Reconstruction of the Pelvic Brim and its Role in the Reduction Accuracy of Displaced T-shaped Acetabular Fracture

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Abstract

Open reduction of the displaced T-shaped acetabular fracture has a problem of accuracy of the fracture reduction. This study was carried out to demonstrate that the reconstruction of the pelvic brim by approaching the pubo-acetabular fragment plays a role in the accuracy of the reduction of displaced T-shaped acetabular fractures. From 1975 to 1990, a retrospective study was carried out of 22 patients who sustained a displaced T-shaped acetabular fracture. The patients were operated on by open reduction and internal fixation of the ischio-acetabular fragment to the posterior column without restoration of the pelvic brim. Radiographs of the pelvis were reviewed. The result showed that there was displacement of the pubo-acetabular fragment including the medial wall in all cases. As the result of this study, a prospective study between 1990 and 1997 was carried out of 15 patients who sustained displaced T-shaped acetabular fractures including 3 cases with medial displacement of the femoral head. The pubo-acetabular fragment was anatomically reduced and fixed to the anterior column of the acetabulumn as the first approach to restore a disrupted pelvic brim. There, patterns of the acetabular fracture were subsequently re-evaluated especially the ischio-acetabular fragment including the position of the femoral head by using an intraoperative portable X-ray technique. The stability of the hip joint was assessed by hip flexion. The intraoperative radiograph appearances of the ischio-acetabular fragment were visually confirmed by a second surgical exposure. The results showed that the intraoperative radiographs gave spontaneous reduction of the ischio-acetabular fragment in all patients except one. There was a reduction of the displaced femoral head into the hip socket in the three patients. The hip joints were stable in all patients. The second surgical exposure showed that there was good spontaneous reduction of the ischio-acetabular fragment to the posterior column by ligamentotaxis in 14 patients. Therefore, it is not necessary to address the ischio-acetabular fragment. In the exceptional case, the ischio-acetabular fragment was displaced as a free bone which could not be reduced by ligamentotaxis. However, reduction and internal fixation of the ischio-acetabular fragment to the posterior column for complete re-application of the hip joint onto the

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pelvic ring of this case was facilitated. Postoperative 2 year and 5 year follow-up showed that the fracture had healed without heterotrophic ossification or premature osteoarthrosis of the hip joint. The exceptional case had a broken plate at the anterior column of the acetabulum. Hip function was evaluated clinically using Merle D' Aubigne's hip score. All patients had a "very good score". The study showed that reconstruction of the pelvic brim by anatomical reduction and fixation of the pubo-acetabular fragment to the anterior column plays an important role in the accuracy of fracture reduction of a displaced T-shaped acetabular fracture.

Key word : Pelvic Brim, Pubo-acetabulum, Reduction Accuracy, T-shaped Acetabular Fracture

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The pelvic brim is an important structure to provide strength and a complete circular configuration of a pelvic ring[1]. Displaced T-shaped acetabular fractures besides causing intra-articular fracture of the hip joint also simultaneously produce disruption of the pelvic brim at pubo-acetabular fragment which results in the discontinuity of the circular configuration of the pelvic ring[1-3]. Joint congruity is essential for good function of the hip[1,4]. Open reduction and internal fixation will improve results only if anatomical reduction is achieved[1,4]. Thus, the technique of surgical treatment is important. The question is whether the intervening pubo-acetabular fragment or the ischio-acetabular fragment of the displaced T-shaped acetabular fracture should be approached as the first peripheral fragment. In the series of Judet and Letournel[5], surgical treatment was mainly performed at the posterior. Only 74 per cent of their cases achieved anatomical reduction and the remaining 26 per cent had imperfect reduction of the fractures especially at the pubo-acetabular fragment. Consideration of the anatomical and biomechanical aspects of the pelvic brim[1,2] and of the hip joint[1,6] indicate that the pubo-acetabular part of the anterior column of the acetabulum is a part of the pelvic brim[1,6] and contributes with other pelvic bones to form the upper pelvic ring in a circular configuration and has its arrangement of bones in the same plane[6]. This configuration has more mechanical advantages[7] than the ischio-acetabular part of the posterior column which is not a part of the pelvic brim and contributes with pelvic bones in a different plane to form the lower pelvic ring. This biomechanical advantage was confirmed by a biomechanical experiment to show that the pubo-acetabular part of the anterior column provided 2.75 times more pelvic ring stability than the ischio-acetabular part of the posterior column does[8]. Moreover, the pubo-acetabular part of the anterior column includes the minor articular surface of the hip joint[6] but the ischio-acetabular part of the posterior column includes more[6]. Since the hip joint is a structure on the pelvic ring, the surgical technique for treatment of displaced T-shaped acetabular fractures should approach the pubo-acetabular fragment as the first peripheral fragment to restore the disrupted pelvic brim in order to achieve strength and a complete circular configuration of the pelvic ring before going on to completely reapply the hip joint onto the pelvic ring by addressing the ischio-acetabular fragment. The aim of this study was to demonstrate results of the restoration of the disrupted pelvic brim on the accuracy of fracture reduction of displaced T-shaped acetabular fractures.

