J Vet Sci. 2023 Jan;24(1):e12
https://doi.org/10.4142/jvs.22226
pISSN 1229-845X·eISSN 1976-555X

Journal of Veterinary Science

Original Article
Surgery

Check for updates

Comparison of dorsal and medial arthroscopic approach to canine coxofemoral joint: a cadaveric study

Sangjun Oh, Jinsu Kang, Namsoo Kim, Suyoung Heo*

Department of Surgery, School of Veterinary Medicine, Jeonbuk National University, Iksan 54596, Korea

Received: Sep 13, 2022
Revised: Dec 1, 2022
Accepted: Dec 6, 2022
Published online: Jan 11, 2023

***Correspondence author:**
Suyoung Heo
Department of Surgery, University Veterinary Teaching Hospital, School of Veterinary Medicine, Jeonbuk National University, 79 Gobong-ro, Iksan 54596, Korea.
Email: syheo@jbnu.ac.kr
https://orcid.org/0000-0002-7733-3263

ABSTRACT

Background: Arthroscopic exploration of ventromedial part of canine coxofemoral joint is limited in conventional dorsal approach.
Objectives: We evaluated the efficacy of a medial arthroscopic approach to the coxofemoral joint of dogs by analyzing the joint visible area and performing a safety analysis.
Methods: Arthroscopic approaches to the coxofemoral joint were made in five cadavers using a traditional (dorsal) and novel (medial) approach. Three observers scored the visible area of images and videos of the acetabulum and femur. A safety analysis was performed via dissection of the medial hind limb. The distance between neurovascular structures and arthroscopic portals was measured.
Results: The acetabulum was more visible in the dorsal than in the medial approach, with mean visualization scores of 16 ± 0.00 and 11.83 ± 1.26, respectively. The medioventral side of the femur was significantly more visible in the medial than in the dorsal approach, with mean visualization scores of 3.9 ± 0.99 and 6.93 ± 0.58, respectively. Safety analysis confirmed the medial portal site was safe, provided that the surgeon has comprehensive knowledge of the joint. The minimum distance from the arthroscopic medial portals to the nearest neurovascular structures was 2.5 mm.
Conclusions: A medial arthroscopic approach to the canine coxofemoral joint has potential clinical application. Dorsal and medial approaches differ significantly and have distinct purposes. The medial approach is useful to access the ventromedial joint, making it an eligible diagnostic method for an arthroscopic evaluation of this area.

Keywords: Arthroscopy; hip joint; medial approach; safety analysis; dog

INTRODUCTION

In veterinary medicine, the first documented description of arthroscopy was described in 1974 by Hall in large animals [1]. In dogs, it was initially described for assessing the stifle joint in 1978 and in the 1980s [2-4].

Although arthroscopy of the elbow, shoulder, and stifle joint in dogs has been frequently cited, studies on the coxofemoral joint are rarely reported [5]. The indications for

Journal of Veterinary Science

ORCID iDs
Sangjun Oh
https://orcid.org/0000-0002-3413-6972
Jinsu Kang
https://orcid.org/0000-0001-5501-7983
Namsoo Kim
https://orcid.org/0000-0003-2160-1203
Suyoung Heo
https://orcid.org/0000-0002-7733-3263

Author Contributions
Conceptualization: Oh S, Heo S; Data curation: Oh S, Kang J, Heo S; Formal analysis: Kang J; Funding acquisition: Heo S; Investigation: Oh S; Methodology: Kang J, Heo S; Project administration: Oh S; Resources: Oh S; Software: Oh S, Kang J, Heo S; Supervision: Kim N, Heo S; Validation: Heo S; Visualization: Oh S, Kang J; Writing - original draft: Oh S; Writing - review & editing: Kim N, Heo S.

Conflict of Interest
The authors declare no conflicts of interest.

coxofemoral joint arthroscopy in dogs include assessment of articular cartilage, pain or crepitus not associated with hip dysplasia, radiographic evidence of intra-articular fracture, and degenerative changes not typical of hip dysplasia [6]. In its initial description of hip joint arthroscopy, Person described an arthroscopic method that approaches the joint from the dorsolateral side. Although there are slight differences in portal sites among studies regarding coxofemoral joint arthroscopy, the approach to the joint has always been via the dorsolateral side with the patient positioned in lateral recumbency. This approach has clear palpable landmarks and is anatomically safe [5].

