*J Vet Clin* 28(5) : 467-472 (2011)

Journal of Veterinary Clinics
www.ksvc.or.kr

# Clinical Analysis of Pelvic Fracture in 54 Dogs

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(Accepted: Sep 09, 2011)

**Abstract :** This study was conducted to describe clinical presentation of pelvic fracture and compare clinical outcomes of each part of pelvic fractures in 54 client-owned dogs. There was an average of 3.61 pelvic fractures per dog and 47 dogs had more than two fractures. The average time until initial weight-bearing on the affected leg, hospitalization after surgery, and lameness score at final check in 31 dogs that underwent surgery were 7.04 days, 16.39 days, and 1.25, respectively, and there were no significant difference in the incidence of sacroiliac luxation, iliac fracture, and acetabular fracture among them. The length of hospitalization and the lameness score upon final check of the dogs with over two surgically repaired sites were significantly longer and higher than those of the dogs with one surgically repaired site ($P = .043$ and $P = .008$, respectively). Upon final check of the dogs with bilateral pelvic fracture that was surgically treated, the hospitalization and lameness score were significantly longer and higher than those of dogs with unilateral pelvic fracture that was surgically treated ($P = .034$ and $P = .033$), respectively. The number of pelvic fractures treated surgically appears to be a more influential factor influencing recovery from pelvic fractures than the location of the pelvic fractures.

***Key words*** **:** pelvic fracture, dog, clinical outcomes.

## Introduction

The pelvis consists of several bones including the sacrum, ilium, pubis, and ischium (4,9). Momentary strong impact such as car accident can cause complicated pelvic fracture by breaking the organic connections of these bones (7,9,18). In addition, the choice of treatment, application of appropriate surgical method and implant may also have decisive effects on clinical results (1,2,5,11,12,16,17). It is difficult to compare the clinical outcomes for individual parts of the pelvis because of variable factors including concurrent injuries and injuries in other parts of the pelvis (6). However, such comparisons facilitate prediction of the prognosis of healing status in dogs with multiple pelvic fractures. To the best of the authors' knowledge, there have been no studies conducted to compare the clinical outcomes of each part of the pelvic fractures. Therefore, this study was conducted to describe clinical presentation of pelvic fracture and compare clinical outcomes of various pelvic fractures in dogs.

## Materials and Methods

### Inclusion Criteria

The medical records and radiographs of dogs with pelvic fracture referred to the Veterinary Medical Teaching Hospital of Konkuk University between January 2002 and December 2009 were reviewed. Details obtained from medical records included gender, age, body weight, breed, and healing status after surgical treatment. The number and location of pelvic fractures were identified on the preoperative radiographs.

### Surgical Technique

Surgical techniques including the type and number of implants were selected based on the extent and the location of fracture (6,18). In cases of sacroiliac luxation, stabilization of the sacroiliac joint was accomplished using one long cortical screw. According to the grade of luxation, a combination of one screw and an additional Kirschner wire (K-wire) was used. Bone plates, screws, or wires were applied to stabilize iliac fracture. In cases of acetabular fracture, either bone plate or femoral head and neck osteotomy (FHO) was used for stabilization. Conservative managements were selected for ischial or pubic fractures. Following surgery, soft bandage and restrictive exercise were applied for one to two months in all cases.

### Postoperative Clinical Assessment

The duration until initial weight bearing on the affected limb(s), hospitalization, and lameness score upon final recheck, which was between 4 and 8 weeks after surgery, were evaluated. The degree of lameness was scored on a scale of 0 to 4 (0 = no lameness; 1 = subtle weight-bearing lameness; 2 = obvious weight-bearing lameness; 3 = intermittent non-weight-bearing lameness; 4 = consistent non-weight-bearing lameness) (12). Radiographs were taken immediately postoperatively and 4 - 8 weeks later to evaluate the reduction of fracture, position of the implant, and healing status.