MATERIAL AND METHOD

A retrospective study was made between 1975 and 1992 of 22 patients who sustained a displaced T-shaped acetabular fracture and radiographs showing superior weight bearing surface with a

step of more than 2 mm or a roof arc angle of less than 45 degrees. The pelvic brim was not restored. The patients had all been involved in traffic accidents. Their ages ranged from 18 to 57 years old (average 31), with 16 males and 6 females. The fracture involved 9 left sides and 13 right sides. Two patients had associated medial displacement of the femoral heads. These fractures were operated on by our senior surgeons. The displaced T-shaped acetabular fracture was posteriorly approached, the ischio-acetabular fragment was anatomically reduced and stabilized to the posterior column of the acetabulumn with plates, but the pubo-acetabular fragment was not operated on (Table 1). The post-operative radiographs of anteroposterior, internal and external oblique views of the pelvis of these patients were reviewed. Displacement of the pubo-acetabular fragment and position of the femoral head were evaluated. According to the findings of this study including biomechanical and anatomical bases of pelvic brim and hip joint, a prospective study was carried out between 1990 and 1997 on fifteen consecutive patients who sustained displaced T-shaped acetabular fractures including medial displacement of the femoral head in three cases. The radiographs of the pelvis in anteroposterior, internal and external oblique views showing superior weight bearing surface had a step of more than 2 mm or a roof arc angle less than 45 degrees. The pelvic brim was restored by approaching the pubo-acetabular fragment. All patients had been involved in traffic accidents. There were 12 males and 3 females with ages ranging from 17 to 54 years (average 31). The fractures involved eleven right sides and four left sides. (Table 2). The pelvis was X-rayed in anteroposterior view and in both 45 degree internal and external oblique views. After resuscitation, the patients underwent surgery at the earliest within 24-48 hours and with a delay of not more than 1 week. The surgery was done by the first author and co-authors. The patients who had associated injuries and could not have surgery within one week were excluded. The patients were placed in the supine position and under general anesthesia. The pubo-acetabular fragment of the acetabular fracture was exposed by ilioinguinal approach. The pubo-acetabular fragment and the medial wall of the acetabulum were identified. The capsular attachment of the hip joint to the pubo-acetabular fragment was assessed. The pubo-acetabular fragment was anatomically reduced and fixed to the anterior column of the acetabulum by a 3.5 millimeter reconstruction plate (Synthes, Bettlach, Switzerland). When the pelvic brim was completely reconstructed, intraoperative roentgenographs of the pelvis in anteroposterior, 45 degree internal and external oblique views were taken by portable X-ray technique to evaluate the position of the ischio-acetabular fragment and of the femoral head. The stability of the hip joint was evaluated three times at neutral rotation hip flexion in the range of 0 to 90 degrees. The intraoperative radiographic appearance of the ischio-acetabular fragment was visually confirmed by a second operation to expose the posterior column. The patients were put in the lateral position with the effected site upwards. The ischio-acetabular fragment was exposed by the Kocher-Langenbach approach. The stability of the hip joint was re-evaluated by the same maneouver. When optimal reduction of the ischio-acetabular fragment to the posterior column was obtained, there was no need to address the ischio-acetabular fragment. On the other hand, if the ischio-acetabular fragment had imperfect reduction, addressing the ischio-acetabular fragment was performed and fixed to the posterior column for complete reapplication of the hip joint onto the pelvic ring. The patient was put on a bed and skin traction applied with an 8 pound weight for 3 weeks postoperatively then non-weight bearing ambulation with crutches was started at week 16. The roentgenographic results were evaluated by X-ray films of the anteroposterior, 45 degree internal and external oblique views of the pelvis at 2-3 month intervals until the fracture healed. The clinical follow-up was made between 2 and 5 years postoperatively. Finally, the hip function was finally assessed by Merle D' Aubigne's hip score[9].