However, visualizing the entire hip joint is difficult, and to our knowledge, no studies have evaluated the portal site that directly approaches the medioventral area of the joint in veterinary medicine. Medioventral approach to hip joint could be indicated in case of round ligament damage, hip dysplasia, or avulsion fracture of the femoral head [7] which has a potential to be diagnosed with hip arthroscopy. Although reports of medial lesions on the coxofemoral joint are rare in veterinary medicine, there are many reports in human medicine. We designed a study to compare the traditional method of approach to a newly designed medial approach. This novel technique approaches the joint from the medioventral side with the patient in ventral recumbency.

This study aimed to evaluate the efficacy of the medial arthroscopic approach to the coxofemoral joint of dogs by comparing the visible area of the joint and performing a safety analysis. We hypothesized that the medial approach would be useful in exploring the medioventral side of the joint compared to the dorsolateral approach.

MATERIALS AND METHODS

All arthroscopic approaches and safety analyses were performed by a single 2nd year resident surgeon, and three observers were 1st year resident surgeons.

Cadaveric specimens

Ten coxofemoral joints from five mixed-breed dogs were included in this study. Two dogs were spayed females, and three were castrated males. The mean body weight was 11.5 kg (range, 8.8–13 kg), and the median age was 7 years (range, 5–10 years). All dogs were euthanized for reasons unrelated to this study, as approved by the Institutional Animal Care and Use Committee (Jeonbuk National University, IACUC JBNU 2021-0171), and donated with the owners' consent. Cadavers were stored at −20°C and thawed at room temperature [5] for 24–36 h depending on joint and muscle flexibility. Radiographic examination confirmed the absence of abnormalities. All five specimens were included in both the dorsal and medial approach studies.

Pilot study

One additional cadaveric specimen was dissected to understand the anatomy of the medial hind limb and select the proper landmark for the medial arthroscopic approach. Through meticulous dissection, all muscles visible from the medial aspect were identified. Efforts were made to preserve as many neurovascular structures as possible. Through this pilot study, the iliopubic eminence, which is the origin of the pectineus muscle, was chosen as a palpable landmark for arthroscopic medial portal placement. The iliopubic eminence is easily palpable from the skin; its originating muscle belly is also easily palpable and lies proximal to

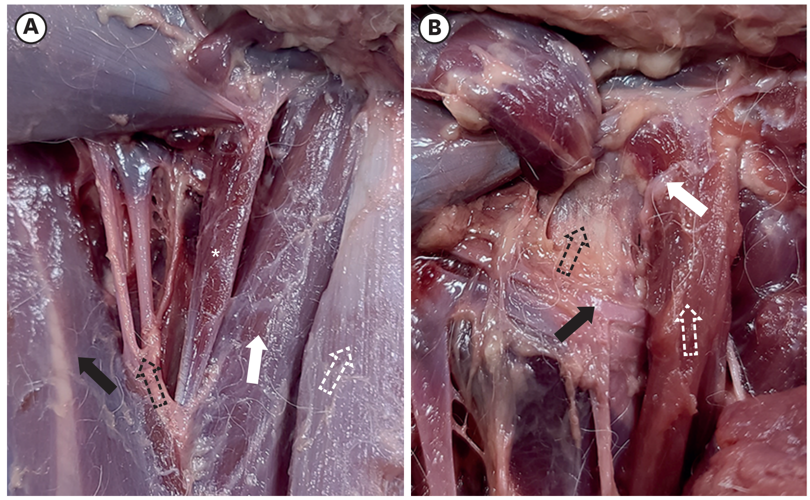

Fig. 1. Dissected images of medial side of right pelvic limb. (A) Medial side of the limb with intact pectineus muscle (white asterisk), femoral bundle (dotted black arrow), adductor muscle (white arrow), sartorius muscle (black arrow), and gracilis muscle (dotted white arrow). (B) Visualization of joint after cutting pectineus muscle away from its insertion, showing obturator nerve (white arrow), coxofemoral joint (dotted black arrow), medial circumflex femoral bundle (black arrow), and adductor longus muscle (dotted white arrow).

the coxofemoral joint. Neurovascular structures to be evaluated in the medial approach study were also visualized and confirmed (**Fig. 1**).

