

The Treatment of Coxofemoral Luxation by Modified Synthetic Capsule Technique in Dogs: 6 Cases ^[1]

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Summary

In this study, it was aimed to investigate that long-term clinical efficacy of modified synthetic capsule technique in treatment of coxofemoral luxation in dogs. As animal materials, six dogs which different breeds, sex and ages that detected coxofemoral luxation in clinical and radiological examination were subjected. As different from modified synthetic capsule technique, two cortical screws were inserted into the dorsal rim about 5 mm away from the acetabular edge at the 10- and 12-o'clock positions for the left hip and the 12- and 2-o'clock positions for the right hip. Also, the transverse hole was created in greater trochanter. Non-absorbable monofilament suture material was tied to the screw heads previously and then the suture ends were passed as crosswise through the transverse tunnel in the trochanter major. Subsequently, the suture material was tied on the greater trochanter by stretching following that the femoral head was placed into the acetabulum. It was seen that there was no complication related with the reduction or screws in clinical and radiological examinations of the dogs at fourth week. We determined that five dogs recovered "perfect" and one dog "good" end of sixth months.

Keywords: Coxofemoral luxation, Synthetic capsule technique, Dog

Köpeklerde Kalça Eklemi Çıkığının Modifiye Sentetik Kapsül Tekniği ile Sağaltımı: 6 Olgu

Özet

Bu çalışmada, köpeklerde coxofemoral lüksasyonun sağaltımında modifiye sentetik kapsül tekniğinin uzun dönem klinik etkinliğinin araştırılması amaçlandı. Materyali, klinik-radyolojik muayenesinde, kalça çıkığı saptanan değişik yaş ve ırkta 6 köpek oluşturdu. Tekniğin orijinalinden farklı olarak; sağ kalça için saat 12 ve 2, sol kalça için saat 10 ve 12'ye denk gelecek şekilde, asetabular kenardan 5 mm kadar uzağa, iki kortikal vida yerleştirildi ve trochanter majore transversal tünel açıldı. Emilmeyen monofilament iplik önce vida başlarına bağlandı, sonra çaprazlaştırılarak trochanter majora açılan tünel içerisinden geçirildi. Daha sonra femur başı asetabulumu yerleştirildi ve iplikler gergin şekilde trochanter major üzerinde düğümlendi. Dördüncü hafta yapılan klinik ve radyolojik muayenelerde köpeklerde redüksiyon veya yerleştirilen vidalara ilişkin herhangi bir komplikasyon yaşamadığı görüldü. Altıncı ayın sonunda 5 köpeğin mükemmel, 1 köpeğin ise iyi düzeyde basış sergilediği saptandı.

Anahtar sözcükler: Koksofemoral çıkık, Sentetik kapsül tekniği, Köpek

INTRODUCTION

In small animals, luxation of coxofemoral joint is the most common among all joint ^[1]. The coxofemoral luxation constitutes 39-90% of all luxations which occur in dogs have been reported by some investigators ^[2,3]. Due to strong pulling force of gluteal and iliopsoas muscles, direction of

the coxofemoral luxations is often craniodorsal and rarely caudodorsal, ventral and medial ^[4-6].

The most common causes of the hip joint luxations are traffic accidents and falling from high. Traumatic luxations



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originate from the shifting of gravity center to outside of the hip in the cases which suddenly jumped or fell [7,8]. The joint capsule and also round ligament may completely or partially tear [3].

The basic principles of hip luxation treatment are to provide stability without damage to joint surfaces for regenerate the normal functioning of the joint and to restrict the animal movements for healing surrounding soft tissues as soon as possible [3]. Closed reduction is usually possible in normal joint luxation without any complication [4-6,8,9]. However, closed reduction can be ideally made in 48-72 hours after trauma [1,10]. As increase of elapsed time, closed reduction becomes more difficult, because of severity and width of inflammation, fibrosis and cartilage damage also increases [2,11]. Some methods have been used for supporting of closed reduction such as Ehmer sling stabilization, ischio-iliac pinning or dynamic transarticular pinning [1,2].