RESULT

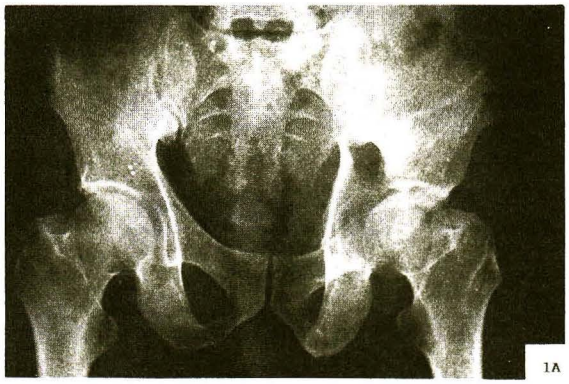
In this retrospective study of 22 patients, the pelvic brim was not restored, but the radiograph of the pelvis showed that the ischio-acetabular fragment had anatomical reduction and fixation to the posterior column of the acetabulum with one or two plates. However, there was medial displacement of the pubo-acetabular fragment including the medial wall of the acetabulum in all patients (Table 1 and Fig. 1). In the associated medial displacement of the femoral head in two patients, the femoral head remained displaced. In the prospective study of the 15 patients whose pelvic brim was restored, the

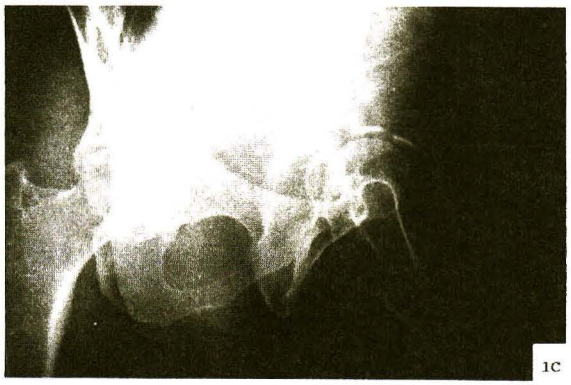
Table 1. Data on 22 patients who had displaced T-shaped acetabular fracture, the ischio-acetabular fragment was fixed without restoration of pelvic brim.