Dorsal approach study

For the dorsal arthroscopic approach, a previously described technique was used. Specimens were positioned in lateral recumbency, with the surgeon standing on the dorsal, an assistant on the caudal end, and a monitor positioned ventral to the specimen [6]. Ventral traction was applied to the limb, and according to the clock face analogy, the telescope portal was placed at 12 o'clock, and the egress portal at either 2 or 10 o'clock. [8] An 89-mm 20-gauge spinal needle (Jangwoo Medical, Korea) was inserted into the joint in a medial direction immediately dorsal to the greater trochanter. Fluid backflow confirmed the proper placement of the needle, and the joint was distended with saline. A conventional approach to the joint was made with a No. 11 scalpel blade and curved mosquito hemostat [6]. A 2.4-mm-diameter telescope (Arthrex, USA) was used in all arthroscopic approaches. The acetabulum, round ligament of the head of the femur, transverse acetabular ligament, femoral head/neck, labrum, and attached joint capsule were evaluated after joining the joint. The time from spinal needle placement to visualization of the joint was also recorded.

Medial approach study

After conducting the dorsal approach study, the same cadaver was used in the medial approach study, which comprised two procedures: 1) arthroscopic approach to the coxofemoral joint and investigation of joint components and 2) dissection of the medial aspect of the hind limb for the safety analysis.

Arthroscopic approach

The patient was positioned in dorsal recumbency, with no tilting of the body. The surgeon stood caudal to the specimen, an assistant on the side of the limb to be examined, and a monitor opposite to the assistant. As previously selected in a pilot study, the iliopubic eminence was palpated as a landmark. The entrance point of the telescope portal lies

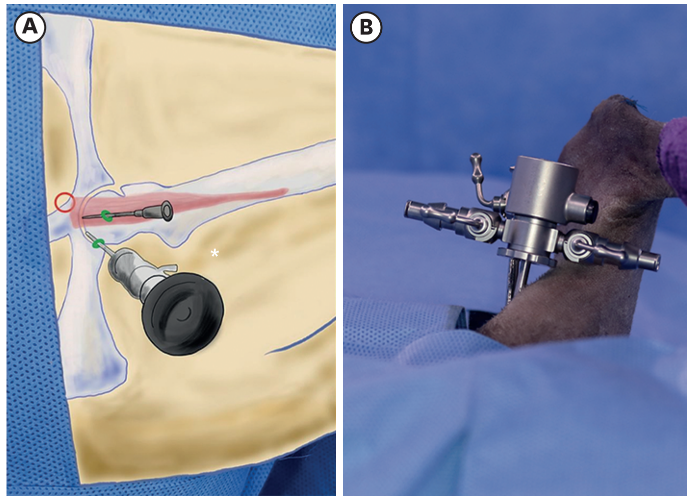

Fig. 2. Schematic image (A) and photograph (B) of arthroscopy applied showing positioning of the leg and portal site of the medial approach. (A) The red circle indicates the iliopubic eminence, and green circles indicate portal sites. Generally, the instrument portal is inserted 1 cm distal to the iliopubic eminence, and the telescope portal is inserted 1 cm caudal and 1 cm distal to the iliopubic eminence. The pectineus muscle is shown in light red color. (B) Telescope portal and egress canula was inserted slightly medially to avoid contacting femoral head. When inserting arthroscopy, the limb was flexed to a degree similar to that of a standing position, which was approximately 70 to 80 degrees to an operating table.

approximately 1 cm distal and 1 cm caudal to the iliopubic eminence. With limb traction toward the assistant and flexing the limb similar to that of the standing position, the same spinal needle used in the dorsal study was inserted in a slightly medial direction toward the coxofemoral joint. The same technique was used after the insertion of the spinal needle. Additional portal placement was made cranial to the telescope portal, with placement of a spinal needle 1 cm distal to the iliopubic eminence (**Fig. 2**). The acetabulum, round ligament of the femoral head, transverse acetabular ligament, femoral head/neck, labrum, and attached joint capsule were evaluated. The time from spinal needle placement to visualization of the joint was also recorded.