The luxation should be treated surgically; if there are complications such as hip dysplasia existence prior to trauma, femoral and/or acetabular avulsion fractures, intra articular fractures, arthrosis and conditions such as multiple orthopedic injuries or chronic luxation, closed reduction failure and extreme instability after reduction [5,8,12,13]. Techniques which are used for the surgical treatment of coxofemoral luxations can be categorized as extracapsular such as suture of a joint capsule (capsulorrhaphy) [3,5,12], synthetic capsule technique [2,3,6,14], transposition of the greater trochanter [2,5,6,12], triple pelvic osteotomy [2,8] and intra capsular techniques such as Modified Knowles Toggle pin fixation [3,6,8,15,16], Toggle rod stabilization [17,18], trans acetabular pinning [2,6,19] transposition of the sacrotuberous ligament [20,21]. Additionally, flexible external fixation [8], total hip replacement [22-24] and femoral head and neck osteotomy [2,25,26] can be also applied for the treatment of hip luxation. For surgery, there are different surgical exposures techniques (such as cranio-lateral or dorsal approach) which can be selected depending on the method of surgery, luxation direction, accompanying complications and physician's habits [8,13,27-29]. Postoperative immobilization

should be provided with most of the surgical technique as with the closed reduction [3,19,28].

The joint capsule repair and tightening following the reduction is a technique that can be applied for luxations which occurred with simple tears [3,5,12]. Synthetic capsule technique is performed with eight shape suture between a transverse hole created in femoral neck (or a screw placed in the trochanteric fossa) and two bone screws which is inserted into the dorsal rim of the acetabulum at the 10- and 1-o'clock positions for the left hip and the 11- and 2-o'clock positions for the right hip. Care must be taken not to damage to the articular surface during screwing [1,3,8]. In intra articular techniques, mostly, caput femoris and acetabulum are connected to each other by various materials that mimic an intra-articular ligament. The major disadvantages of these methods are that they cause extra damage to the articular surface and may create predisposition to degenerative joint disease in long-term [8,30]. In the pinning techniques, complications such as pin tract infection or position changing of pin from where applied are possible [9,31]. The techniques of femoral head and neck osteotomy and total hip replacement are proposed for the dogs with hip dysplasia from mild to severe and for the animals with complications which restrain closed and open techniques [8].

In the present study, it was aimed to investigate and present that long-term clinical efficacy of the modification of synthetic capsule technique which is often preferred in case with wide joint capsule defect and considered to cause relatively fewer complications compared to other techniques for the treatment of coxofemoral luxation.

MATERIAL and METHODS

As materials, six dogs from various breeds and at different ages which were presented to Adnan Menderes University Veterinary Faculty Animal Hospital with complaints of severe lameness or inability to stand up and detected coxofemoral luxation at clinical and radiological examination were subjected (Table 1).

Table 1. The distribution of breed, age, gender, body weight, and clinical findings of cases

Tablo 1. Olguların ırk, yaş, cinsiyet, vücut ağırlığı ve klinik bulgularının dağılımı

No	Breed	Age (month)	Gender	Weight	PTP (day)	Presentation	Diagnosis
1	Mix Breed	24	M	28 kg	4	Severe Lameness (Unilateral)	Unilateral Luxation (Right)
2	Pointer	72	M	22 kg	3	Constant Recumbency	Unilateral Luxation (Right), Femoral Fracture (Left)
3	German Shepherd	120	M	26 kg	4	Constant Recumbency	Bilateral Luxation, Greater Trochanter Fracture (Right)
4	Husky	48	M	25 kg	5	Severe Lameness (Unilateral)	Unilateral Luxation (Left)
5	Kangal	18	F	37 kg	3	Severe Lameness (Unilateral)	Unilateral Luxation (Left)
6	Mix Breed	72	M	18 kg	4	Severe Lameness (Unilateral)	Unilateral Luxation (Left)

M: Male, F: Female; PTP, Posttraumatic Period

According to the history; each of hip luxation resulted from traffic accident, 2 of dogs were not able to stand up and 4 of dogs could not use related legs. Posttraumatic periods were 3 days for 2 dogs, 4 days for 3 dogs and 5 days were 1 dog.