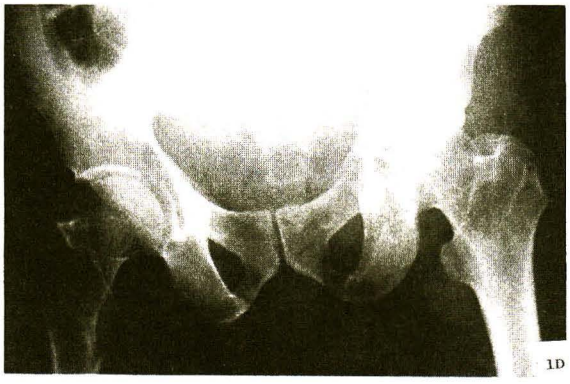
Patients	Gender Age (yrs)	Involved Side	Type of accident	Associated Skeletal Injuries	Medial Displacement of the femoral head	Internal Fixation	Result of fracture reduction after Fixation of ischio-acetabular fragment		
							ischio-actabular	pubo-acetabulum	position of femoral head
1	F, 20	R	Motorcycle	-	-	One plate	Good	displaced	-
2	M, 57	R	Motorcycle	Fracture tibia	-	One plate	Good	displaced	-
3	F, 35	R	Car	Fracture Patellar	-	One plate	Good	displaced	-
4	M, 25	L	Motorcycle	-	Yes	Two plates	Good	displaced	medial displacement
5	M, 46	R	Motorcycle	-	-	One plate with lag screws	Good	displaced	-
6	M, 39	R	Motorcycle	-	-	One plate	Good	displaced	-
7	M, 24	R	Car	Fracture Femur	-	One plate	Good	displaced	-
8	M, 21	L	Motorcycle	Fracture Radius	Yes	One plate	Good	displaced	medial displacement
9	F, 54	R	Motorcycle	Fracture tibia and femur	-	Two plates	Good	displaced	-
10	M, 21	R	Motorcycle	-	-	Two plates	Good	displaced	-
11	M, 39	R	Motorcycle	-	-	Two plates	Good	displaced	-
12	M, 24	L	Motorcycle	Fracture radius and ulnar	-	One plates	Good	displaced	-
13	M, 23	L	Car	-	-	One plate	Good	displaced	-
14	M, 25	L	Car	-	-	Two plates	Good	displaced	-
15	M, 32	R	Motorcycle	Fracture radius	-	Two plates	Good	displaced	-
16	M, 34	R	Motorcycle	Fracture carpal Scaphoid	-	Two plates	Good	displaced	-
17	M, 33	L	Motorcycle	-	-	One plate	Good	displaced	-
18	F, 18	R	Motorcycle	-	-	One plate	Good	displaced	-
19	M, 39	L	Motorcycle	Fracture clavicle	-	Two plates	Good	displaced	-
20	F, 24	L	Car	Fracture femur	-	Two plates	good	displaced	-
21	M, 54	R	Motorcycle	Fracture clavicle	-	Two plates	Good	displaced	-
22	F, 25	L	Motorcycle	-	-	One plate	Good	displaced	-

Table 2. Data on 15 patients who had displaced T-shaped acetabular fracture. The pelvic brim was restored.

Patients	Gender Age (yrs)	Involved Side	Type of Accident	Associated skeletal injuries	Medial Displacement of the femoral head	Internal fixation at		Result of fracture reduction after fixation of pubo-acetabular fragment			Complication	Hip score (Point)		
						Anterior column	Posterior column	pubo-acetabulum	ischio-acetabulum	position of femoral head		Pain	Range of Motion	Gait
1	M, 30	R	Motorcycle	Fracture distal radius	-	One plate	-	good	good	-	-	6	6	6
2	M, 28	R	Motorcycle	-	-			good	good	-	-	6	6	6
3	F, 53	L	Car	-	Yes	One plate	-	good	good	good	-	6	6	6
4	M, 25	R	Motorcycle	Fracture tibia	-	One plate	-	good	good	-	-	6	6	6
5	M, 25	R	Car	-	-		-	good	good	good	-	6	6	6
6	M, 21	L	Motorcycle	Fracture hemurus	-	One plate	-	good	good	-	-	6	6	6
7	M, 18	R	Motorcycle	Fracture femur	-	One plate	One plate	good	good	-	A broken plate at the anterior column	6	6	6
8	F, 36	R	Car	Fracture femur and tibia	Yes	One plate	-	good	good	-	-	5	6	6
9	F, 30	R	Car	-	-	One plate	-	good	good	-	-	6	6	6
10	M, 24	R	Motorcycle	-	-	One plate	-	good	good	-	-	5	6	6
11	M, 29	L	Motorcycle	Fracture both femurs	Yes	Two plates	-	good	good	good	-	6	6	6
12	M, 30	L	Car	Fracture radius and ulnar	-	One plate	-	good	good	-		6	6	6
13	M, 53	R	Car	-	-	One plate	-	good	good	-	-	6	6	6
14	M, 17	R	Motorcycle	-	-	One plate	-	good	good	-	-	6	6	6
15	M, 55	R	Car	Fracture patellar	-	One plate	-	good	good	-		6	6	6



