they recommended anatomical reduction with internal fixation for any displaced acetabular injury. Since then, acetabular surgery had become more common and hence, more studies had shown good and excellent result from acetabular surgery. As a result from this, open reduction and internal fixation currently is the standard for any displaced acetabular fracture (Letournel & Judet, 1964).

To have a good outcome in reduction, the choice of approach will play a major role. The approach selected should be sufficient enough to provide a good view of the injured site and can be manipulated easily and provide a good control to achieve anatomical reduction. Letournel had introduced the classical ilioinguinal approach in 1961 (Letournel & Judet, 1964). It had been used to treat elementary and associated type of acetabular injury and it is well proven in many literatures. Stoppa introduces the intra-abdominal approach for groin hernia repairs in 1984 (Stoppa et al., 1984). This later was modified by Cole and Bolhofner in 1994 and named it as anterior intrapelvic approach or modified stoppa approach (Cole & Bolhofner, 1994).

Kunlong, 2013 had compared the ilioinguinal approach and modified stoppa approach; they noted that the modified stoppa approach shows reduced intraoperative blood loss and shorter operative time compared to ilioinguinal approach. There are no significant differences in intraoperative complication rate, quality of reduction, radiological result and clinical outcomes in these two groups based on a randomized control trial involving 60 patients. Shazar, 2014 had compared 215 patients that underwent anterior approach for acetabular surgery and noted that modified stoppa is a safe alternative for ilioinguinal approach and offers a better exposure and improved reduction quality and no difference in intraoperative complication. Elmadag 2014 had compared 36 patients between the two groups. He noted that both surgical approaches give successful result in reduction of the fracture but there is no significant difference in blood loss of the two groups. He also noted that although the modified stoppa approach is non-invasive technique, the amount of blood loss is the same for both groups. Hammad, 2015, 55 patients noted that the mean operative time for modified stoppa approach was longer compared to the ilioinguinal approach, but it is statistically insignificant (Elmadağ, Güzel, Acar, Uzer, & Arazi, 2014; Hammad & El-Khadrawe, 2015; Ma et al., 2013; Shazar et al., 2014)

1.2 OBJECTIVES

1.2.1 General Objective

To compare the clinical outcome of modified stoppa approach and ilioinguinal approach in treating acetabular injury via anterior approach in acetabular surgery.

1.2.2 Specific Objectives

1. To determine the duration of surgery taken for each approach.
2. To determine the amount of intraoperative blood loss in each approach

1.2.3 Hypothesis

The modified stoppa approach in treating acetabular injury will lead to less intraoperative blood loss and will shorten the duration of surgery.

CHAPTER TWO

LITERATURE REVIEW

2.1 ANATOMY

The hip joint is the articulation between the pelvis and the femur. It is a ball and socket type of synovial joint. It is the point where the axial skeleton connects with the lower extremity. The pelvic bone is formed by the joining of 3 bones, ilium, pubis and ischium (Shivji, Quah, & Forward, 2015). During childhood, the point of joining of the bone forms a cartilage, the triradiate cartilage (Ponseti, 1978).

The acetabulum is formed by two columns, the anterior column and posterior column (Letournel & Judet, 1964). These two columns had been described as forming an inverted Y when viewed laterally. The anterior column is larger but thinner compared to the posterior column. The posterior column involves the thick sciatic notch.

The anterior column comprises the anterior border of the iliac wing, pelvic brim, the anterior wall of the acetabulum, and the superior pubic rami. The posterior column consists of the ischial part of pelvic, including the greater sciatic and lesser sciatic notches, the posterior wall of the acetabulum, the majority part of the quadrilateral area, and the ischial tuberosity. The roof of the acetabulum is the thick, weight bearing portion of the acetabulum. It forms a separate fragment in bicolumnar fractures. The medial wall or the floor of the acetabulum is formed by the thin quadrilateral plate. The pelvic bone is irregular in shape and has differing thickness in cross-section in different areas.