During clinical and radiological examination; coxo-femoral luxations were determined as unilateral of 5 dogs, 3 at the left side and 2 at the right side, and bilateral of 1 dog. There was also femoral fracture in one dog with right sided hip luxation (case no. 2) and one dog with bilateral hip luxation (case no. 3) had also greater trochanter fracture. All of luxation was cranio-lateral direction, with one ventral direction exception (case no. 3, bilateral luxation). Treatment of the luxation in ventral direction of the dog which had bilateral luxation was not included the study. Furthermore, in study animals, it was determined that there were no other complications accompanying luxation and any stage of the hip dysplasia which exist prior to trauma by radiological examinations (Table 1).

Dogs underwent surgery following 24 h starving period. Induction of anesthesia was performed with combination of atropine sulfate 0.04 mg/kg body weight, subcutaneously (Atropin®, Teknovet, Turkey), xylazine HCl 0.5 mg/kg body weight (Alfazyne®, Egevet, Turkey) and ketamine HCl 10 mg/kg body weight (Alfamine®, Egevet, Turkey), intramuscularly. Anesthesia was maintained with inhalation of Isoflurane (Forane®, Abbott, Latina, Italy) at a concentration of 2%.

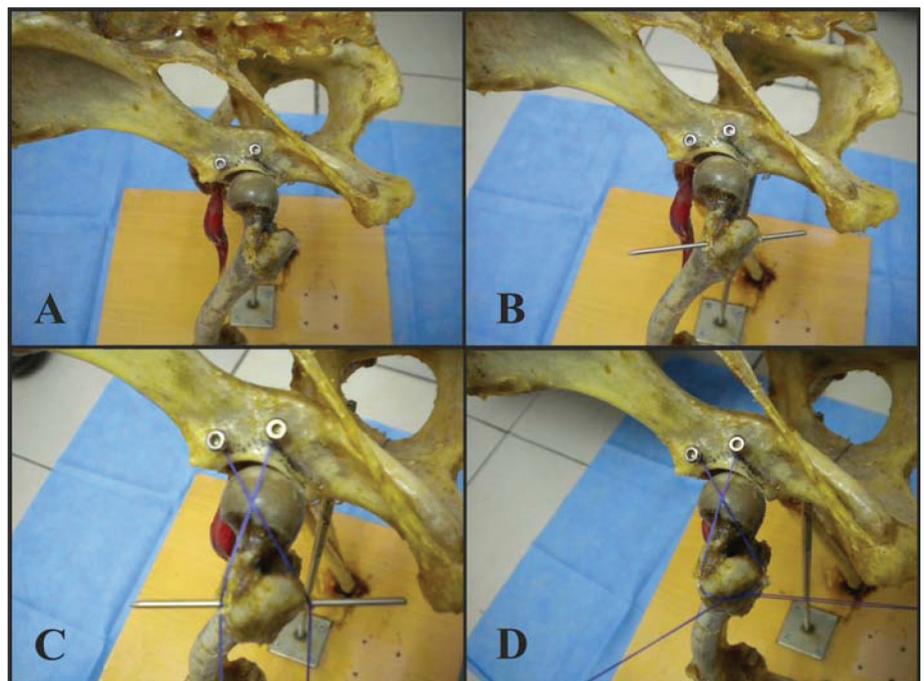
The dog was placed in the lateral recumbence upon operating table. After disinfection of the region, the operation was started with skin incision extended up and down from front of the greater trochanter by using dorsal