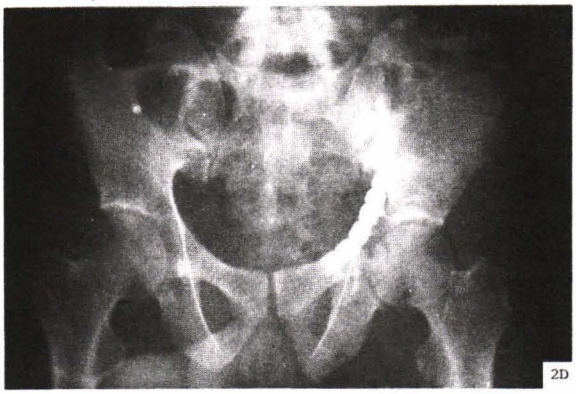




Figs. 1A, B, C, D, E and F. Radiographs of anteroposterior, internal and external oblique views of the pelvis showing a displaced T-shaped right acetabular fracture which reduction was performed and fixed the ischio-acetabular fragment to the posterior column without restoration of pelvic brim.

Figs. 1A, B and C. Radiographs showing the fracture involving the pubo-acetabular part of the anterior column and the ischio-acetabular part of the posterior column. The pelvic brim was disrupted at the pubo-acetabular fragment.

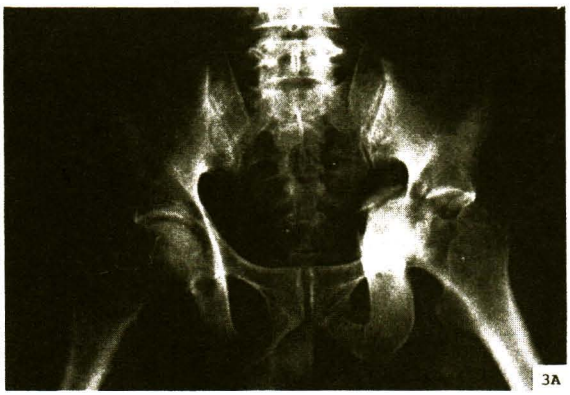
Figs. 1D, E and F. Radiographs showing anatomical reduction and fixation of the ischio-acetabular fragment to the posterior column, but medial displacement of the pubo-acetabular fragment remained. The pelvic brim was not restored.

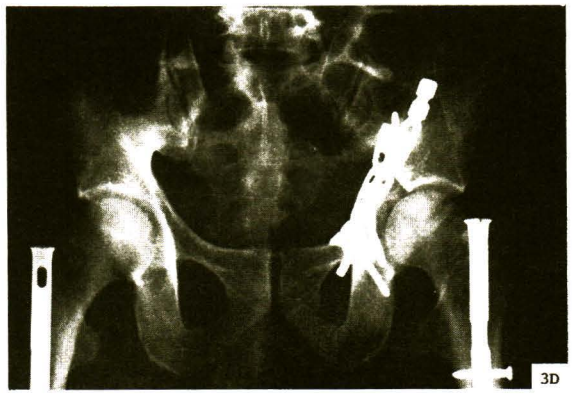


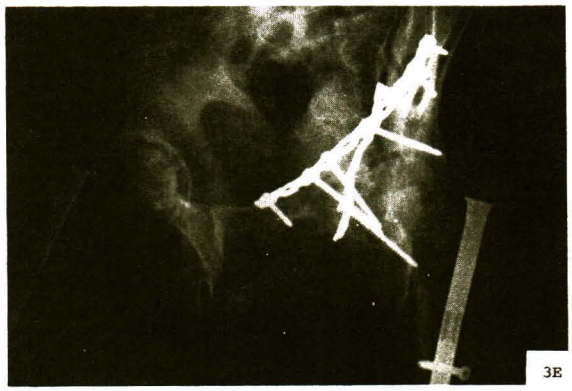
Figs. 2A, B, C, D, E and F. Radiographs of anteroposterior, internal and external and external oblique views of the pelvis showing a similar displaced T-shaped right acetabular fracture as in figure 1. The pelvic brim was restored by reduction and internal fixation of the pubo-acetabular fragment to the anterior column.

