Treatment of acetabular fractures in cats and dogs with locking veterinary acetabular plates

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Abstract

This study aimed to assess the intraoperative application and postoperative outcomes of locking acetabular plates in the management of acetabular fractures in dogs and cats. The study analyzed intraoperative and postoperative data from feline and canine patients diagnosed with acetabular fractures. Variables evaluated included fracture location, degree of displacement, severity of lameness, coexisting orthopedic conditions, neurologic deficits, interval between injury and surgery, quality of fracture reduction, and postoperative complications. A total of 19 acetabular fractures were repaired: 9 fractures in 8 dogs and 10 fractures in 10 cats. The acetabular plate was utilized in 16/19 cases. In 3/19 cases of acetabular fractures, a reconstruction plate was utilized due to the inability to apply an acetabular plate for various reasons. However, these cases were included in the study. As a result of the study, it was observed that acetabular plates provide successful results, especially in fractures located in the central region; however, in fractures located in the caudal regions, reduction may be difficult due to the limited bone stock where the plate can be placed. In cases involving concurrent fractures of the ilium or ischium fracture, more easly shaped implants, such as reconstruction plates, were found to be more advantageous. These findings underscore the importance of tailoring implant selection to the specific anatomical and clinical characteristics of each fracture to optimize surgical outcomes.

Introduction

Acetabular fractures represent a challenging clinical entity for surgeons due to the complexity of the surgical approach, difficulties in achieving precise anatomical reduction, and the risk of causing permanent injury to adjacent vital structures, such as the sciatic nerve (*nervus ischiadicus*) and the colon. These fractures are relatively uncommon in veterinary practice. Reported incidence rates in dogs range between 3% and 7.5% (7, 24, 27), while in cats, they account for approximately 4.5% to 5.2% of fractures (19, 26).

The management of intra-articular fractures, such as acetabular fractures, necessitates the preservation of joint integrity to maintain optimal joint functionality. Post-traumatic osteoarthritis, a common complication following such fractures, is attributed to two primary factors: (1) damage to joint structures, particularly hyaline cartilage, caused by the high-energy forces transmitted during the initial trauma, even in the absence of a fracture; and (2) joint incongruity resulting from incomplete or suboptimal anatomical reduction (13). The treatment objectives for acetabular fractures include achieving precise anatomical reduction, ensuring rigid and stable fixation, and establishing interfragmentary compression at the earliest opportunity to restore joint congruity and minimize the risk of degenerative joint disease. These principles are critical for optimizing functional outcomes and mitigating long-term complications (2, 4, 11, 24, 33, 35, 38).

Many methods are used for the fixation of acetabular fractures, including dynamic compression plates (17), veterinary acetabular plates (3), string of pearl (16), reconstruction plates (13), plate luting (2), and screw wires with or without polymethylmethacrylate (4, 23).

Although MIPO (10) and external fixator use (15) have been reported in recent years, it is still unclear whether these methods provide additional benefits. Preformed locking acetabular plates reduces the need for plate contouring, which is one of the challenging aspects of acetabular fracture surgery, while also providing the biomechanical advantages of locking plates (1).

The aim of this study is to present the information obtained regarding the intraoperative application and postoperative outcomes of acetabular fractures treated with locking veterinary acetabular plates.

Materials and Methods

The study population consisted of cats and dogs presented to the Surgery Clinic of the Kırıkkale University Faculty of Veterinary Medicine Research and Practice Hospital between 2020 and 2024, which were diagnosed with acetabular fractures. Signalment data for all patients were collected, including species, breed and age. Comprehensive clinical evaluations were performed to assess the degree of lameness, co-existing orthopedic conditions, and neurological deficits. Radiographic assessments were conducted to determine the fracture localization and degree of displacement. Data from these assessments were systematically recorded. The success of fracture reduction achieved during surgical intervention was evaluated using immediate postoperative radiographs. Postoperative outcomes included monitoring the time to initial limb usage and final functional recovery of the affected extremity.