Data analysis

Safety analysis: anatomic study

The safety of portal placement was evaluated by a method previously adopted in a human study [9]. Polesello et al. [9] conducted a study on the anatomical safety of the medial hip arthroscopy portal by selecting neurovascular structures to be evaluated and measuring the distance from each portal. Based on previous studies and a pilot study, the medial circumflex femoral bundle, obturator nerve, and femoral bundle were selected [5,9]. Before dissection, two portals were substituted with Kirchner wire equal to the diameter of the telescope sheath and egress cannula (Arthrex). After meticulous dissection, each structure was identified, and the distance was measured in millimeters using paper ruler (**Fig. 3**).

Evaluation of the degree of visualization

To compare the proportions of the acetabulum and femur in each approach, each area was divided into four sections. Five lines were drawn for the acetabulum: 1) 1 bisecting line from the center of the acetabular fossa, 2) a line connecting the center of the acetabular fossa and the most dorsal part of the ischial tuberosity, 3) a line connecting the center of the acetabular fossa and caudal acetabular notch, 4) a line connecting the center of the acetabular fossa and cranial acetabular notch, and 5) lines bisecting 1) and 2). Two lines were drawn from

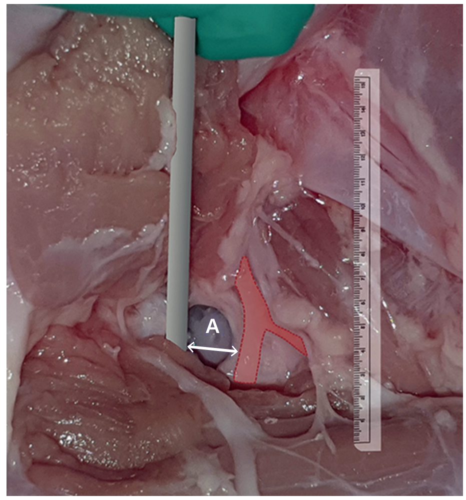

Fig. 3. Schematic image showing method of evaluating anatomical safety. Distance was measured between Kirschner wire and neurovascular structure, indicated as A in the image, using paper ruler. Distance was measured in millimeters.

the femur: 1) a line over the crest between the greater trochanter and femoral head, which continued over the surface of the femoral head and over the portion of the femoral neck, and 2) starting from the cranial aspect, a bisecting line of the femoral head and neck, which continued over the surface of the femoral head to the opposite side of the neck. Based on these lines, four sections were created for the acetabulum and femur, named a1, a2, a3, a4, and f1, f2, f3, and f4 (**Figs. 4** and **5**).

Scoring system

For each section of the acetabulum and femur, a scale of four systems was used to analyze data, and three different observers evaluated the degree of visualization with the same recorded video. Scores of 1, 2, 3, and 4 indicated that observers were able to visualize and measure 0%–25%, 26%–50%, 51%–75%, and 76%–100%, respectively, of the entire section.

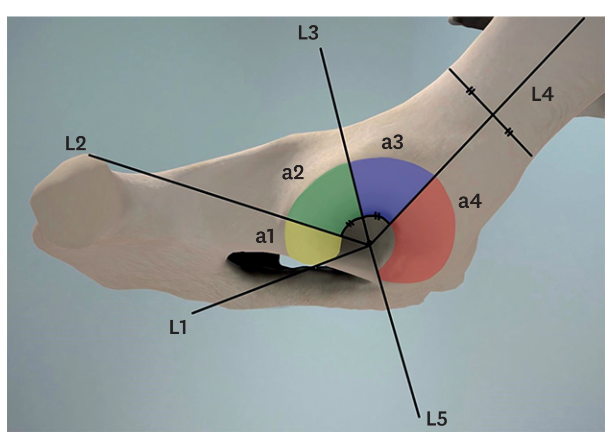

Fig. 4. Illustration of sections a1 to a4. Section a1 (yellow) indicates the area of the acetabulum between L1 and L2. Section a2 (green) indicates the area between L2 and L3. Section a3 (blue) indicates the area between L3 and L4. Section a4 (purple) indicates the area between L4 and L5 (L1 = line from center of acetabular fossa to caudal acetabular notch; L2 = line from center of acetabular fossa to the most dorsal part of ischial tuberosity; L3 = bisecting line of L2 and L4; L4 = line from center of acetabular fossa to the bisecting point of the narrowest part of iliac shaft; L5 = line from center of acetabular fossa to cranial acetabular notch).