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### Statistical Analysis

The mean and standard error for numerical variables such as age or body weight, and the percentage of dogs affected for categorical variables such as breed or location of pelvic fractures were calculated. The Kruskal-Wallis test or Mann Whitney U test were used to determine significant differences in clinical outcomes among the location and number of fractures surgically repaired. Fisher's exact test was used to compare the occurrence of implant failure and second surgery between dogs that underwent surgical correction for unilateral pelvic fracture and for bilateral pelvic fractures. Statistical analyses were conducted using the SPSS software (SPSS 16.0, IBM Co., Somers, New York). A $P < 0.05$ was considered to indicate significance.

## Results

### Signalment, Causes, and Seasonal Population

Fifty four consisting of 27 males (50%) and 27 females (50%) met the inclusion criteria. Overall, 17 breeds were represented (Table 1). Maltese (n = 11, 20.37%) was the most common breed, followed by mongrel (n = 8, 14.81%). The ages of the dogs ranged from 1.7 to 168 months (32.8 ± 4.70 months, Table 2), with dogs aged 13 to 60-month-old being most common (n = 33, 61%), followed by dogs under 12-month-old (n = 13, 24%). The body weight of the dogs was distributed from 1.5 to 33 kg (6.9 ± 0.81 kg). The causes of pelvic fracture included traffic accident (n = 45, 83%), falling (n = 4, 7%), unknown (n = 3, 6%), kicked (n = 1, 2%), and stuck in the door (n = 1, 2%). Nineteen dogs (35%) were injured during summer, 15 in fall, 12 in spring, and eight in winter.

**Table 1.** The distribution of breeds with pelvic fractures

| Breed | Pelvic Fracture | |
|---|---|---|
| | Dogs | Percentage |
| Cocker Spaniel | 6 | 11.11% |
| Dachshund | 1 | 1.85% |
| Dalmatian | 1 | 1.85% |
| Jindo-dog | 1 | 1.85% |
| Malamute | 2 | 3.70% |
| Maltese | 11 | 20.37% |
| Old English Sheepdog | 1 | 1.85% |
| Pekingese | 1 | 1.85% |
| Pointer | 1 | 1.85% |
| Poodle | 7 | 12.96% |
| Pungsan-dog | 1 | 1.85% |
| Sharpei | 1 | 1.85% |
| Shih Tzu | 4 | 7.41% |
| Yorkshire terrier | 6 | 11.11% |
| Mongrel | 8 | 14.81% |
| Chihuahua | 1 | 1.85% |
| German shepherd | 1 | 1.85% |
| Total | 54 | 100% |

### Number and Location of Pelvic Fracture

A total of 195 pelvic fractures in 54 dogs were present, giving an average of 3.61 pelvic fractures per dog. Only seven dogs (13%) were confirmed to have a single lesion in the pelvis (Table 3). Among the remaining 47 dogs, eight had two lesions, nine had three lesions, 14 had four lesions, 10 had five lesions, three had six lesions, and three had seven lesions. In the distribution of their location, 67 pubic fractures (34%), 46 ischial fractures (24%), 39 iliac fractures (20%), 30 sacroiliac luxations (15%), and 13 acetabular fractures (7%) were identified.

**Table 2.** Summary of signalments, causes, seasonal population, and concurrent injuries of 195 pelvic fractures in 54 dogs

| | | Dogs | Percentage |
|---|---|---|---|
| Age | Under 6-month-old | 6 | 11% |
| | 7-12-month-old | 7 | 13% |
| | 13-36-month-old | 19 | 35% |
| | 37-60-month-old | 14 | 26% |
| | 61-120-month-old | 6 | 11% |
| | Over 121-month-old | 2 | 4% |
| | Mean ± SE (Range; min-max) | 32.8 ± 4.70 months (1.7-168) | |
| Body weight | Under 3 kg | 10 | 19% |
| | 3-10 kg | 31 | 57% |
| | 10-25 kg | 12 | 22% |
| | Over 25 kg | 1 | 2% |
| | Mean ± SE (Range; min-max) | 6.9 ± 0.81 kg (1.5-33) | |
| Cause | Traffic accident | 45 | 83% |
| | Falling | 4 | 7% |
| | Kicked | 1 | 2% |
| | Stuck in the door | 1 | 2% |
| | Unknown | 3 | 6% |
| Seasonal population | Spring (March-May) | 12 | 22% |
| | Summer (June-August) | 19 | 35% |
| | Fall (Setember-November) | 15 | 28% |
| | Winter (December-February) | 8 | 15% |
| Concurrent injuries | Orthopedic injuries | 16 | 50% |
| | -Fractures of other bones | 17 | 53% |
| | -Luxations of other bones | 7 | 22% |
| | -Spinal cord injuries | 2 | 6% |
| | Soft tissue injuries | 9 | 28% |
| | -Skin laceration | 5 | 16% |
| | -Pulmonary injuries | 4 | 13% |
| | -Urinary tract injuries | 3 | 9% |
| | -Hepatic injuries | 3 | 9% |
| | -Herniations | 2 | 6% |
| | Combined injuries | 7 | 22% |
| | Total | 32 / 54 dogs | 60% |

