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Clinical evaluation of complications after surgical treatment of patella dislocations in dogs: A retrospective study

Evaluación clínica de las complicaciones tras el tratamiento quirúrgico de las luxaciones de rótula en perros: Un estudio retrospectivo

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ABSTRACT

Patellar luxation is one of the important orthopedic problem in dogs. Patellar luxation, which has been accepted as a developmental disorder in recent years, usually occurs medially in small breeds and laterally in large breeds. The aim of this study was to evaluate surgical treatment (femoral trochleoplasty, tibial tuberosity transpositions and imbrication techniques together), postoperative complications, early and late results in dogs with patellar luxation. Thirty-two dogs with grade 3 and grade 4 patella luxation were used in this study. While patellar luxation was treated in all cases, tibia fracture was seen in one dog as the most important complication. During tibial tuberosity transpositions technique, attention should be paid to the cutting process and the tibia should not be weakened. In conclusion, the combined use of femoral trochleoplasty, tibial tuberosity transposition and imbrication techniques can be used for patellar luxation. Complete recovery may not be possible in grade 4 patellar luxations.

Key words: Dogs with patellar luxation; femoral trochleoplasty; imbrication; tibial tuberosity transpositions; postoperative complications

RESUMEN

La luxación rotuliana es uno de los problemas ortopédicos importantes en los perros. La luxación rotuliana, que se ha aceptado como un trastorno del desarrollo en los últimos años, suele ocurrir en la parte media en las razas pequeñas y en la parte lateral en las razas grandes. El objetivo de este estudio fue evaluar el tratamiento quirúrgico (trocleoplastia femoral, transposiciones de tuberosidad tibial y técnicas de imbricación en conjunto), complicaciones postoperatorias, resultados tempranos y tardíos en perros con luxación rotuliana. En este estudio se utilizaron 32 perros con luxación rotuliana de grado 3 y grado 4. Si bien la luxación rotuliana se trató en todos los casos, la fractura de tibia se observó en un perro como la complicación más importante. Durante la técnica de transposición de la tuberosidad tibial, se debe prestar atención al proceso de corte y no se debe debilitar la tibia. En conclusión, el uso combinado de la trocleoplastia femoral, la transposición de la tuberosidad tibial y las técnicas de imbricación pueden utilizarse para la luxación rotuliana. La recuperación completa puede no ser posible en las luxaciones rotulianas de grado 4.

Palabras clave: Perros con luxación rotuliana; trocleoplastia femoral; imbricación; transposiciones de tuberosidad tibial; complicaciones postoperatorias

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INTRODUCTION

Patellar luxation has an important place among hind leg lameness in dogs (*Canis lupus familiaris*). It is possible to encounter both large and small breed dogs [1, 2, 3, 4, 5, 6, 7]. The luxation may be medial or lateral. While medial luxation is seen in small breed dogs, lateral luxation is more common in large breed dogs [4, 6, 8, 9, 10]. The incidence of medial patellar luxation in small breed dogs is 12 times higher than in large breed dogs [4, 6, 9].

Patellar luxation has been defined as a congenital/developmental disorder in recent years [6, 7, 11, 12, 13], but it can also occur as a result of a traumatic accident that causes rupture or stretching of the joint capsule and fascia leading to femoropatellar instability [6, 11, 12]. Although the cause of patellar luxation is not fully understood, malalignment in the quadriceps mechanism are important in the development of this disease. Parts of the extensor mechanism of the knee joint are the quadriceps muscle group, the patella, the trochlear groove, the patellar ligament and the tibial tuberosity. Any irregularity in this mechanism leads to some anatomical changes in the distal femur and proximal tibia during the growth period, followed by patellar instability [6, 12, 14, 15]. Additionally, causes such as distal femoral varus or valgus, external or internal torsion of the distal femur, proximal tibial varus or valgus, internal or external tibial torsion and shallow trochlear sulcus structure also cause patellar luxation [6].

The diagnosis of patellar luxation is easy with clinical examination as well as radiological examination [6, 15, 16, 17, 18]. Among the surgical treatment methods, besides soft tissue techniques, bone correction operations such as block recession sulcoplasty, wedge recession sulcoplasty, and tibial tuberosity transposition have also been defined [5, 6, 19]. Various complications can be encountered in many of these operative techniques. These complications include recurrences, delayed union, lack of union or inadequate fixation at the osteotomy line, infection, implant failure and/or loosening, meniscal tear, tuberositas tibia fracture/avulsion, troclear fracture, seroma, and osteoarthritis. Among the implant–related complications, recurrence and fracture of the tibial crest are the most common complications [6, 20]. Excess body weight has been associated with a greater incidence of complications after operations of the patellar luxation [20, 21]. In a study [4] conducted in dogs with patellar luxation (medial luxation, lateral luxation, or both) weighing > 15 kg, postoperative complications were reported in 29% of dogs, and it was stated that there may be a relationship between body weight and the development of complications. In another study [19] with a similarly mixed population of 109 dogs with patellar luxation, the prevalence of dogs with complications and major complications and the frequency of relapses were greater among dogs weighing > 20 kg. Lateral patella luxation is more common in larger dogs. Therefore, dogs with a higher body weight may be at greater risk for postoperative complications [21]. It has also been reported that there may be a relationship between the simultaneous single session in cases with bilateral patella luxation and the risk of complications [6, 21]. It has been stated that this situation may cause excessive stress on the implants and healing tissues in dogs undergoing bilateral surgical repair in a single session, and recurrences may develop [21].

The purpose of this study was to report the history, clinical features and outcome in dogs treated surgically for patellar luxation. In this study postoperative complications and early and late outcomes were evaluated.

