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Minimally Invasive Treatment for Sacroiliac Dislocation in Dogs

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Abstract : Sacroiliac dislocation is the separation of the iliac wing from the pelvic bone and needs to be repaired by surgery. Corrective surgical methods include open reduction and minimally invasive techniques. In the present study, we used a minimally invasive surgical technique in seven dogs with sacroiliac dislocation. Five cases had unilateral sacroiliac joint luxation and two cases had bilateral sacroiliac joint luxation; all were referred to hospital after being hit by an automobile. All cases were treated with a fluoroscope-assisted, minimally invasive technique. Patients were evaluated by measuring surgery time, postoperative ambulatory time, and calculating pelvic canal diameter ratios. Surgery time was measured from initial incision to completion of skin closure. Mean surgery time was 30.6 minutes in unilateral sacroiliac joint luxation and 68 minutes in bilateral sacroiliac joint luxation. Mean preoperative pelvic canal diameter ratio was 1.22 (± 0.27), immediate postoperative pelvic canal diameter ratio was 1.26 (± 0.10), and at 2 weeks after surgery, the pelvic canal diameter ratio was 1.37 (± 0.22). All cases were ambulatory within 1 week and mean postoperative ambulatory time was 5 days. Based on the results, the use of a minimally invasive technique for correction of sacroiliac dislocation can decrease surgical time, lessen operative and postoperative burdens on patients, and provide owners with a good prognosis.

***Key words* :** minimally invasive, sacroiliac joint, pelvic canal diameter ratio, dog.

Introduction

Sacroiliac dislocation is a traumatic separation of the iliac wing from the sacral wing in which the ilium is often displaced cranially and slightly dorsal to the sacrum (14). In dogs, 57.8% of pelvic fractures are associated with sacroiliac joint luxation and 13.3% pelvic fractures are associated with sacral fracture, and such fractures commonly occur as the result of an incident with an automobile (5). Usually, pelvic fracture is accompanied by peripheral nerve injury and intra-abdominal injury including hematochezia, hematuria, hemoabdomen, and uroabdomen (5,6). When sacroiliac dislocation occurs, 77% of cases have a unilateral sacroiliac dislocation, and most are accompanied by fractures including those of the acetabulum, ilium, tibia, and femur (3).

Surgical repair techniques for sacroiliac dislocation include open reduction and minimally invasive techniques (2). In the open reduction technique, the surgeon is able to visualize the fracture line directly; however, that approach requires extensive soft tissue dissection in order to insert surgical screws correctly (2). Minimally invasive techniques are used in various surgeries including treatment of radius, ulna, and tibia fractures, thoracolumbar spinal canal surgery, abdominal laparoscopic surgery, and sacroiliac joint luxation (9,11). Minimally invasive techniques can decrease infection rates, reduce soft tissue damage, and lead to increased callus formation and preservation of the periosteal blood supply (10-12,18). Using a minimally invasive technique to correct sacroiliac dislocation minimizes soft tissue disruption, results in less pain, allows accurate and safe screw positioning, shortens surgical duration, and leads to a decrease in hospitalization duration (2,15). Disadvantages of using a minimally invasive technique are exposure to radiation, high initial cost of equipment, and the need for a high-level of surgical skill (17). In correcting a bilateral sacroiliac joint luxation, the dislocations can be reduced by using a single trans-sacral screw, trans-ilial fixation accompanied by trans-sacral brace fixation, or by two lag screws (4,7,8).

Postoperative assessments of sacroiliac joint dislocation include determination of pelvic canal diameter ratio, sacroiliac joint reduction percentage, and screw reduction percentage (17). Among these assessment methods, pelvic canal diameter ratio is a suitable postoperative assessment method when concerned about pelvic canal narrowing. Postoperative pelvic canal narrowing can lead to obstipation or dystocia (1). Pelvic canal diameter ratio is determined by measuring the distance between caudal aspects of the sacral joint and comparing it with the distance between the medial aspects of the acetabulum (Fig 1) (1). A normal pelvic canal diameter ratio has been defined as being ≥ 1.1 (1).

The purpose of this study is to describe the use of a minimally invasive technique and the associated results in seven dogs with sacroiliac dislocations.