The acetabular fractures were categorized based on a modified classification system initially described by Butterworth et al. (1994). This classification included the following categories: cranial, central, and caudal. As the number of cases increased, two additional classifications were introduced: "craniocentral" (fractures involving the physis between the cranial and central regions) and "centrocaudal" (fractures involving the physis between the central and caudal regions).

The degree of acetabular fracture displacement was classified into three grades (8). However, certain cases in this study presented with free fracture fragments displaced into the pelvic canal. To account for these instances, a fourth category, "Grade 4: Severe comminuted fractures with significant displacement," was added to the classification.

Lameness was assessed using a composite scoring system derived from multiple grading scales (9, 12, 30). The severity of lameness was classified into six grades: grade 0: Normal gait, grade 1: Mild lameness (noted with the trained eye), grade 2: Moderate lameness (typically with distinct “head bob”), grade 3: Severe, weight-bearing lameness with ground contact only by the toe, grade 4: Non-weight-bearing lameness, characterized by ambulation on three limbs, grade 5: Unable or unwilling to rise.

Neurological deficits were systematically evaluated in the preoperative period and monitored postoperatively to assess improvement, based on established grading criteria (32). According to this classification system, it was divided into 6 groups as grade 0 (normal neurological function), grade 1 (presence of pain without associated neurological deficits, grade 2 (paresis, with or without pain, characterized by varying degrees of motor and proprioceptive impairment), grade 3 (plegia, defined as a complete loss of voluntary movement in the affected limbs and/or tail), grade 4 (plegia accompanied by loss of voluntary urinary control), grade 5 (plegia with concurrent loss of voluntary urinary function and absence of conscious perception of noxious stimuli (deep pain perception) in the affected limbs and/or tail).

Radiographic evaluation of fragment reduction was performed immediately post-surgery and categorized according to a predefined classification system (14): grade 1 (anatomic reduction), grade 2 (good reduction and functional outcome), grade 3 (malaligned and possibly requires revision) and grade 4 (unable to achieve adequate reduction).

Postoperative complications were categorized following the criteria defined by Cook et al. (2010) into three groups: minor (requiring minimal intervention), major (requiring additional surgery or medical treatment) and catastrophic (unacceptable function).

Functional outcomes of the affected limb were assessed using the criteria defined by Troger et al. (2008): grade 1 (return to complete normal function), grade 2 (very mild/intermittent lameness after prolonged exercise), grade 3 (frequent mild/moderate weight bearing lameness), grade 4 (permanent moderate severe lameness). The evaluation was based on the latest follow-up visit, ensuring a standardized and comprehensive assessment of extremity function.

Preoperative Management: The operation was planned after laterolateral and frog leg radiographs taken in the preoperative period. The anesthesia protocol was performed with 0.2 mg/kg butorphanol, 0.02 mg/kg medetomidine hydrochloride and 2 mg/kg ketamine hydrochloride. The patient was intubated after propofol administration intravenously (1.5 mg/kg), and anesthesia was maintained with isoflurane (1-3%).

For intraoperative analgesia, butorphanol (0.2 mg/kg/h), ketamine (0.1 mg/kg/h) and lidocaine (3 mg/kg/h) (only in dogs) were administered as a constant rate infusion. Cefazolin (25 mg/kg) was added 20 minutes before the incision and additional doses were administered at one-hour intervals until the operation was completed.

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Surgical Technique: The patients were placed lateral recumbency on the surgery table with the affected acetabulum uppermost. Great trochanter osteotomy (Gorman method) or gluteal muscle tenotomy approach of the acetabulum was used (21). At the end of the operation, orthogonal radiographs were taken to evaluate the implant position and fracture reduction. In this study, locking acetabular plates and locking reconstruction plates made of grade 5 medical titanium (TiAI4V6) were used (Figure 1).