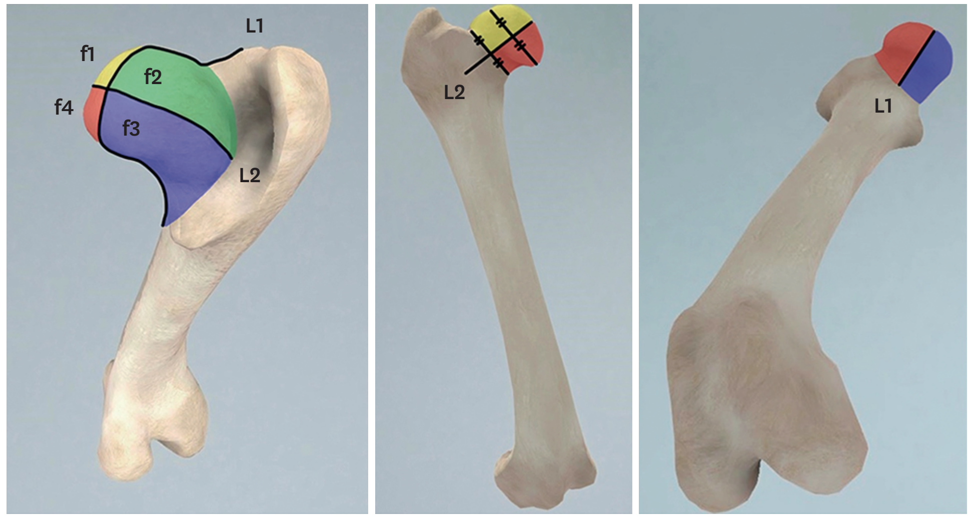

Fig. 5. Illustration of sections f1 to f4. Section f1 (yellow) indicates the craniodorsal area of femur between L1 and L2. Section f2 (green) indicates the caudodorsal area between L1 and L2. Section f3 (blue) indicates the caudoventral area between L1 and L2. Section f4 (purple) indicate cranioventral area between L1 and L2 (L1 = line over the crest between greater trochanter and femoral head; L2 = bisecting line of femoral head and neck to the opposite side).

Statistical analysis

Statistical analyses were performed using SPSS version 26.0 (IBM, USA). The intraclass correlation coefficient two-way random model for consistency was used to analyze measurement reliability and calculate intra-observer reproducibility. The Mann-Whitney test was used to compare the scores between the medial and dorsal approach. Statistical significance was set at $p < 0.05$. Descriptive statistics were calculated as mean, standard deviation (SD), and 95% confidence index (CI).

RESULTS

The acetabulum, round ligament of the head of the femur, transverse acetabular ligament, femoral head/neck, labrum, and attached joint capsule were all visible in both approaches. The mean ± SD of approach time was 368.9 ± 110.9 (95% CI, 303.9–433.4; range, 215–513) seconds in the dorsal approach and 736.2 ± 105.8 (95% CI, 677.0–795.6; range, 612–883) seconds in the medial approach (**Table 1**). All intra-class observer reliability test results were considered significant ($p < 0.05$). The intraclass correlation ranged from 0.595 to 1.000.

Dorsal approach study

Ten coxofemoral joints from five cadaveric specimens were evaluated. In each section of the acetabulum and femur, three observers evaluated how much of the same section was visible and scored on a scale of 4. The mean ± SD of sections from a1 to f1 was 4 ± 0.00, the same

Table 1. Time from spinal needle placement to joint visualization

Variables	Dorsal (sec)	Medial (sec)
Mean ± SD approach time	368.9 ± 110.9	736.2 ± 105.8
Range	215–513	612–883
95% CI	303.9–433.4	677.0–795.6

SD, standard deviation; CI, confidence index.

https://doi.org/10.4142/jvs.22226

Journal of Veterinary Science

Table 2. Intra-observer score of acetabulum and femur in dorsal and medial approach