**Table 3.** The number and location of pelvic fractures in 54 dogs

| Number of pelvic fractures | | | Location of fractures | | |
|---|---|---|---|---|---|
| Lesion | Dogs | Percentage | Fracture site | Number | Percentage |
| 1 | 7 | 13% | | | |
| 2 | 8 | 15% | Pubic fractures | 67 | 34% |
| 3 | 9 | 17% | Ischial fractures | 46 | 24% |
| 4 | 14 | 26% | Iliac fractures | 39 | 20% |
| 5 | 10 | 19% | Sacroiliac luxation | 30 | 15% |
| 6 | 3 | 5% | Acetabular fractures | 13 | 7% |
| 7 | 3 | 5% | | | |
| Total | 54 | 100% | Total | 195 | 100% |

**Concurrent Injuries**

Thirty two of 54 dogs (60%) had concurrent injuries, such as 16 orthopedic injuries (50%), nine soft tissue injuries (28%), and seven combined injuries (22%, Table 2). Orthopedic injuries included fractures of other bones (n = 17, 53%), luxations of other joints (n = 7, 22%), and spinal cord injuries (n = 2, 6%). Soft tissue injuries consisted of skin lacerations (n = 5, 16%), pulmonary injuries (n = 4, 13%), urinary tract injuries (n = 3, 9%), hepatic injuries (n = 3, 9%), and herniations (n = 2, 6%).

**Clinical Outcomes of Surgical Treatment**

Overall, 31 of the 54 dogs were treated by surgical correction, 13 by medication and cage confinement, four were euthanized upon the owners' request, one died from concurrent injuries before surgery, and the outcomes of five were not recorded. Thirteen dogs that were treated conservatively were excluded from clinical outcome analysis because they were lost to follow-up.

Sixteen sacroiliac joints in 15 dogs were repaired by surgery. Nine sacroiliac joints were stabilized using one long screw, three using K-wires, and four using a screw and a K-wire. In three sacroiliac joints, implant loosening was identified. Second fixation was conducted in one of three dogs to stabilize the sacroiliac joint.

Repairs of iliac fractures were conducted in 23 ilia in 21 dogs. Fourteen iliac fractures were corrected using one plate, four using one plate combined with wires, and four using two plates. Plate migrations occurred in four ilia. Among these four dogs, three had to undergo surgical treatment again due to displacement of bone fragments.

Five acetabular fractures in 5 dogs were surgically stabilized. Plate fixations were conducted in four dogs and FHO was conducted in one dog. Plate migrations occurred in two dogs, one of which underwent a second surgery consisting of figure-of-eight wires, while the other dog underwent figure-of-eight wiring and additional FHO. Five luxated coxofemoral joints in 5 dogs were treated by FHO.