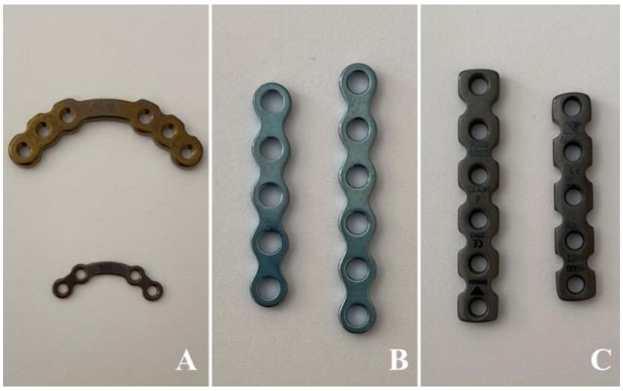

Figure 1. Locking acetabular plate for large dog and cats/small breed dog (A), 1.5 mm reconstruction plates with different number of holes for cat/small breed dog (B) and 3.5 mm reconstruction plates for large breed dog (C).

Postoperative Management: Meloxicam (0.2 mg/kg) was given for its anti-inflammatory and analgesic properties, while amoxicillin-clavulanic acid (12.5 mg/kg) was administered to provide broad-spectrum antimicrobial coverage. Strict cage confinement was advised for the first 10 days to limit patient movement and promote stable healing. No external support, such as bandages or splints, was applied to the operated limb to avoid unnecessary immobilization of surrounding structures. Long-term follow-up evaluations were conducted via clinical examinations and radiographic imaging. During follow-up, extremity functions were evaluated by physical examination, and radiographic images were taken to evaluate the presence/absence of the fracture line, callus formation, and fixation quality.

Results

As the majority of cases involved stray animals, precise age determination was not feasible. Therefore, cases were classified as either mature or immature based on the status of the epiphyseal plates, specifically whether they were open or closed. Out of the 18 animals diagnosed with acetabular fractures (10 cats and 8 dogs), five were stray animals for which the precise time of trauma could not be determined. For the remaining 13 animals with known histories, the mean interval from injury to surgical intervention was 3.7 days, ranging from a minimum of 1 to a maximum of 10 days. Weight and breed distributions are given in detail in tables 1 and 2.

Acetabular fractures demonstrated distinct patterns of localization between species. In dogs, fractures were most frequently observed in the central region (62%) of the acetabulum, whereas in cats, they predominantly occurred in the cranial (40%) region. Bilateral acetabular fractures were identified in 12.5% (1/8) of the canine cases, whereas all feline cases exhibited unilateral fractures.

Neurological evaluations in the preoperative period revealed proprioceptive neuropathy in two of the eight canine cases. Both cases experienced immediate resolution of neurological deficits following surgical intervention. Postoperatively, the average time to initiate weight-bearing on the affected limb in seven dogs was recorded as two days. Data for case 11 could not be obtained for postoperative follow-up, as the owner transferred the animal to another veterinary facility shortly after surgery.

Preoperative neurological evaluations revealed that seven of the ten cats with acetabular fractures exhibited normal proprioceptive reflexes, while three cats presented with proprioceptive neuropathy. Postoperatively, the average time to regain weight-bearing ability on the affected limb in cats with intact proprioceptive reflexes (excluding case 13) was one day. In case 13, however, weight-bearing was delayed to five days post-surgery. Among the three cats with proprioceptive neuropathy, two (excluding case 18) resumed limb use approximately one month postoperatively. Case 18 was euthanized on the 10th postoperative day due to a systemic infection, preventing sufficient time for neurological recovery. It is presumed that the neurological deficits in this patient remained unresolved at the time of euthanasia.

The plate, which was contoured during the intraoperative period, was first fixed to the caudal fragment. This approach was adopted for two primary reasons. Firstly, the caudal region of the acetabulum provides limited bone stock; therefore, securing the plate to the cranial fragment first could result in difficulty identifying adequate bone stock for screw placement in the caudal segment. Secondly, the cranial fragment exhibited greater inherent stability, which facilitated precise repositioning and fixation of the caudal fragment. This strategic order of fixation ensured optimal stability and alignment of the fractured acetabular components.