Figs. 2A, B and C. Radiographs showing the fracture involving the pubo-acetabular fragment of the anterior column and the ischio-acetabular fragment of the posterior column. The pelvic brim was disrupted at the pubo-acetabular fragment.

Figs. 2D, E and F. Radiographs showing anatomical reduction and internal fixation of the pubo-acetabular fragment to the anterior column. The disrupted pelvic brim was restored. There was simultaneous reduction of the ischio-acetabular fragment to the posterior column.







Figs. 3A, B, C, D, E, and F. Radiographs of anteroposterior, internal and external oblique views of the pelvis showing a displaced T-shaped left acetabular fracture and there was medial displacement of the femoral head. The pelvic brim was restored by reduction and internal fixation of the pubo-acetabular fragment to the anterior column.

Figs. 3A, B and C. Radiographs showing the fracture involving the pubo-acetabular part of the anterior column and the ischio-acetabular part of the posterior column. The femoral head was displaced medially. The pelvic brim was disrupted at the pubo-acetabular fragment.

Figs. 3D, E and F. Radiographs showing anatomical reduction and fixation of the pubo-acetabular fragment to the anterior column by the first plate. The disrupted pelvic brim was reconstructed. The second plate was applied as a splintage of medial wall. Without manipulation of the ischio-acetabular fragment, there was simultaneous reduction of the ischio-acetabular fragment to the posterior column and of the femoral head.

Fig. 4A. The fracture had a wide displacement of the ischio-acetabular fragment as a free bone.

Fig. 4B. The reduction and fixation of the pubo-acetabular fragment to the anterior column of the acetabulum was performed. Although the pelvic brim was restored, the ischio-acetabular fragment could not be reduced by ligamentotaxis. The reduction and fixation of the ischio-acetabular fragment to the posterior column of the acetabulum was performed for complete reapplication of the hip joint onto the pelvic ring.

Fig. 4C. The plate fixed at the posterior column was removed three years postoperatively. The fracture healed without osteoarthrosis of the hip joint. In this case, there was a broken plate at the pubo-acetabular fragment 6 months postoperatively.

Figs. 4A , B and C. Radiograph showing a displaced T-shaped right acetabular fracture.

results showed that there was capsular attachment of the hip joint to the pubo-acetabular fragment in all patients. The intraoperative radiographs showed that there was spontaneous reduction of the ischio-acetabular fragment in all patients except one. The medial displacement of the femoral head in three patients had spontaneous reduction. The hip joint was stable in all patients (Table 2, Fig. 2 and Fig. 3). The second surgical exposure showed that fourteen patients had good reduction of the ischio-acetabular fragment to the posterior column by ligamentotaxis. The hip joint was re-evaluated showing good stability. There was no need for addressing the ischio-acetabular fragment to the posterior column. In the exceptional case, the second surgical exposure showed that the ischio-acetabular fragment was widely displaced as a free bone and could not be reduced by ligamentotaxis. However, the hip joint of this patient was stable. The ischio-acetabular fragment was reduced and fixed to the posterior column of the acetabulumn with a 3.5 millimeter reconstruction plate (Fig. 4). At a minimum follow-up of 2 years and maximum of 5 years, radiographs showed all patients had good healing of the fractures in three months, good stability of the hip joints, no premature osteoarthritic changes and no heterotrophic ossification of the hip. There was no displacement of the ischio-acetabular fragment from the posterior column in the fourteen patients who had no internal fixation of the ischio-acetabular fragment. The exceptional patient had a broken plate fixation of the pubo-acetabular fragment six months postoperatively, but no broken plate fixation at the ischio-acetabular fragment (Fig. 4). The hip joint was clinically evaluated at final follow-up showing very good scores in all patients.