approach technique. After dissection of the subcutaneous tissues, the area where is in the triangle consisting of m. tensor fasciae latae and underlying rectus femoris at cranial, m. gluteus at dorsal and vastus lateralis at caudal was reached as a blunt. The joint capsule and the joint were exposed by external rotation. The remains of the round ligament and fibrous tissues were removed from the joint. Differently from original technique, two cortical bone screws (3.5Ø, 22-26 mm) were inserted into the dorsal acetabular rim about 5 mm away from the acetabular edge at the 10- and 12-o'clock positions for the left hip and the 12- and 2-o'clock positions for the right hip with a slope that provide not to enter into the joint (Fig. 1/A, Fig. 2/A,B). Also, the transverse hole was created in greater trochanter instead of femoral neck (or a screw placed in the trochanteric fossa) (Fig. 1/B). Non-absorbable monofilament suture material (USP:1, Ethilon, Ethicon, UK) was tied to the screw heads previously (Fig. 2/C), then the suture ends were passed as crosswise through the transverse tunnel in the trochanter (Fig. 1/C). Subsequently, the suture material was tied on the greater trochanter by stretching following that the femoral head was placed into the acetabulum (Fig. 1/D and Fig. 2/D). During above mentioned tying procedure, the femoral head was compressed into the acetabulum. The joint capsule was sutured within the possibilities. Skin and subcutaneous tissues were closed routinely.

Ehmer sling was applied to all dogs for one week after the surgery. Postoperative antibiotic, cefazolin sodium (20 mg/kg body weight, IM, Ilespor®, I. E. Ulagay, Istanbul) and anti-inflammatory drug, carprofen (2 mg/kg body weight, PO, Rimadyl®, Pfizer, Zaventem, Belgium), were prescribed to the all of cases for 5 days. After a week, weight bearing of the related leg was allowed.

Fig 1. The modified synthetic capsule technique; **A-** insertion of the screws into the dorsal rim; **B-** the transverse tunnel drilled in the greater trochanter; **C-** tying of the suture material to the head of screws and passing of the suture as crosswise through the transverse tunnel in the greater trochanter; **D-** tying and stretching of the suture material on the greater trochanter

Şekil 1. Modifiye sentetik kapsül tekniği; **A-** dorsal kenara vidaların yerleştirilmesi; **B-** trochanter major'e açılan transversal kanal; **C-** vida başlarına dikiş materyalinin bağlanması ve ipin trochanter major'deki transversal tüneldən çapraz şekilde geçirilmesi; **D-** dikiş materyalinin trochanter major üzerinde bağlanması ve gerilmesi