In animals receiving acetabular plates, a full set of screws was placed in some cases (four screws in cats and eight screws in dogs). However, in others, certain screw holes were left empty, particularly in cranial and/or caudal regions where bone stock was insufficient due to the plate's contouring. Especially in fractures in the cranial or caudal region, since the plate could not be placed symmetrically, it was observed that the most cranial screw hole and the most caudal screw hole in fractures in the caudal region remained empty (Figure 2).

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Table 1. Preoperative period – Dog.

Case	Breed	Bone growth	Weight (kg)	Sex	Location	Side affected	Degree of displacement	Severity of lameness on presentation	Grade of neurological deficit	Concomitant injury
1	German Shepherd	Immature	20	F	Centrocaudal	R	1	4	3	Ischial fracture (C) Pubis fracture (B) Hip dysplasia
2	Mixed	Mature	32	M	Central (comminuted)	R	4	5	4	Coxofemoral luxation (C) Ischial fracture (B)
7	Mixed	Mature	35	M	Central	R	3	4	1	Ilial fracture (I) Sacroiliac luxation (C)
8	Mixed	Immature	22	M	Centrocaudal	L	2	5	2	Ilial fracture (I)
11	Anatolian Shepherd	Immature	22	F	Centrocaudal (comminuted)	R	2	5	1	Pubis fracture (I) Radial paralysis (L)
14	Mixed	Immature	24	F	Central	L	2	3	1	Femoral fracture (C)
16	Mixed	Immature	11	F	Central	L	3	2	1	Ilial fracture (I)
20	Chihuahua	Mature	3.2	F	Central (L) Craniocentral (R)	B	2 (L) 3 (R)	4	1	-

F: Female, M: Male, C: Contraletral, B:Bilateral, I: Ipsilateral, L:Left, R: Right.

Table 2. Preoperative period – Cat.

Case	Breed	Bone growth	Weight (kg)	Sex	Location	Side affected	Degree of displacement	Severity of lameness on presentation	Grade of neurological deficit	Concomitant injury
3	Tabby	Immature	1.5	F	Cranial	R	2	3	1	Coxofemoral luxation (C) Pelvic symphysis separation
4	Tabby	Immature	2.6	F	Cranial	R	3	3	1	-
9	Tabby	Immature	2.5	M	Cranial	L	1	4	1	-
10	Tabby	Immature	3.1	F	Craniocentral	L	2	4	1	Ilial fracture (I)
12	Tabby	Immature	2.8	M	Craniocentral	L	3	3	1	-
13	Tabby	Immature	2.4	F	Cranial	L	3	3	1	-
15	Tabby	Mature	3.4	F	Caudal	L	2	5	1	Sacroiliac luxation (B)
17	Tabby	Mature	3.5	M	Centrocaudal	L	1	4	3	-
18	Tabby	Immature	3.4	M	Caudal	L	2	4	3	Tibial fracture (C) Sacroiliac luxation (C) Urinary bladder herniation Pelvic symphysis separation
21	Tabby	Immature	2.1	M	Central	R	Grade 1	Grade 4	Grade 3	Sacroiliac luxation (C)

F: Female, M: Male, C: Contralatreal, B: Bilateral, I: Ipsilateral, L: Left, R: Right.

Figure 2. Radiographic images taken immediately after surgery. There is an empty screw hole in the cranial section of case 20 (A) and another in the caudal section of case 12 (B).

Figure 3. Laterolateral and frog-legged radiographic image of case 18 with acetabular fracture and concomitant righ tibial fracture and right sacroiliac luxation in the contralateral extremity and urinary bladder herniation into the pelvic canal.

In one cat (case 13), a second screw could not be placed in the caudal segment of the plate due to plate breakage during intraoperative contouring. Despite the presence of only a single screw in the caudal portion of the plate, no implant-related complications were observed during the postoperative period.

Major complications were observed in only one case (1/18). In case 7, both the cranial and caudal screw positions were incomplete due to insufficient bone stock. By the postoperative seventh day, the two screws in the caudal segment had broken, resulting in displacement of the caudal acetabular fragment into the pelvic canal. Therefore, a second revision surgery was performed.