DISCUSSION

The retrospective study was of 22 patients who sustained displaced T-shaped acetabular fracture although the ischio-acetabular fragment had anatomical reduction and stabilization to the posterior column of the acetabulumn. However, the pubo-acetabular fragment remained in medial displacement and the femoral head of the two patients also remained in medial displacement. This resulted in incongruity of the hip joint. This could be explained by the disrupted pelvic brim at the pubo-acetabular fragment not being restored and stabilized; therefore, strength and a complete circular configuration of pelvic ring was not obtained to bear the force from the femoral head transmitted through the acetabulum into the pelvic ring(3,7,8). Moreover, ligamentotaxis of the hip joint could not function well when the disrupted pelvic brim was not restored and stabilized. The results of the prospective study of 15 patients who sustained displaced T-shaped acetabular fractures showed that the pubo-acetabular fragment was first approached by reduction and stabilization to the anterior column of the acetabulumn. This provided spontaneous reduction of the ischio-acetabular fragment to the posterior column and of the femoral head into the hip socket. Moreover, it provided the stability of the hip joint without fixation of the ischio-acetabular fragment to the posterior column. This could be explained by the fact that the disrupted pelvic brim was restored and stabilized by reduction and stabilization of the pubo-acetabular fragment to the anterior column. So, strength and a complete circular configuration of the pelvic ring was obtained and the mechanism of ligamentotaxis of the hip joint capsule including the ligamentum teres capitis functioned well providing stability of the femoral head into the hip socket as well as producing spontaneous reduction of the ischio-acetabular fragment to the posterior column. In the study, fourteen patients achieved good reduction of the fractures and had good stability of the hip joint. However, in one exceptional case, there was displacement of the ischio-acetabular fragment from the posterior column as a free bone which could not be reduced by ligamentotaxis. Nevertheless, the hip joint was stable. This may be because the mechanism of ligamentotaxis of the hip capsule and of the ligamentum teres capitis functioned well on the restored pelvic brim after stabilization of the pubo-acetabular fragment to the anterior column of the acetabulum. Nevertheless, addressing the ischio-acetabular fragment in order to complete reapplication of the hip joint to the pelvic ring by reduction and stabilization of the ischio-acetabular fragment to the posterior column of the acetabulum could be facilitated since reduction and internal fixation of the fracture was performed on the stable frame of the pelvic ring. In the postoperative follow-up, the exceptional patient had a broken plate at the pubo-acetabular fragment without failure of the plate fixation at the posterior column, because the patient had started weight ambulation too early before healing of the fracture was obtained. Although this study did not include the stability of the posterior column, it can be concluded that the reconstruction of pelvic brim by reduction and fixation of pubo-acetabular fragment to the anterior column of the acetabulum provides the accuracy of fracture reduction of T-shaped acetabular fracture. However, intraoperative X-ray films of the pelvis are important to assess whether perfect reduction of T-shaped acetabular fracture is obtained.

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การจัดสร้าง Pelvic brim ของวงกระดูกเชิงกรานมีบทบาทต่อความเที่ยงของการเข้าที่ในกรณีชิ้นกระดูกเบ้าตะโพกแตกเป็นรูปตัว T