Sections	Dorsal (Mean ± SD)	Medial (Mean ± SD)
a1	4 ± 0.00	3.6 ± 0.68
a2	4 ± 0.00	1.63 ± 1.00
a3	4 ± 0.00	3.6 ± 0.62
a4[a]	4 ± 0.00	4 ± 0.00
f1	4 ± 0.00	1 ± 0.00
f2	3.93 ± 0.25	2 ± 0.45
f3	2.5 ± 0.50	4 ± 0.00
f4	1.4 ± 0.50	2.93 ± 0.58

All values, from a1 to f4, have p values of < 0.05, in the intra-class correlation coefficient test. All values, except a4, have p values of < 0.05, as determined by the Mann-Whitney U test. p = 1.000 in a4.
SD, standard deviation.

score being given by all three observers. The mean ± SD of f2, f3, and f4 was 3.93 ± 0.25, 2.5 ± 0.50, and 1.4 ± 0.50, respectively (**Table 2**).

Medial approach study

The same ten coxofemoral joints from five specimens were evaluated in the medial approach study. Using the same methodology, each section of the acetabulum and femur was evaluated. The mean ± SD of a1, a2, a3, a4 was 3.6 ± 0.68,1.63 ± 1.00, 3.6 ± 0.62, and 4 ± 0.00, respectively, and that of f1, f2, f3, and f4 was 1 ± 0.00, 2 ± 0.45, 4 ± 0.00, and 2.93 ± 0.58, respectively. There was a significant difference between the dorsal and medial approach in all sections ($p < 0.05$), except for a4 ($p = 1.000$). The scores of the three observers were in complete consensus for sections a4, f1, and f3.

Safety analysis: anatomic study

All specimens were evaluated for anatomical safety after all arthroscopic approach studies were performed. The safety of portal placement was evaluated based on the distance between portals and major neurovascular structures. The mean ± SD distance between the telescope portal and obturator nerve, medial circumflex femoral bundle, and femoral bundle was 4.9 ± 1.29 (range, 3–8), 5.4 ± 1.50 (range, 3–8), and 25.9 ± 4.50 (range, 21–34) mm, respectively. The mean ± SD distance between the instrument portal and obturator nerve, medial circumflex femoral bundle, and femoral bundle was 8.65 ± 2.21 (range, 6–14), 3.85 ± 0.88 (range, 2.5–5), and 17.9 ± 4.62 (range, 11–24) mm, respectively (**Table 3**).

DISCUSSION

Arthroscopy of the coxofemoral joint is indicated when hip evaluation is necessary, such as investigation of hip dysplasia prior to surgery, osteoarthritis, joint laxity, biopsy (bone, cartilage, synovial membrane), intra-articular fracture, lytic lesion, femoroacetabular impingement, or septic arthritis [6,8,10-12]. Additional evidence suggesting that initial imaging studies can miss hip injuries in 2%–10% of patients also advocates its use [13].

Table 3. Distance between neurovascular structure and arthroscopic portal

Variables	Telescope portal (mm)		Instrument portal (mm)	
	Mean ± SD	Range	Mean ± SD	Range
Obturator nerve	4.9 ± 1.29	3–8	8.65 ± 2.21	6–14
Medial circumflex femoral bundle	5.4 ± 1.50	3–8	3.85 ± 0.88	2.5–5
Femoral bundle	25.9 ± 4.50	21–34	17.9 ± 4.62	11–24

SD, standard deviation.

In 1989, arthroscopic surgery in the canine coxofemoral joint was first documented by Person [14]. Since the initial report, the traditional method of approach was via the dorsolateral technique. The patient was positioned in lateral recumbency with the affected limb uppermost, and the surgeon stood ventral or dorsal to the patient. This approach provides safe entrance to the joint [5], provided that the surgeon has a thorough anatomical understanding of the coxofemoral joint and allows for exploration of a vast area of the joint. However, it does not provide complete and satisfactory access to the medial side of the joint, as has been described in human medicine [15]. Possible indications for medial lesion exploration include biopsy for septic arthritis, fine needle aspiration of neoplastic lesions [16], evaluation of synovial chondromatosis, or assessment of intra-articular fracture. If such lesions had occurred on the ventromedial side of the joint, it would have been difficult to sufficiently acquire diagnostic results or perform arthroscopic surgery.