Concomitant orthopedic injuries were encountered in 5 out of 10 cats and all dogs except the case 20. In case 18, in addition to the orthopedic concomitant injury, herniation of the urinary bladder into the pelvic canal was encountered (Figure 3).

A surgical approach was applied to cats with acetabular fractures with great trochanteric osteotomy (7/10) or gluteal muscle tenotomy (3/10). In all dogs, the surgical approach involved great trochanteric osteotomy. It is established that gluteal muscle tenotomy does not provide adequate exposure in large animals (21). Consequently, gluteal muscle tenotomy was not performed in any of the dogs included in this study. In cats, the decision to perform the procedure was left to the surgeon's preference. In patients who underwent a surgical approach with great trochanteric osteotomy, the osteotomized bone was fixed with Kirschner wire and/or screw. No tension band was utilized for any of the fixation performed with Kirschner wires. No complications such as pin/screw loosening or non-union were encountered in any of the patients who underwent greater trochanter osteotomy.

Long-term follow-up (>1 year) was possible for only three of the ten cats treated for acetabular fractures. Of the remaining seven, three died to presumed viral infections, while the other four were released back to the streets, preventing further follow-up. Similarly, none of the eight dogs treated for acetabular fractures could be followed for the long term due to similar circumstances. Preoperative, postoperative and long-term radiographs of a case with acetabular plate are shown in Figure 4. Detailed preoperative data for all patients are provided in tables 1 and 2, while postoperative outcomes are presented in tables 3 and 4.

Table 3. Postoperative period – Dog.

Case	Implant	Reduction grade	Weight bearing on the affected limb (postoperative-day)	Complication	Neurological condition	Follow-up (day)	Injury-to-surgery (day)	Limb function (Final follow-up)
1	AP (6 screw)	1	2nd	-	Normal	12	2	1
2	AP (1 screw missing-cranial)	3	3th	-	Normal	30	10	1
7	AP (2 screws missing-cranial/caudal)	2	1st	Minor (discharge) Major (The screw head broke on the 6th postoperative day)	Decreased proprioception 6th postoperative day (temporary)	30	Unknown	3
8	RP	3	4th	-	Normal	10	4	4
11	AP (6 screw)	2	Could not be followed up	Could not be followed up	Could not be followed up	Could not be followed up	Unknown	Could not be followed up
14	AP (2 screws missing-cranial/caudal)	4	2nd	-	Normal	5	5	3
16	AP (6 screw)	1	1st	-	Normal	10	4	1
20	AP (1 screw missing-cranial)	1 (both)	1st	-	Normal	10	2	1

AP: Acetabular plate, RP: Reconstruction plate.

Table 4. Postoperative period – Cat.

Case	Implant	Reduction grade	Weight bearing on the affected limb (postoperative-day)	Complication	Neurological condition	Follow-up (day)	Injury-to-surgery (day)	Limb function (Final follow-up)
3	AP (1 screw missing-cranial)	2	1st	-	Normal	12	Unknown	1
4	AP (4 screw)	2	1st	-	Normal	14	Unknown	2
9	AP (4 screw)	2	1st	-	Normal	>1 year	2	1
10	RP	1	1st	Lameness occurred on the 18th postoperative day (temporary)	Normal	75	Unknown	1
12	AP (1 screw missing-cranial)	1	1st	-	Normal	11	4	1
13	AP (1 screw missing-caudal)	2	5th	-	Normal	11	3	3
15	RP	2	1st	-		15	4	1
17	AP (4 screw)	1	35th	-	Normal (5th week)	>1 year	1	1
18	AP (4 screw)	1	Euthanasia	-	Delay in proprioception	10	2	4
21	AP (4 screw)	1	30th	-	Normal (4th week)	>1 year	6	1

AP: Acetabular plate, RP: reconstruction plate.