There is a lot of vital structures surrounding the acetabulum since it is located deep in the pelvic region. Therefore, a clear knowledge of the surrounding structure is important during any acetabular surgery.

Anteriorly, it is bounded by the inguinal canal; there are the femoral vessels and femoral nerve with the tendon of ilio-psoas underneath it. At the lateral part of the inguinal ligament, there is the lateral femoral cutaneous nerve of the thigh (Rudin, Manestar, Ullrich, Erhardt, & Grob, 2016). This nerve is in danger during the ilioinguinal approach of the acetabular surgery (Rickman & Bircher, 2008). The exact location of the nerve is variable, this making it difficult to be detected and often can be injured.

At the lateral side, the acetabulum is surrounded by the gluteus muscle which extends to the posterior part. The gluteus muscle covers the superior gluteal nerve and vessels. The sciatic nerve emerges from the sciatic notch and descends posterior to the hip joint. It is commonly injured in posterior wall fracture.

Medially, there are the obturator vessels and nerve which crosses the obturator foramen (J. W. Kim, Shon, & Park, 2017). At the medial side also, there is an anatomical variance of an anastomosis between the obturator and external iliac or inferior epigastric vessel. The name given for this anastomosis is corona mortis which means crown of death (Darmanis, Lewis, Mansoor, & Bircher, 2007; Teague, 1997). This is important for the surgeon doing the modified stoppa approach due to its high incidence of variance and injury to the vessels can cause massive haemorrhage (Rocca, Spina, & Mazzi, 2014).

The acetabulum receives its blood supply from a few arteries, namely the superior gluteal artery, inferior gluteal artery and obturator artery. The obturator artery gives the acetabular branch which supply the pelvic surface, this artery goes through the acetabular notch. The superior and postero-inferior region is supplied by the deep branches from the superior and inferior gluteal artery (Coughlin, Shivji, Quah, & Forward, 2018).

2.2 CLASSIFICATION

Letournel had developed the classical fracture classification of the acetabular fracture. It is broadly divided into 2 groups which is the elementary group and the associated group (Alton & Gee, 2014; Beaulé, Dorey, & Matta, 2009; Letournel & Judet, 1964; Visutipol, Ketmalasiri, Pattarabanjird, & Va, 2000). This classification is mainly based on plain radiograph (Alton & Gee, 2014). Two views are required which are the anteroposterior and Judet’s view.

The elementary group consist of 5 types of fracture which is:

- Posterior wall fracture
- Posterior column fracture
- Anterior wall fracture
- Anterior column fracture
- Transverse fracture

The associated group is combination of the elementary fractures; it consists of 5 types which are:

- Posterior wall and posterior column fracture
- Transverse posterior wall fracture
- T-shaped fracture

- Anterior with posterior hemi transverse fracture
- Both columns (bicolumnar) fracture

The most common pattern of injury in elementary is the posterior wall fracture of the acetabulum which is 23.3% followed by anterior column fracture at 14.7%, transverse fracture at 8.6% posterior column fracture at 6.7% and anterior wall fracture at 1.8%. For associated fractures, the most common is the bicolumnar fracture at 13.5% followed by T-Shaped fracture at 11%, transverse posterior wall fracture 9.2%, anterior with hemitransverse fracture 6.7% and posterior wall with posterior column fracture at 4.3% (Coughlin et al., 2018; Giannoudis et al., 2007).