Consequently, we conducted an arthroscopic study that compared two approaches. In contrast to the conventional dorsolateral approach, we designed a novel medioventral approach that allows for direct visualization of the medioventral side of the joint. The initial portal site was designed based on a previous study and dissection of the medial side of the limb [9]. As described previously in this study, the iliopubic eminence was chosen as a landmark because it is easily palpable and lies close to the coxofemoral joint. However, further evaluation is needed in case of heavily overweight patients whether if this landmark is still easily palpable.

Three observers evaluated the same recorded video of the joint. For the acetabulum, the medial approach score was overall low compared to the dorsal approach score. This was particularly due to section a2, which represents the caudal part of the acetabulum. Compared to other sections, we were unable to sufficiently visualize the a2 section of the acetabulum because of the round ligament of the head of the femur. When positioned in dorsal recumbency, the ligament is located close to the ventral portion of the joint capsule, thereby limiting the movement of the portal. Limited view due to limited movement was the cause of the low score in the medial approach study. However, in the authors' opinion, it would be possible to visualize most of the acetabulum if severe hip joint laxity were present. For the femur, there was a distinct difference in the visual field between the dorsal and medial approaches. The f1 and f2 scores were higher in the dorsal approach, whereas the f3 and f4 scores were higher in the medial approach. Sections f3 and f4 represent the ventral femur. As a higher score corresponds to a larger field of visualization, it can be assumed that these areas are more easily visualized in the medial approach than in the dorsal approach.

The safety analysis study was designed based on previous reports [5,9]. Each portal site was replaced with Kirschner wires of equal diameter, and the distance between the selected neurovascular structures was measured. Although no injuries to the neurovascular structures occurred in our study, the medial circumflex femoral artery and obturator nerve were put at risk. The medial circumflex femoral artery originates from the deep femoral artery. It enters the adductor muscle between the quadriceps and pectineus muscles, and when in proximity to the adductor muscle, it gives off a deep branch towards the adductor muscle and vastus lateralis muscle. A small vessel then branches off near the coxofemoral joint. The instrument portal site is located close to the medial circumflex femoral artery, and because the medial circumflex femoral artery runs through lateral side of the joint when looking at the ventral aspect, it is advisable that portals be directed slightly medially to minimize the risk. The obturator nerve arises from 4th, 5th, and 6th lumbar nerve and travels caudolaterally near the shaft of the ilium before coursing between the ischial and iliopubic parts of the levator ani muscle. It then courses through the cranial portion of the obturator foramen to the adductor muscle. As it is located close to the adductor muscle, it is closer to the telescope portal. Thus, the telescope portal should be carefully inserted and directed slightly cranially. Knowing these anatomies is extremely important, and practice of meticulous dissection and approach is recommended prior to clinical application.

The mean approach time was significantly lower in the dorsal approach study, wherein it was defined in this study as the time from spinal needle placement to visualization of the joint. Because approach time is directly related to the duration of surgery and hence anesthesia, it can be said that the dorsal approach has advantages over the medial approach method. However, the dorsal approach has been studied for over 30 years, whereas the medial approach is a novel technique. Various references aid in the study of anatomic structures and the dorsal method itself, but not in the medial method. It can therefore be concluded that the approach time of the medial method has the potential to be reduced in future studies.

The limitations of this study were lack of objectivity of the data, lack of differences in the size of cadavers, and small numbers. Objectivity of the data was difficult to achieve because of the nature of the study. Because the comparison of the visible areas of both the acetabulum and femur in each approach was the main aspect of this study, other means to obtain objectivity, such as having the same distance between the telescope and the object in every recording was almost impossible. As an alternative, we designed the study to have three different observers to evaluate the data, and all have proven to be statistically reliable ($p < 0.05$). Because all arthroscopic approaches were made with a 2.4-mm telescope, differences in the size of cadavers could have affected the outcome of this study. With a larger specimen, more flexible movement of the scope could have been possible. With more flexible movement of the scope, more areas could be visualized. Further studies are needed to compare the areas that could be visualized among cadavers of different sizes. All cadaveric specimens used in this study were donated by their owners. For this reason, it was difficult to procure cadaveric specimens with intact coxofemoral joints. However, various published studies [5,9,17] have sample sizes similar to those of this study, thus making the sample size of this study acceptable.