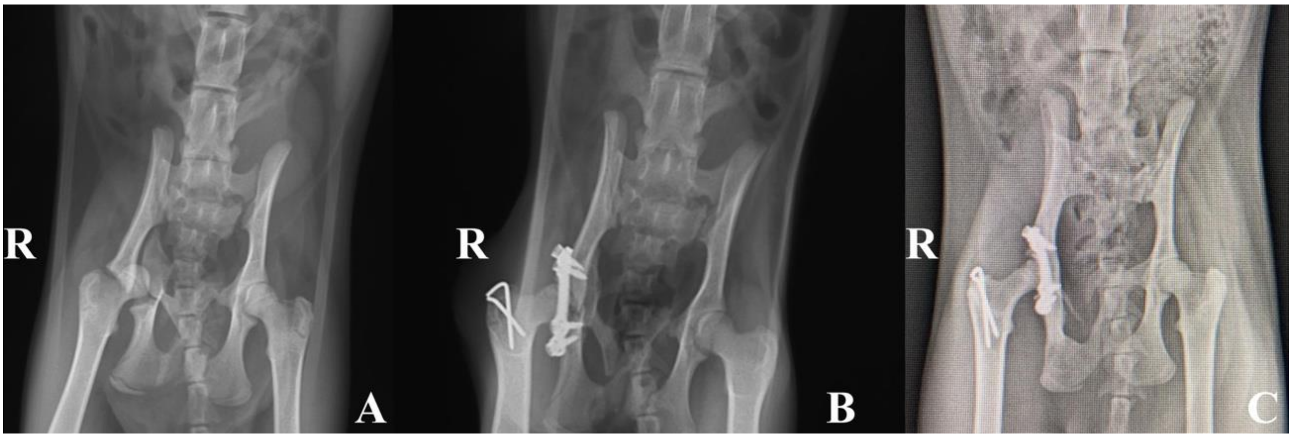

Figure 4. Preoperative (A), postoperative (B) and long-term (11 months) radiographic images (C) of case 21.

Discussion and Conclusion

In a biomechanical analysis conducted by Prieur et al. (1980), it was observed that the primary load transmitted to the hip joint in running dogs occurs predominantly in the horizontal plane and is directed forward. Based on this finding, some authors have argued that fractures of the caudal acetabulum occur in regions subjected to minimal biomechanical stress and, consequently, this region can be treated conservatively (8, 13, 20, 28). However, subsequent research has challenged this perspective. A study focusing on the canine acetabulum (29) demonstrated that the cranial and caudal thirds of the acetabulum endure loads approximately 7.9 and 13.1 times greater, respectively, than the central region. Similarly, Beck et al. (2005) reported in a feline acetabulum study that the central and caudal regions bear significantly higher mechanical loads than the cranial region. Despite these biomechanical insights, clinical fracture patterns present an intriguing contrast. In our study, 50% of acetabular fractures in dogs were located in the central third, a region identified as being subject to lower mechanical stress in prior studies (29). In feline cases, the highest proportion of fractures was observed in the cranial third, an area noted for bearing the least load according to Beck et al. (2005). These findings suggest that factors beyond mechanical loading, such as species-specific anatomical differences, bone morphology, and potential variations in trauma mechanisms, may play a critical role in fracture distribution patterns in both dogs and cats.

It was reported that most animals with acetabular fractures had a high rate (46/49) of concomitant orthopedic injuries, including pelvic fractures, and these were mostly seen in small breeds and young animals (36). In this study, concurrent orthopedic injuries were seen in 87% of dogs (7/8) and 50% of cats (5/10). Additionally, a study reported that non-orthopedic injuries, such as urinary system trauma and neurological complications, were present in approximately 59–72% of patients with pelvic fractures (22). In one of the cases included in our study (case 18), the urinary bladder herniated into the pelvic canal, and this hernia was repaired at the same time as the acetabular fracture. Cases with concomitant orthopedic injuries were managed either medically or surgically. In all cases requiring surgical intervention, the additional orthopedic injuries were addressed concomitantly with acetabular fracture repair. In 10 of the 12 cases, no complications were observed aside from prolonged operative time. Of the remaining two cases, one developed septicemia secondary to multiple trauma and was euthanized, while the other experienced postoperative screw breakage, necessitating revision surgery.