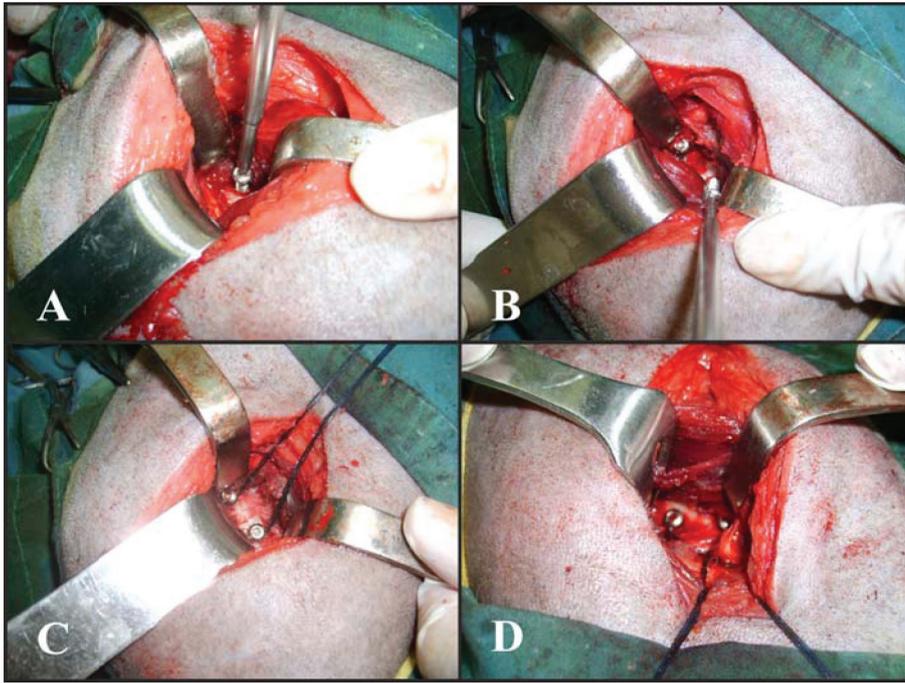


Fig 2. Implementation of the modified synthetic capsule technique during the operation; **A, B-** insertion of the screws into the dorsal acetabular rim; **C-** tying of the suture material to the head of screws; **D-** tying and stretching of the suture material between the screws and greater trochanter

Şekil 2. Operasyon sırasında modifiye sentetik kapsül tekniğinin uygulanışı; **A,B-** dorsal asetabular kenara vidaların yerleştirilmesi; **C-** vida başlarına dikiş materyalinin bağlanması; **D-** dikiş materyalinin vida başları ile trochanter major arasında bağlanması ve gerilmesi

Table 2. At postoperative periods, start of weight bearing (post-operative day) and lameness scoring (at week 1, 2, 4) of dogs

Tablo 2. Köpeklerin operasyon sonrası dönemde ağırlık taşımaya başladıkları süre (postoperatif gün) ve topallık skorları (1, 2 ve 4. haftada)

Case No	Start of Weight Bearing (post-op. day)	Lameness Scoring (Postoperative)		
		Week 1	Week 2	Week 4
1	9	Severe	Mild	Not Exist
2	12	Severe	Moderate	Not Exist
3	14	Severe	Moderate	Mild
4	10	Severe	Moderate	Not Exist
5	8	Severe	Mild	Not Exist
6	9	Severe	Mild	Not Exist

RESULTS

Clinical and radiological examinations were performed for all cases at weeks 1, 2 and 4 (Fig. 3). For lameness evaluation, each of the dogs was observed by investigator while an assistant made the dog walk at least 10 m and lameness status was scored as; not exist, mild, moderate and severe (Table 2).

At first week radiological examination, there was no problem in terms of the reduction in all of cases and then Ehmer slings were removed. None of the dogs were able to use the related legs. However, it was learned that one dog started to use the related leg on the day after, two dogs on 2 days after and one dog 3 days after removal of the Ehmer sling, with limping at different stages from the owners. Also, it was expressed that the dog with bilateral hip luxation were not able to stand up without support and the dog with right sided hip luxation plus left sided femoral fracture stood up with aid of the right leg but received support from bandage on left side while standing up.

Skin sutures were removed at second week controls. No infection-related complications were determined within this time period in all of cases. During clinical examination, 3 of dogs could use the related legs with frequently and one dog occasionally. The bandage on the dog's left sided femoral fracture, which applied after fracture repair, was removed and the dog started to use the right leg more. Besides, the dog with bilateral luxation was reluctant to stand up and showed rotational weight bearing between two rear legs, but more used the leg which performed synthetic capsule technique.

Clinical and radiological examination findings at fourth week were as follows; there was no complication related with reduction or screws in all of dogs, 3 of dogs were able to walk without limping and one dog with slightly limping, the dog with right sided hip luxation plus left sided femoral fracture could walk with the right side as completely healthy and with the left side as slightly limping and the dog with bilateral luxation (for treatment of right hip luxation with greater trochanter fracture, femoral head and neck osteotomy was performed) was not able to use

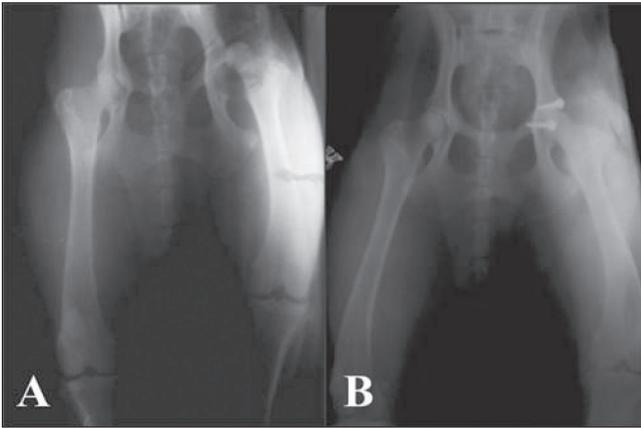


Fig 3. Preoperative (A) and postoperative 1st week (B) radiographs of the Case 6 (72 months old male mix breed dog)