In conclusion, the medial arthroscopic approach to the canine coxofemoral joint is a novel technique that has the potential to be applied in clinical practice. Dorsal and medial approaches have shown significant differences and have distinct purposes. The medial approach is useful for accessing the ventromedial part of the joint, making it an eligible diagnostic method for an arthroscopic evaluation of this area. Further studies are warranted to verify the results of this study clinically.

ACKNOWLEDGEMENTS

The authors would like to thank M.Y., J.E., J.Y., and the members of surgery laboratory team at the School of Veterinary Medicine, Jeonbuk National University, for their support.

REFERENCES

1. Beale BS. History of arthroscopy. In: Beale B, Hulse D, Schulz K, Whitney W, editors. *Small Animal Arthroscopy*. 1st ed. Philadelphia: WB Saunders; 2003, 1-3.
2. Person MW. A procedure for arthroscopic examination of the canine stifle joint. J Am Anim Hosp Assoc. 1985;21:179-186.
3. Kivumbi CW, Bennett D. Arthroscopy of the canine stifle joint. Vet Rec. 1981;109(12):241-249.
PUBMED | CROSSREF
4. Siemering GH. Arthroscopy of dogs. J Am Vet Med Assoc. 1978;172(5):575-577.
PUBMED
5. Saunders WB, Hulse DA, Schulz KS. Evaluation of portal locations and periarticular structures in canine coxofemoral arthroscopy: a cadaver study. Vet Comp Orthop Traumatol. 2004;17(4):184-188.
CROSSREF
6. McCarthy TC. 6. Hip joint. In: *Veterinary Arthroscopy for the Small Animal Practitioner.* Hoboken: John Wiley & Sons; 2021,192-206.
7. L'Eplattenier HF, Montavon PM. Avulsion fractures of the femoral head: internal fixation using a ventral approach to the hip joint. Vet Comp Orthop Traumatol. 1997;10(1):23-26.
CROSSREF
8. Beale BS. Arthroscopically assisted surgery of the hip joint. In: *Small animal arthroscopy.* Philadelphia: WB Saunders; 2003:96-115
9. Polesello GC, Omine Fernandes AE, de Oliveira LP, Tavares Linhares JP, Queiroz MC. Medial hip arthroscopy portals: an anatomic study. Arthroscopy. 2014;30(1):55-59.
PUBMED | CROSSREF
10. Capaldo F, Gilley R, Kapatkin A. Diagnostic and surgical applications of arthroscopy in dogs: Hindlimb joint diseases. Compend Contin Educ Pract Vet. 2005;27(8):596-610.
11. Luther JF, Cook JL, Stoll MR. Arthroscopic exploration and biopsy for diagnosis of septic arthritis and osteomyelitis of the coxofemoral joint in a dog. Vet Comp Orthop Traumatol. 2005;18(1):47-51.
PUBMED | CROSSREF
12. Horisberger M, Brunner A, Herzog RF. Arthroscopic treatment of femoroacetabular impingement of the hip: a new technique to access the joint. Clin Orthop Relat Res. 2010;468(1):182-190.
PUBMED | CROSSREF
13. Alfikey A, El-Bakoury A, Karim MA, Farouk H, Kaddah MA, Abdelazeem AH. Role of arthroscopy for the diagnosis and management of post-traumatic hip pain: a prospective study. J Hip Preserv Surg. 2019;6(4):377-384.
PUBMED | CROSSREF
14. Person MW. Arthroscopy of the canine coxofemoral joint. Compend Contin Educ Pract Vet. 1989;11:930-935.
15. Kang C, Hwang DS, Hwang JM, Park EJ. Usefulness of the medial portal during hip arthroscopy. Clin Orthop Surg. 2015;7(3):392-395.
PUBMED | CROSSREF
16. Scherrer W, Holsworth I, Goossens M, Schulz K. Coxofemoral arthroscopy and total hip arthroplasty for management of intermediate grade fibrosarcoma in a dog. Vet Surg. 2005;34(1):43-46.
PUBMED | CROSSREF
17. Huang CH, Hou SM, Yeh LS. The innervation of canine hip joint capsule: an anatomic study. Anat Histol Embryol. 2013;42(6):425-431.
PUBMED | CROSSREF