Of 31 dogs that were surgically treated, the average hospitalization period, time until initial weight-bearing on the affected limb after surgery, and lameness score upon final check were $16.39 \pm 2.38$ days, $7.04 \pm 1.13$ days, and $1.25 \pm 0.17$, respectively (Table 4). The average durations of hospitalization after repair of sacroiliac luxations, iliac fractures, and acetabular fractures were $15 \pm 2.16$, $16.1 \pm 1.92$, and $30.8 \pm 11.29$ days, respectively. The average time until initial weight bearing on the affected leg(s) of dogs with sacroiliac luxations, iliac fractures, and acetabular fractures were $7.18 \pm 1.75$, $7.63 \pm 1.46$, and $7 \pm 3.61$ days, respectively. The average lameness score upon final recheck of dogs with sacroiliac luxations, iliac fractures, and acetabular fractures were $1.08 \pm 0.23$, $0.93 \pm 0.23$, and $0.75 \pm 0.25$, respectively. In dogs that underwent surgical correction of acetabular fractures, the average time to initial weight-bearing after surgery was earlier than others. The lameness score upon final check in dogs with sacroiliac luxation was higher than that of the other scores. However, there were no significant differences in the mean time until initial weight-bearing, hospitalization period, and lameness score at final recheck among sacroiliac luxations, iliac fractures, and acetabular fractures.

The average of hospitalization periods and lameness scores at final recheck in dogs with in which two or more sites were surgically treated ($P = .043$ and $P = .008$ respectively) were significantly higher than in dogs that only had one site surgically corrected. The average of hospitalization periods and lameness scores upon final recheck in dogs in which the bilateral pelvis was treated surgically ($P = .034$ and $P = .033$ respectively) were significantly higher than in dogs for which the unilateral pelvis was surgically repaired.

In dogs treated surgically at the bilateral pelvis, the occurrence rate of implant failure was increased when compared with dogs treated surgically at the unilateral pelvis. The percentage of dogs that underwent second surgery was significantly higher when the bilateral pelvis were repaired at one time ($P = .010$) (Table 5).

## Discussion

Pelvic fracture is common and accounts for approximately 25% of all fractures in small animals (4,9,14). Although dogs of all ages are affected, the occurrence of this injury is higher in

**Table 4.** Clinical outcomes of 31 dogs with pelvic fractures that were surgically repaired

| | Total | Location of fracture | | | Number of fractures repaired surgically | | | Unilateral/bilateral pelvis repaired surgically | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Sacroiliac luxations | Iliac Fractures | Acetabular fractures | *P*-Value* | 1 surgical site | 2 surgical sites or more | *P*-Value* | Unilateral pelvis | Bilateral pelvis | *P*-Value* |
| Hospitalization (days) | 16.39 ± 2.38 (n=31) | 15 ± 2.16 (n=15) | 16.1 ± 1.92 (n=21) | 30.8 ± 11.29 (n=5) | .225 | 14.81 ± 3.26 (n=21) | 19.7 ± 2.71 (n=10) | .043† | 14.57 ± 2.98 (n=23) | 21.63 ± 3.01 (n=8) | .034† |
| Initial weight-bearing after surgery (days) | 7.04 ± 1.13 (n=26) | 7.18 ± 1.75 (n=11) | 7.63 ± 1.46 (n=19) | 7 ± 3.61 (n=3) | .966 | 5.89 ± 1.05 (n=19) | 10.14 ± 2.97 (n=7) | .279 | 6.7 ± 1.28 (n=20) | 8.17 ± 2.63 (n=6) | .700 |
| Lameness score at final check | 1.25 ± 0.17 (n=23) | 1.08 ± 0.23 (n=12) | 0.93 ± 0.23 (n=15) | 0.75 ± 0.25 (n=4) | .511 | 0.53 ± 0.19 (n=15) | 1.5 ± 0.19 (n=8) | .008† | 0.63 ± 0.20 (n=16) | 1.43 ± 0.20 (n=7) | .033† |

*P-value based on Mann-Whitney U test for comparison of two categories and Kruskal-Wallis for three categories. †Significance was set at P < .05.

**Table 5.** Comparison of occurrence of implant failure and second surgery between dogs that underwent surgical correction for unilateral pelvic fractures and bilateral pelvic fractures

| | Occurrence rate of implant failure | Dogs treated second surgery |
|---|---|---|
| Unilateral pelvis fracture (n = 23) | 17.4% (n = 4) | 4.3% (n = 1) |
| Bilateral pelvis fracture (n = 8) | 50.0% (n = 4) | 50.0% (n = 4) |
| *P*-value | .092 | .010† |

*P-value based on Fisher's exact test, †Significance was set at *P* < .05

dogs younger than five years old (13,15). The age population in previous studies was similar to the results (84%) observed in the present study. These findings indicated that young dogs tend to be active and harder to control during walks. Pelvic fractures were primarily caused by automobile accidents, which is similar to the results of previous studies (7,9).