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การทำผ่าตัดกระดูกเบ้าตะโพกแตกในลักษณะรูปตัว T นั้น มักมีปัญหาของการจัดกระดูกให้เข้าที่ การศึกษานี้ได้แสดงให้เห็นการจัดชิ้นกระดูก pubo-acetabulum ให้เข้าที่ก่อนเพื่อให้ได้โครงของ pelvic brim ที่สมบูรณ์นั้น มีบทบาทต่อความเที่ยงและง่ายในการจัดกระดูกเบ้าตะโพกแตกรูปตัว T ให้เข้าที่ ระหว่างปี พ.ศ. 2518-2533 คณะผู้วิจัยได้ทำการศึกษาย้อนหลังในผู้ป่วย 22 ราย ที่มีการแตกของเบ้าตะโพกรูปตัว T ผู้ป่วยทั้งหมดได้รับการทำผ่าตัดจัดชิ้นกระดูก ischio-acetabulum ให้เข้ากับ posterior column ของเบ้าตะโพกโดยไม่ได้มีการจัดชิ้นกระดูก pubo-acetabulum ให้เข้าที่ก่อนเพื่อให้ได้ pelvic brim ที่สมบูรณ์ จากภาพรังสีของเบ้าตะโพกแสดงให้เห็นว่ายังคงมีการไม่เข้าที่ของชิ้นกระดูก pubo-acetabulum รวมทั้ง medial wall ของเบ้าตะโพกด้วย จากผลการศึกษาย้อนหลังนี้ คณะผู้วิจัยได้ทำการศึกษาแบบก้าวหน้าในช่วง พ.ศ. 2533-2540 ในผู้ป่วย 15 ราย ที่มีการแตกของเบ้าตะโพกเป็นรูปตัว T และ 3 รายมีการเคลื่อนที่เข้าในของหัวกระดูก femur ร่วมด้วย การศึกษาได้ทำการผ่าตัดจัดชิ้นกระดูก pubo-acetabulum ให้เข้าที่ก่อนเพื่อให้ได้ pelvic brim ที่สมบูรณ์ จากนั้นให้ทดสอบความมั่นคงของเบ้าตะโพกด้วยการงอข้อตะโพกและอาศัยภาพรังสีของเบ้าตะโพกเพื่อดูการจัดตัวใหม่ของกระดูกเบ้าตะโพกที่แตกนั้น พบว่าผู้ป่วยทั้ง 15 ราย ชิ้นกระดูก ischio-acetabulum สามารถเข้าที่ได้เอง ยกเว้นผู้ป่วย 1 รายที่ชิ้นกระดูก ischio-acetabulum ไม่สามารถเข้าที่ได้ นอกจากนี้ในผู้ป่วย 3 ราย ที่มีการเคลื่อนของหัวกระดูก femur เข้าในร่วมด้วยนั้น หัวกระดูก femur สามารถเข้าไปอยู่ในเบ้าตะโพกได้เอง ข้อตะโพกของผู้ป่วยทั้ง 15 ราย มีความมั่นคงดีในขณะที่งอข้อตะโพก การจัดตัวเข้าที่เองของชิ้นกระดูก ischio-acetabulum ที่เห็นในภาพรังสีนั้นได้รับการยืนยันแน่นอนอีกครั้งด้วยการผ่าตัดเข้าไปดูด้วยตา พบว่าชิ้นกระดูก ischio-acetabulum เข้าที่ได้ด้วยผลของ ligamentotaxis ของข้อตะโพกในผู้ป่วย 14 ราย ส่วนรายที่ชิ้นกระดูก ischio-acetabulum ไม่เข้าที่นั้น พบว่าชิ้นกระดูก ischio-acetabulum ได้หลุดเป็นชิ้นกระดูกอิสระ ซึ่งผลของ ligamentotaxis ไม่สามารถจัดให้กระดูกเข้าที่ได้ ผู้ป่วยรายนี้ได้รับการจัดชิ้นกระดูก ischio-acetabum ให้เข้าที่กับ posterior column ของเบ้าตะโพก และยึดตรึงด้วยแผ่นโลหะตามกระดูก จากการศึกษาผลทางคลินิกของผู้ป่วยแต่ละรายหลังทำผ่าตัด 2-5 ปี พบว่ากระดูกเบ้าตะโพกที่แตกมีการประสานของรอยแตกได้ดีไม่มี heterotrophic ossification หรือเกิดภาวะข้อตะโพกเสื่อม การทำงานของข้อตะโพกได้ถูกประเมินด้วยการใช้ Merle D' Aubigne's hip score พบว่าผู้ป่วย 15 รายมีคะแนนอยู่ในเกณฑ์ดีมาก สรุปการศึกษาครั้งนี้ยืนยันว่าการจัดสร้าง ส่วน pelvic brim ที่แตกหักให้สมบูรณ์ โดยการจัดชิ้นกระดูก pubo-acetabulum ให้เข้าที่และยึดตรึงให้มั่นคงแข็งแรง มีบทบาทต่อความเที่ยงของการจัดกระดูกเบ้าตะโพกแตกหักรูปตัว T ให้เข้าที่ได้อย่างสมบูรณ์

คำสำคัญ : Pelvic Brim, Pubo-acetabulum, ความเที่ยงของการจัดชิ้นกระดูก, เบ้าตะโพกแตก

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