Case

Seven dogs referred to the Animal Medical Center after

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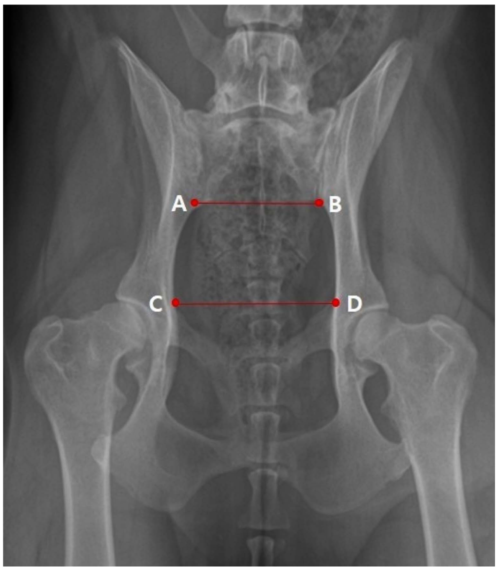

Fig 1. Dorsoventral radiograph of the pelvis and sacrum. Points “A” and “B” are on the right and left caudal part of the sacral wing, respectively. Points “C” and “D” are on the right and left cranial border of the acetabulum rim, respectively. Pelvic canal diameter ratio is defined as CD/AB. A normal pelvic canal diameter ratio is ≥ 1.1.

being for hit by an automobile were included in the study (Table 1). Three dogs were male and four dogs were female. Five breeds were represented: Shih tzu, Pomeranian, Pungsan, Dachshund, and Mixed. The median age of the dogs was 6.4 years (range 3 months to 14 years), and median body weight was 7.8 kg (range 2-24 kg). Upon radiographic examination, unilateral (left, n = 2; right, n = 3) or bilateral (n = 2) sacroiliac joint luxations were observed. Physical examinations revealed they could not bear their weight with the injured hind limbs. There were no remarkable findings in laboratory and neurologic examinations (Table 1).

Propofol (Provive 1%; Claris) 6 mg/kg was used as an anesthetic induction agent and sevoflurane (Sevofran; Hana Pharm) was used as an anesthetic maintenance agent. Cefazolin (Cefazolin; Chong Kun Dang) 22 mg/kg intravenous (IV) and tramadol (Maritrol; JE IL PHARM) 3 mg/kg IV were used as premedications.

All patients were prepared for surgery in lateral recumbency. The pelvis was fixed on a bean bag to maintain a perpendicular position of the pelvis to the operating table. For maneuvering the ilium and ischium, the cranial part of the iliac wing and the caudal part of the ischium were incised. The iliac wing and ischium positions were then fixed by using Kern bone holding forceps. By maneuvering the iliac wing and ischium until superimposition of the seventh lumbar (L7) transverse process and parallelism of the L7 and first sacral endplates, the sagittal plane, which was perpendicular to the X-ray beam, could be achieved (2). Under fluoroscopy ZEN 2090 Pro (GENORAY, Korea), a small Kirschner wire was placed across the sacroiliac joint for temporary fixation and to act as a guide wire. A second Kirschner wire was then inserted near that guide wire to act as a marker pin. Subsequently, a drill guide was inserted over the marker pin to the lateral surface of the ilium. After pulling out the marker pin, a thread hole was created and was followed by gliding hole. Next, an appropriate length cortical screw was inserted into the hole as a lag screw. The cortical screw diameter was selected to be 30% to 40% of sacrum cranial endplate height based on the lateral radiographic image. In bilateral sacroiliac joint luxation, the surgical procedure was the same as above, but each side was performed separately.

Postoperative medications were cefazolin (Cefazolin; Chong Kun Dang) 22 mg/kg bid IV, tramadol (Maritrol; JE IL PHARM) 3 mg/kg bid IV, carprofen (Rimadyl; Pfizer) 2.2 mg/kg bid IV and ranitidine (Ranitac; Hana Pharm) 1 mg/kg bid IV for 2 weeks. In addition, cool pack massage was performed twice daily for fifteen minutes each time, and it was continued for the first week after surgery. For rehabilitation purposes, cage rest was prescribed for 2 weeks after surgery.