In a previous study, it was stated that there was 23% peripheral nerve dysfunction in patients with pelvic fractures in the preoperative period (25). In this study, the rates of peripheral nerve dysfunction were determined as 30% in cats and 20% in dogs. Among the feline cases in our study, two of the three cats diagnosed with preoperative sciatic neuropraxia exhibited functional recovery of the affected limb within an average of four weeks following surgical intervention. Long-term evaluations revealed that these cats regained excellent extremity functionality. Similarly, two canine patients presented with preoperative sciatic neuropraxia, which resolved completely postoperatively. The resolution of neuropraxia in both species is likely attributable to the decompression of the sciatic nerve, achieved through anatomical reduction and stabilization of the acetabular fractures. These findings underscore the critical role of timely surgical intervention in mitigating secondary neural compression and promoting functional recovery in patients with pelvic fractures complicated by sciatic nerve involvement.

There is a possibility of iatrogenic neurotrauma during surgery in acetabular fractures. It was reported that 5 out of 16 dogs without preoperative neuropraxia developed postoperative neuropraxia, but the extremity regained full function at the end of 6 weeks (13). In this study, in one case (case no 13), the patient was normal in the preoperative period, but a loss of proprioceptive reflexes associated with sciatic neuropraxia was observed in the first five postoperative days, but this problem resolved after the fifth day.

In studies examining acetabular fractures, conflicting findings have been reported regarding the relationship between the degree of fragment displacement and the success of fracture reduction. Some studies suggest that a higher degree of displacement negatively impacts fracture reduction outcomes (17), whereas others have found no significant association (36). In our study, we observed no significant correlation between the degree of fragment displacement and the achieved fracture reduction. However, it was observed that in case 2, which involved an acetabular fracture with a displacement classified as "grade 4," the degree of reduction was assessed as "grade 3." This finding suggests a potential positive correlation between the severity of displacement and the extent of postoperative reduction. However, in this particular case, it remains uncertain whether the suboptimal reduction was primarily attributable to the severity of displacement itself or to the presence of fibrous tissue at the fracture site, which may have impeded reduction, given that the interval between trauma and surgical intervention was 10 days.

A statistically significant correlation was observed between the duration of trauma prior to surgical intervention and the degree of fracture reduction achieved. However, due to incomplete trauma time data for two dogs and a prolonged trauma-to-operation interval of 10 days in one case, these three subjects were excluded from the final analysis. Consequently, calculations were performed on the remaining five cases. Based on the revised dataset, the mean trauma-to-surgery interval for these five dogs was determined to be 3.2 days. The average degree of fracture reduction achieved was classified as 2nd degree. In feline cases, due to the lack of precise trauma timing in three individuals, only seven cases were considered for analysis. Among these, the mean interval from trauma to surgical intervention was calculated as 3.1 days, while the mean reduction degree was determined to be 1.4. Although the average time from trauma to surgical intervention was comparable between species, at approximately three days, the degree of reduction differed, with cats demonstrating an average reduction grade of 1.4 compared to 2 in dogs. This disparity may be attributed to anatomical differences between the species, with the smaller size and more delicate skeletal structure of cats potentially facilitating precise anatomical reduction with minimal force during surgical manipulation. Further studies with larger sample sizes are necessary to establish a more definitive relationship between animal size and reduction degree outcomes.

In the two canine cases presenting with preoperative neurological dysfunction, the interval between trauma and surgical intervention was 2 days in one case and 10 days in the other. Despite this variation, both dogs regained functional limb use within an average of 2 days postoperatively. Similarly, among the two feline cases with preoperative neurological deficits (excluding case 18), the time from trauma to surgery was 1 day in one case and 6 days in the other. The mean time to regain functional limb use in cats was 1 month. No significant correlation was identified between the duration from trauma to surgical intervention and the recovery time of neurological function. However, given the limited sample size, these findings should be interpreted with caution.