Şekil 3. Altı numaralı vakanın (72 aylık, erkek melez köpek) preoperatif (A) ve postoperatif 1. hafta (B) radyografileri

both leg fully, but weight bearing mostly was performed with the leg which performed synthetic capsule technique.

The subsequent follow-up of the dogs were continued until 6th postoperative month for 3 of dogs and 12th postoperative month for others by phone call. At the end of these periods, it was learned that the 5 dogs which had “Not Exist” lameness score at week 4 were completely healthy and the one dog (case no. 3) could use both leg similarly but uncoordinatedly.

DISCUSSION

The mechanism of trauma-related hip dislocations; when the dog began to fall in the direction of impact force, the affected leg becomes adducted and the hip moves in ventrolaterally toward the ground. The adducted femoral head directs outward from the acetabulum to the extent permitted by the joint capsule and round ligament. When greater trochanter hits the ground, kinetic energy is transmitted to the caput femoris through the collum femoris. Caput femoris moves upward from acetabular rim, round ligament and joint capsule tear. Usually, caput femoris remains in craniodorsal position because of gluteal muscles contraction [7].

Based on this mechanism, it is understood that the restriction of the adduction of the leg is very important for prevention of relaxation in the postoperative period when joint capsule has not recovered yet. In our technique, distal screw was placed slightly cranially then the original synthetic capsule technique. Femoral connection was established by the transverse hole in the greater trochanter which is relatively more proximal instead of femoral neck (or a screw placed in the trochanteric fossa). Thus, it was hypothesized that the possibility of relaxation would reduce because of suture material tightening in this way would lead to more adduction and internal rotation of

the leg. The original synthetic capsule technique has also restrictive effect on adduction and external rotation of the leg similar to Ehmer sling [8]. In our study, to improve of those effects of original technique was intended.

Closed reduction is possible for normal hip joint within 48-72 h after luxation. If the luxated hip joint waits longer time, the probability of pathological changes of femoral head and acetabulum will increase [1,2,8,10]. Small osteochondral fragments or hemorrhage may cause to closed reduction failure by joint movement restriction. The round ligament and inward folding of the joint capsule may prevent reduction of the femoral head [6].

According to history, posttraumatic period of the dogs included in the study was range 3-5 days. For this reason, it was thought that open reduction is a healthier option. Study was carried out on a series of 6 cases. The dogs which successful closed reduction could be performed and the dogs which the modified synthetic capsule technique was found unenforceable because of any stage of hip dysplasia or accompanying complications were not included in this study. For this reason, the number of cases remained limited.

There are numerous methods which perform successfully for open reduction of hip joint. For hip luxation treatment, the options which have minimal intraoperative and post-operative complications possibilities should be considered. The joint capsule repair and tightening following the reduction is a technique that can be applied for luxations which occurred with simple tears [3,5,12], that's why indication of this method is a relatively limited. The reduction with Toggle pin can be disrupted by suture breaking between femoral head and acetabulum [29,32]. In a study, traumatic craniodorsal coxofemoral luxations in cats and small dogs were treated successfully by using using a modified Knowles technique, but mean weight of included dogs in this study was 15 kg [16]. In another study which compared toggle rod and suture anchor, it was reported that toggle rod constructs failed primarily by breakage of the suture at the rod eyelet and suture anchor constructs failed when the anchors pulled through the medial acetabular wall [17]. In two different studies which used toggle rod with 62 dogs and 13 dogs, relaxation rates were declared as 11% [18] and 23% [33], respectively. Besides, intraarticular stabilization methods may cause articular damage and subsequent arthrosis [30]. The complications related with transarticular pinning or De Vita pinning such as pin migration, pin loosening, septic arthritis, sciatic nerve injury, subluxation, femoral head and neck osteonecrosis, penetration to colon and rectum has been reported [4,8]. There is limited information about flexible external fixator because of it has not been widely used. Possible complications of this technique are hemorrhage, sciatic nerve damage, pin loosening, pin track drainage and disruption of the flexible band [9,31]. Additionally, total hip replacement [22-24] and femoral head and neck osteotomy [2,25,26] can be also