Radiographic examinations were performed preoperatively, immediately after surgery, and two weeks postoperatively to monitor the pelvic canal diameter ratio (Fig 2). Pelvic canal diameter ratio was calculated by dividing the cranial acetabulum length by the caudal sacral wing length in dorsoventral radiographic view (Fig 1). Mean preoperative pelvic canal diameter was 1.22 (SD ± 0.27), mean immediate postoperative pelvic canal diameter ratio was 1.26 (SD ± 0.10), and at two weeks after surgery, the pelvic canal diameter ratio was 1.37 (SD ± 0.22) (Table 2).

Surgery time was measured from initiation of skin incision to completion of skin closure. Mean surgery time was 30.6 minutes in the unilateral sacroiliac joint luxation cases and 68 minutes in the bilateral sacroiliac joint luxation cases.

Table 1. Characteristics of seven sacroiliac dislocation cases

No.	Species	Sex	Age	Body weight (kg)	Chief complaint
1	Shih Tzu	Female	14 yrs	4	Lt. SI joint luxation
2	Mixed	Female	3 months	2	Lt. Si joint luxation
3	Mixed	Male	7 months	7	Rt. SI joint luxation
4	Pomeranian	Male	4 yrs	3.5	Rt. SI joint luxation
5	Pungsan dog	Female	5 yrs	24	Rt. SI joint luxation
6	Mixed	Female	7 yrs	9.1	Bilateral SI joint luxation
7	Dachshund	Male	14 yrs	5	Bilateral SI joint luxation

*SI, sacroiliac; Lt., left; Rt., right.

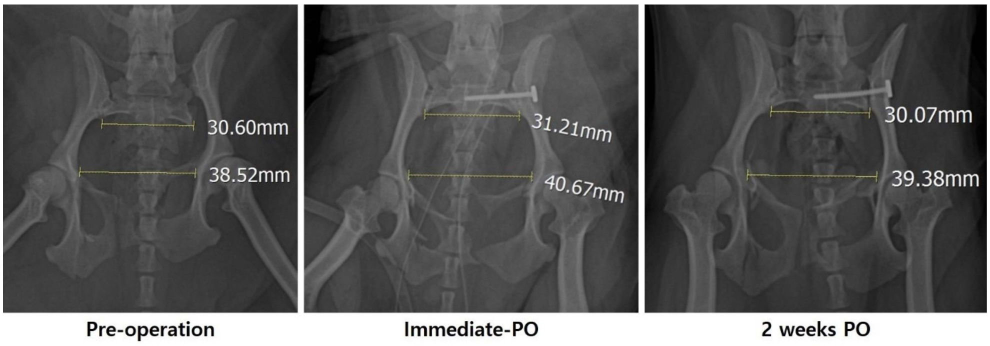

Fig 2. Radiographic examinations of Case 1. Radiographic examination to determine the pelvic canal ratio was performed three times: preoperative, immediate postoperative, and 2 week postoperative examinations. PO, Post-operation.

Table 2. Results from seven sacroiliac dislocation cases. Mean surgery time was 30.6 minutes in unilateral sacroiliac joint luxation and 68 minutes in bilateral sacroiliac joint luxation. Mean preoperative, immediate postoperative, and 2 weeks postoperative pelvic canal diameter ratios were 1.22, 1.26, and 1.37, respectively. Mean postoperative ambulatory time was 5 days

Case no.	Surgery time (min)	Pelvic canal diameter ratio			PO ambulatory time (day)
		Preoperative	Immediate-PO	2 weeks after surgery	
1	27	1.26	1.30	1.31	7
2	31	0.95	1.02	1.10	2
3	24	1.42	1.35	1.36	5
4	36	1.50	1.24	1.28	6
5	35	1.18	1.32	1.35	5
6	71	1.48	1.32	1.33	6
7	65	0.73	1.24	1.86	4

*PO, postoperative

Treating the bilateral sacroiliac joint luxation operations as two separately performed operations, the mean surgery time per operation was 31.6 minutes with a range of 27 to 36 minutes (Table 2).

Postoperative ambulatory time was measured to evaluate patient prognosis. In the bilateral sacroiliac joint luxation cases, postoperative ambulation was present when the patients use both left and right hind limbs. Mean postoperative ambulatory time for all cases was 5 days (Table 2).