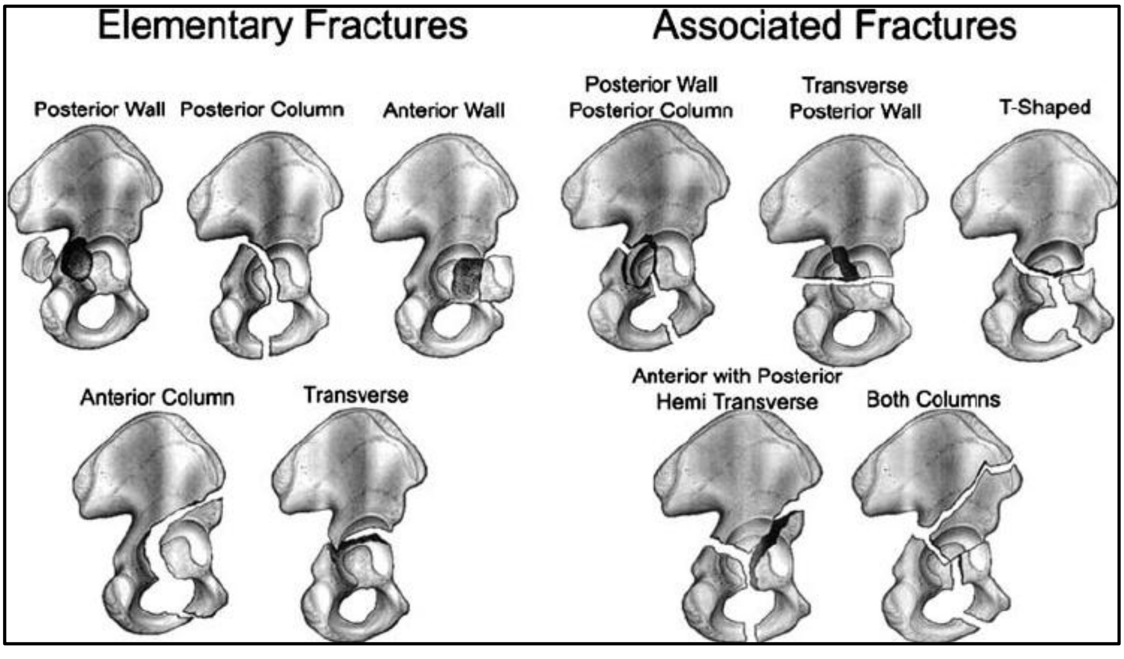

Figure 2.1 Judet and Letournel classification of acetabular fracture.

2.3 MECHANISM OF INJURY

Fracture of the acetabulum could be due to the force that transmitted directly from the femur to the femoral head and then towards the acetabulum. The type and displacement of the fragment is based on the position of the femoral axis during impaction. This is created as if a hammer was pounded directly towards the acetabulum where the force runs through the foot, followed by the knee then transmitted to the greater trochanter and then ended at the acetabulum by the femoral head (Coughlin et al., 2018; Hutt, Ortega-Briones, Daurka, Bircher, & Rickman, 2015; Letournel & Judet, 1964; Phruetthiphat et al., 2017; Visutipol et al., 2000).

Even though we cannot directly ascertain the exact mechanism that the patient sustained during the point of impact, certain correlation of the impact and its pattern of fracture can be recognized. By doing this, we can correlate the fracture pattern and the forces that created it.

Since the force is transmitted through the femoral head, the exact point of impaction on to the acetabulum is in relation to the degree of adduction, abduction of the femur and also the rotation of the femoral head.

When there is no abduction or any adduction of the hip, any external rotation of the hip will cause injury to the anterior column while external rotation of the hip will cause injury to the posterior column. When force is directed in the axis of greater trochanter with some degree of rotation of the hip, the fracture pattern will be as follows:

- Neutral - Central/anterior column
- External rotation (~25°) - Anterior column
- External rotation (~50°) - Anterior wall

- Internal rotation (~25°) – Bicolumnar/T-Shaped/Transverse, depending on the degree of force received.
- Internal rotation (~50°, extreme) - Posterior column with transverse element

When the hip is in neutral (without any rotation), the greater the degree of adduction of the femur, the higher the level of the fracture,and involvement of the roof of the acetabulum will be more. With more abduction of the femur, the fracture line will be more.