applied for the treatment of hip luxation, however these techniques are usually preferred, if there is degenerative joint disease. In a multicenter internet based study on assessment of canine total hip replacement in 170 dogs, there were only 6 dogs which applied total hip replacement with coxofemoral luxation treatment indication [24].

Lower complication rate, higher clinical healing rate [8,13,30,34-36] and also 0 to 6% relaxation rate based on small number case series [14,34] has been reported on synthetic capsule technique. In our study, 4 dogs of 6 had (case no. 1, 4, 5, 6) only unilateral coxofemoral luxation without complications and Dog 2 had femoral fracture and Dog 3 had right hip luxation with greater trochanter fracture together with the opposite side hip luxation. Four dogs which have only coxofemoral luxation began to use their related leg within 7-9 days. The other two dogs needed more time (12 days for Dog 2 and 14 days for Dog 3) to start using their leg which applied modified synthetic capsule technique. The dog with bilateral luxation (for treatment of right hip luxation with greater trochanter fracture, femoral head and neck osteotomy was performed) was not able to use both leg fully, but weight bearing mostly was performed with the leg which performed synthetic capsule technique.

No sign of infection was observed in postoperative period. 5 of all dogs healed with almost excellent degree. According to information from Owner, one dog (case no. 3) could use both leg similarly but uncoordinatedly. No relaxation occurred in all of cases.

In a study on femoral head and neck osteotomy, it was indicated that weight is not as much effective as age on the outcome, when the dogs were grouped as under and above 10 kg body weight [26]. However, according to some sources, femoral head and neck osteotomy require the dog below 17 kg [1] or 22 kg [37] body weight. Acar et al. [33] reported that toggle pin technique is appropriate for the dog below 10 kg body weight based on the observation of relaxation in 3 of 4 dogs which weighing over 10 kg in their study. In our study, all of the dogs were weighed over 17 kg and only one dog was weighed below 22 kg, however 5 dogs healed completely, including even the dog which weighed 37 kg. Besides, it was thought that the uncoordinated walking of the one dog (case no. 3) might be resulted from spinal nerve injury which occurred during trauma. These results have led us to consider that the technique is effective regardless of the weight of the dog.

Smith et al. [7] has been indicated the hip luxation does not arise from individually rupture of the round ligament, joint capsule or dorsal acetabular rim. The hip luxations in small animals mostly result from simultaneous rupture of the round ligament and the joint capsule [10]. Based on this information, it was thought that the strong joint capsule can support position of femoral head within acetabulum.

The expectation of the synthetic capsule technique is the formation of organized scar tissue and remodeling of the joint capsule provide stabilization of reduction [3,38]. Some studies on hip luxation and subsequent joint capsule and ligament healing showed that fibrous reaction of the joint capsule and round ligament healing occurred at 14th day [39]. Also, using of Ehmer sling or other temporary stabilization materials for 2 weeks has been shown to be effective enough in ensuring the long term stability of the joint [6,13]. In our study, although Ehmer sling removed from all of dogs 1 week after surgery, no relaxation occurred. This results were attributed to modification of the original technique more limits the joint movement by providing more adduction and internal rotation.

As a result, postoperatively, infection signs, the hip joint laxity or relaxation were not determined in clinical and radiological examinations. Although a precise comment could not be made about contribution of the modification to the prevention of relaxation because of 7 days Ehmer sling application, the lower relaxation rate (0%) compared with reported relaxation rate of original technique (6%) seem to be advantage.

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