Discussion

When a patient has a sacroiliac dislocation, it can be treated via open reduction or minimally invasive techniques. The open reduction technique enables the surgeon to see the fracture line directly, but the technique is invasive and inserting the surgical screw correctly can be challenging (2,15). In contrast, a minimally invasive approach to sacroiliac joint luxation can achieve more accurate screw insertion and more consistent sacral screw placement than that by the open reduction technique (2). Also, a minimally invasive approach can shorten operating time and the time to weight bearing with less pain (2,16). Considering these advantages, the seven cases in the present study were treated by using a fluoroscope-assisted, minimally invasive technique. Mean total surgery time was 30.6 minutes, and mean postoperative ambulatory time was 5 days.

In this study, when applying the minimally invasive technique to sacroiliac joint luxation under fluoroscopy, the marker pin and guide wire were inserted in a step-wise manner, and the marker pin insertion point was used as the lag-screw insertion point. However, sometimes when inserting a marker pin, the drill guide can slip along the iliac wing due to its concave surface; in such a case, the second inserted guide wire would be a more appropriate point to insert the lag screw. In such a situation, the guide wire insertion point should be used as the lag-screw insertion point, because repeated wire insertion to achieve an exact screw insertion point could impair iliac wing and sacral bone cortex.

In bilateral sacroiliac joint luxation, the dislocations can be reduced by using single trans-sacral screw or two lag screws (4,7). Single trans-sacral screw-based operations have been performed with the open reduction technique, and it has been reported that a single screw approach has less bone-purchasing force than that from two screws, regardless of screw size (7,13). In this study, the two cases with bilateral sacroiliac joint luxation were reduced by using the two lag-screw fixation method in order to increase bone-purchasing forces. Although two screws generate more purchasing force than a single screw, there is also a risk of the two screws counteracting each other when the second screw is inserted. To avoid this situation, Radasch et al. positioned the first screw just caudal to the sacral notch and the second screw 8 mm caudal to the first screw (13). Also, placing first screw just caudal to the sacral notch and keeping a distance between the first and second screws is important, because inserting the second screw is difficult due to fluoroscope signal interruption due to the presence of the first screw.

Postoperative assessment for sacroiliac dislocation can include determining sacroiliac joint reduction percentage, screw reduction percentage, and pelvic canal diameter ratio (17). Sacroiliac joint reduction percentage is achieved by measuring, on ventrodorsal radiograph, the cranial to caudal ilium length that is in contact with the articular surface of the sacral wing (3,17). Screw reduction percentage is obtained by measuring the amount of screw thread within the sacrum, as seen on ventrodorsal radiograph (3,17). Pelvic canal diameter ratio is obtained by comparing the distance between the caudal aspects of sacral joint and the distance between medial aspects of acetabulum (1). Among these assessment methods, we determined the pelvic canal diameter ratio in order to evaluate the amount of pelvic canal narrowing, which is a major complication after pelvic fracture surgery. Pelvic narrowing can lead to constipation, obstipation, megacolon, and dystocia (1). In a previous report, a normal pelvic canal diameter ratio was set at ≥ 1.1 (1). In this study, mean preoperative, immediate postoperative, and 2 week postoperative pelvic canal diameter ratios were 1.22 (± 0.27), 1.26 (± 0.10) and 1.37 (± 0.22), respectively. Although preoperative pelvic canal diameter ratio was within the normal range, except in cases 2 and 7, it is considered for other accompanying fractures like pelvic symphysis and pubis fracture. Postoperative pelvic canal diameter ratios were normal in all cases, which reflects a good prognosis. Moreover, there were no other complications after surgery.

Pelvic canal diameter ratio can be determined from radiographic images. However radiographic images are two-dimensional, so they only reflect lateral compression of the pelvic canal (5). In our experience, pelvic canal volume also has an effect on a patient's prognosis; however, computed tomographic (CT) examination is required to measure pelvic canal volume accurately. Unfortunately, postoperative CT examinations could not be performed due to their high cost; absence of such results is a limitation of this study. In future study, performance of postoperative CT examinations would provide useful information when developing a prognosis.

Although these cases provide little information to compare with results in previous studies, we conclude that the fluoroscope-assisted minimally invasive technique used to treat sacroiliac dislocation in our study can shorten both total surgery time and postoperative ambulatory time from those from the open reduction technique, and can provide dog owners with a good prognosis.

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