The use of appropriate plates for fixation in acetabular fractures is widely regarded as the optimal approach for achieving precise anatomical reduction and providing rigid stabilization. However, several challenges associated with this technique have been documented. In certain fractures, implant size may be constrained by anatomical limitations, particularly in cases involving the caudal acetabular fragment, where limited bone stock can restrict optimal screw placement. Additionally, in bilateral acetabular fractures, early postoperative loading of the affected extremity can lead to complications such as screw loosening or breakage (3, 13, 18, 31). Although screw loosening is uncommon in locking plate systems, previous reports suggest that angulation of locking screws may compromise the locking mechanism, potentially leading to screw loosening (34). In the present study, particularly in feline cases, some locking screws had to be inserted at an angle due to insufficient caudal acetabular bone stock. Despite this deviation from the optimal screw trajectory, no instances of screw loosening were observed in any of the cases (except case 7). A notable example from our study involved case 7, which presented with an ipsilateral ilium fracture and contralateral sacroiliac dislocation in addition to the acetabular fracture. On the postoperative sixth day, screw heads in the caudal fragment failed due to the biomechanical stresses imposed. Corrective surgery was performed due to the displacement of the caudal fragment into the pelvic canal and the intra-articular nature of the fracture.

In some cases, the failure to achieve optimal reduction following plate fixation can primarily be attributed to inadequate contouring of the plate to conform precisely to the anatomical shape of the acetabulum. Although C-type acetabular plates and reconstruction plates were utilized in this study, and locking mechanisms were employed to enhance stability, achieving perfect contouring proved challenging. Despite efforts to shape

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the plates intraoperatively, anatomical mismatches occasionally persisted. Implant failure was observed in case 13 due to over-shaping of the acetabular plate used. Therefore, one screw was placed incompletely in the caudal acetabulum. No complications were observed in the postoperative period. This outcome may be attributed to the use of locking plates, which are known to maintain a degree of mechanical stability even with a reduced number of screws, though this is suboptimal (33). Although stainless steel is known to be softer than titanium and exhibits greater plastic deformation before fracturing, a direct comparative analysis of these materials in the context of acetabular plate application would provide more definitive insights (6).

The findings and clinical insights gained from this study indicate that achieving optimal reduction of fractures in the central acetabular region using "C" plates is associated with highly favorable clinical outcomes. For fractures located in the cranial acetabular region, effective reduction and fixation can be achieved with reconstruction plates extending towards the corpus ossis ilium. In contrast, fractures in the caudal acetabulum present greater challenges for reduction. This difficulty arises from the limited bone stock available for secure screw placement in the caudal fragment, compounded by the ventral curvature and termination of the acetabular arch. Despite these challenges, reconstruction plates remain a viable option for fixation in this region, similar to their use in cranial fractures. Based on our surgical experience with 19 acetabular fractures, it is evident that these injuries result in significant lameness. However, with precise anatomical reduction and stabilization, excellent clinical outcomes can be achieved. Consequently, primary surgical repair should be prioritized over conservative management or salvage procedures such as excision arthroplasty. While excision arthroplasty may be considered as a secondary option, it should be reserved for cases where primary repair is unfeasible, given the potential for orthopedic complications to develop in the contralateral limb over time. These findings reinforce the importance of prioritizing anatomical reduction and stabilization to optimize functional recovery and long-term patient outcomes (24, 38).

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Ethical Statement

This study was carried out after the animal experiment was approved by Kırıkkale University Local Ethics Committee (Decision number: 99-257526).

Conflict of Interest

The authors declared that there is no conflict of interest.

Author Contributions

MB and BK conceived the idea and planned the manuscript. MB, and BK contributed to sample preparation. MB and BK have made significant scientific support and also contributed to the interpretation of the results. Both authors provided significant contributions by giving feedback and help shape the manuscript.

Data Availability Statement

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Animal Welfare

The authors confirm that they have adhered to ARRIVE Guidelines to protect animals used for scientific purposes.

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