If the knee is in flexed position during the point of impact, the fracture pattern will depend on the degree of adduction, abduction, flexion or extension of the hip. There is no role played by rotation of the femoral head against the acetabulum. As in sitting position, the knee and hip is in flexion at 90 degrees, the pattern of fracture depends on the abduction- adduction of the hip as follows:

- Neutral adduction-abduction - Posterior wall fracture
- Maximum abduction - Posterior column with transverse element fracture
- Mild (~15°) abduction - Posterior column fracture
- Adduction - Posterior dislocation of the hip, with or without posterior-wall fracture

When the force is transmitted from the foot up to the knee, with the knee in extended position, the fracture pattern depends on the position of the hip at the point of impact as follows:

- Hip extended (eg, fall from height) - Transtectal transverse fracture

- Hip flexed (eg, frontal collision in a vehicle, force transmitted from the car pedal to the foot) - Depending on the position, as per through flexed knee.

2.4 IMAGING

The initial diagnosis of the fracture is by plain radiograph. Anteroposterior view of the pelvis with Judet view. In anteroposterior view, patient lies supine with the xray plate on the posterior part of the pelvis. In this view, viewer should view 5 lines and 5 areas (Chotai, Arshad, & Bates, 2018).

The five lines are:

i. Ilio-ischial line for posterior column
ii. Ilio-pectineal line for anterior column
iii. Dome of acetabulum
iv. Anterior wall
v. Posterior wall

The five zones that should be viewed are:

i. The iliac wings
ii. Obturator foramen
iii. Tear drop
iv. Pubic symphysis
v. Sacro-iliac joints

The ilio-ischial line runs from the medial border of the iliac wing up to the medial border of the ischium, this line will end at the ischial tuberosity. Any disruption along this line will represent fracture over the posterior column of the acetabulum. While the ilio-pectineal line runs from the inner border of the ilium till the end of the superior surface of the superior pubic rami. This will be presenting the anterior column (Sandstrom, Gross, & Linnau, 2016). The anterior and posterior wall of the acetabulum can be seen over the AP radiograph. The anterior wall is the most medial and more shallow line, the posterior wall id the most lateral line and wider which extend laterally and superimposed with the femoral head (Bishop, Rao, Pouliot, Beaulieu, & Bellino, 2015; Chotai et al., 2018). The dome of the acetabulum is represented with line that starts supero-laterally over the femoral head and ends on top of the fovea medially.

There are a few additional views the of pelvic radiograph, namely the internal obturator view and the external iliac view, they are also called as judet view (Scheinfeld et al., 2015). The internal obturator view will clearly show the anterior column of the acetabulum and the posterior rim of the acetabulum. The patient will be positioned supine on the x-ray table with the affected side tilted at an angle of 45 degrees where the anterior part of the pelvis will move anteriorly and the beam will be directed parallel to the injury. The external iliac view will clearly show the posterior column of the acetabulum and also anterior wall of the acetabulum. Patient will be as same as in internal obturator, the main difference is the unaffected side of the pelvis will be tilted 45 degrees and the posterior part of the affected side will rotate posteriorly. The beam will be directed towards the affected side (Chotai et al., 2018).

Since the development and advancement of computed tomography (CT) scan becomes widely and easily available, almost most of tertiary referral centre have the service available around the clock. By having CT scan pre-operatively, planning can be done correctly and further evaluation of the fracture can be visualize clearly and precise diagnosis can be made to prevent any mishap intra-operative. Ideally, the cut of the CT scan should be around 1mm. With this advancement of CT scan, any intra-articular loose body or the displacement over the dome of the acetabulum can be seen can detect prior to surgery (Van Loon, Kuhn, Hofmann, Hessmann, & Rommens, 2011). In recent years, the quality of CT scan had improved and high-quality 3D images can be produced (Brasel, Pham, Yang, Christensen, & Weigelt, 2007). With CT 3D images, pre-operative planning for plate or screw fixation can be done.