In previous reports, the most common concurrent injury was thoracic trauma (50%), followed by trauma of the urinary tract (39%) (9,10). However, in the present study, orthopedic injuries such as fractures of other appendix bones or vertebrae occurred at a high rate (30%), and thoracic trauma and urogenital injuries were 7% and 4%, respectively.

Surgical correction of pelvic fracture is required for fractures of weight-bearing area such as the sacrum, ilium, and cranial 2/3 part of the acetabulum, contralateral orthopedic injuries, fractures resulting in narrowing of the pelvic canal by 50% or more, and fractures in working dogs or breeding females (6,9). The surgical procedure varies according to the location and type of fracture. Selection of an appropriate implant and accurate reduction of the anatomic location are associated with positive prognosis after surgery (18). Conservative treatment is considered when fracture of the pubis, ischium or caudal 1/3 part of the acetabulum occurs (4,18). In the present study, 13 dogs for which surgery was recommended were conservatively treated because of the owner's financial burden. Additionally, some dogs did not undergo the recommended healing period owing to costs. These findings indicate that fees may influence the selection of treatment methods and subsequent recovery time.

Repair failures may be caused by the placement of inappropriate implants and displacement of bone fragment. In the sacroiliac luxation, repair failure could occur when the length of the screw is too short, or the screw is suboptically applied (3,5,10,16-19). In present study, migration of the screw was observed in three dogs, two of which were retreated surgically. In iliac fracture, the use of too few screws can lead to failure (8,18). Four dogs that underwent surgery to repair iliac fracture showed migration of the plates and screws, three of which were retreated surgically. Of two dogs with acetabular fractures, implant failure and displacement of bone fragment occurred. The combination of screws and interfragmentary wiring were conducted to treat these dogs (2,12).

It is well known that the site of pelvic fractures influences the recovery of pelvic fractures. The time to union of the fractured bone in the sacroiliac luxation and iliac body fracture has been shown to take 6-12 weeks, whereas acetabular fracture has been reported to take 12-18 weeks (11). In the present study, the hospitalization period following acetabular fracture was longer than that of other pelvic fractures, although this difference was not significant.

In dogs with fractures of the bilateral pelvis, the occurrence of implant failure was higher. It is believed that weight bearing on the affected limbs of dogs with bilateral pelvic fractures contributed to implant failure (1).

The results of this study indicated that clinical outcomes were affected by the number of fractures, not their location. Specifically, surgical treatment of more injured sites resulted in a higher lameness score at the time of the last follow up evaluation.

## Acknowledgement

This paper was supported by Konkuk University in 2009.

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# 54두 개에서 발생한 골반 골절의 임상적 분석

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**요 약** : 본 연구의 목적은 골반 골절을 지닌 54두의 환축의 임상적 결과를 분석하고 체중 지지까지의 기간, 입원 기간, 수술 후 파행 등급 등을 평가하는데 있다. 54두의 환축에서 총 195 부위의 골절을 확인하였으며, 이중 47두에서는 2 부위 이상 골절이 확인되었다. 수술을 실시한 31마리에서 수술 이후 체중 지지까지 걸린 평균 기간은 7.04일이었으며, 평균 입원 기간은 16.39일이었다. 또한 수술 이후 평균 최종 파행 등급은 1.25 이었다. 천장골 탈구, 장골 골절, 관골구 골절 간의 체중 지지 기간, 입원 기간, 최종 파행 등급에서 유의적 차이는 없었다. 수술을 2 부위 이상 실시한 경우와 양측 골반을 동시에 수술한 경우에서 입원 기간과 최종 파행 등급은 유의적인 증가를 보였다. 결론적으로 골절의 위치보다 골절의 개수가 골절의 회복에 더 큰 영향을 주는 것으로 생각된다.

**주요어** : 골반골절, 개, 임상 결과