Recent advancement of CT scan also had made virtual radiograph available. As this virtual radiograph will reduced the discomfort and also radiation exposure to the patient. The quality of image as on par with conventional radiograph. Apart from that, it is advisable to use virtual radiograph as most of the acetabular injury will require CT scan and its 3D reconstruction (Bishop et al., 2015).

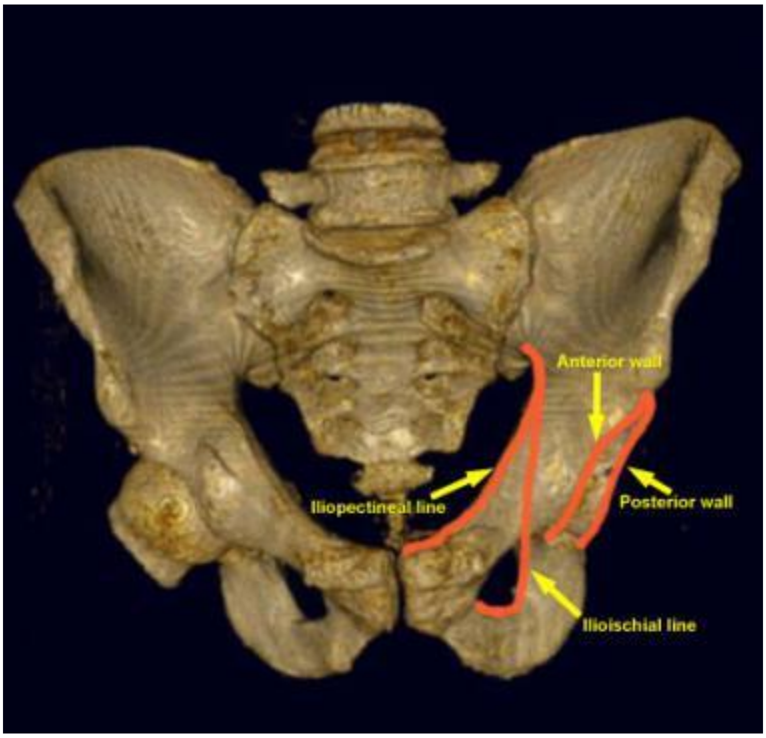

Figure 2.2 Lines that should be visualize in CT 3D reconstruction and Antero-posterior radiograph

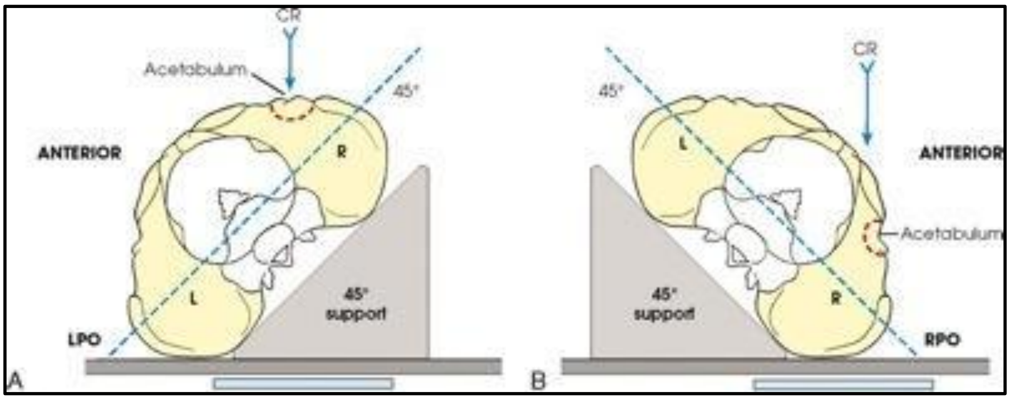

Figure 2.3 Position of the pelvis during radiograph of Judet view with the injured site at the Right acetabulum.

Figure 2.4 Right internal obturator view showing the anterior column of right acetabulum