MATERIALS AND METHODS

The clinical records of 32 dogs who applied to Dicle University Veterinary Faculty Surgery Clinic between August 2019 and December 2022 with patellar luxation were analyzed. Gender, age, body weight, breed, etiology (developmental or traumatic), unilateral or bilateral luxation, duration of lameness, degree of luxation, direction of luxation (medial or lateral), degree of lameness at presentation, presence of concomitant cranial cruciate ligament rupture, treatment method and complications were evaluated.

Grade of patellar luxation and lameness score

Degree of patellar luxation and lameness, Gibbons *et al.* [4] were categorized as described. According to this;

TABLE I
The degrees of patellar luxation and lameness described by Gibbons *et al.* [4]

Degree of patellar luxation	Grade 1	The patella was easily luxated with manual pressure and returned to the femoral trochlea when released
	Grade 2	Patellar luxation occurred with rotation and stifle flexion of the paw and returned to the femoral trochlea
	Grade 3	The patella was permanently luxated but could be reduced with manual pressure
	Grade 4	The patella can be permanently luxated and manually reduced
Lameness scores	0	No lameness
	1	Mild or intermittent lameness
	2	Moderate lameness
	3	Severe lameness
	4	Non–weight bearing lameness

Examination and evaluation of the patient

Among the dogs diagnosed with patellar luxation according to clinical examination findings and radiological findings (FIG. 1), dogs with grade 3 and grade 4 were included in the study.

Surgery

Routine preparations such as shaving asepsis and antisepsis of the knee joint area of each dog with patellar luxation or patellar instability included in the study were made and limited to sterile covers.

Dogs with patellar luxation, induction with 1–3 mg·kg^{-1} IM xylazine HCl (Rompun 2%, Bayer, Turkiye), 15–20 mg·kg^{-1} IM ketamine HCl (Ketasol 10%, Richter Pharma, Turkiye) followed by inhalation with Sevoflurane (Sevorane 100%, AbbVie, Turkiye) was anesthetized.

Under general anesthesia, stifle arthrotomy was performed by parapetellar incision in all cases. The femoral trochlea, cranial cruciate ligament, and menisci were evaluated. If there were partial injuries or growths, they were removed. Femoral trochleoplasty was performed using a trochlear block recession as previously defined [3]. Tibial tuberosity transpositions were performed manually using a bone

FIGURE 1. Radiographic images of different cases. A: A case of bilateral medial luxation of the patella and unilateral coxofemoral luxation in the ventrodorsal position. B: A case of patellar luxation in the mediolateral view. C: A case of medial luxation of the patella in the tangential radiographic position

saw. In some cases, it was stabilized with one or two K–wires, using a tension band wire. In some cases, it was stabilized with two cortical screws. The compatibility of the patella within the femoral trochlea was evaluated. To increase the tension, a piece of medial or lateral soft tissues (deep fascia, retinaculum, joint capsule) was excised and closed by suturing at an appropriate tension.

Dogs with bilateral patellar luxation were treated by surgery in a single session.

Postoperative radiographs were obtained in all dogs and they were followed for 2 months. Short– and long–term outcomes of dogs were graded as very good (no lameness), good (mild or intermittent lameness), moderate (moderate lameness), or poor (severe lameness or non–weight–bearing lameness). In addition, the development of surgical complications was followed up.

RESULTS AND DISCUSSION

Of the 32 dogs included in the study, 18 were female and 14 were male. Dogs evaluated in the study were of various breeds (Miniature Pinscher (n=3), Pomerian (n=3), Terrier (n=5), Pekingese (n=3), Poodle (n=3), Pug (n=2), Spaniel Cocker (n=2), Chihuahua (n=3), Golden Retriever (n=1), Labrador Retriever (n=1), Rottweiler (n=2), Chow Chow (n=1), Belgian Malinous (n=2), German shepherd (n=1)). Their ages ranged from 8 to 22 months and their body weights ranged from 6 to 56 kg. Five of these cases had lateral patellar luxation and they were large breed. Only 1 of these five dogs had unilateral luxation and the other four had bilateral luxation. In cases with medial patellar luxation, 27 dogs were bilateral and 3 dogs were unilateral. Patellar luxation was considered to be developmental in all cases in this study. Especially in the radiological examination, the deformation of the tibia in the medial dislocations was remarkable.

Patellar luxation type, degree and lameness scores are summarized in TABLE II.

There was no cranial cruciate ligament rupture in any of the patients. However, there was a meniscus laceration in one case. In another case, there were osteophytic growths in the femoral lateral trochlea.

Surgically, femoral trochleaplasty (trochlear block recession) was performed by a single surgeon with the same procedure in all cases. For tibial tuberosity transposition, K wire and tension band (FIG. 2) were used in 14 cases (43.75%), while two cortical screws (FIG. 3) were used in all other 18 cases (56.25%).

TABLE II
Patellar luxation type, degree and lameness scores of the cases

Type of patellar luxation		Degree of luxation		Scores of lameness					BW (mean, kg)	Gender	
		Grade 3	Grade 4	0	1	2	3	4		F	M
Medial n=27	Unilateral n=3	–	3 (2R,1L)	–	–	–	–	3	9.33	3	–
	Bilateral n=24	22	2	–	–	–	19	5	19.54	15	9
Lateral n=5	Unilateral n=1	–	1 (R)	–	–	–	–	1	56.00	–	1
	Bilateral n=4	–	4	–	–	–	–	4	50.50	0	4

R: Right, L: Left, F: Female, M: Male

In all dogs with medial patellar luxation weighing less than 25 kg, lameness disappeared at the end of the 4th postoperative week. In a 28 kg dog (3.12%) with medial patellar luxation and a K–wire and tension band, healing at the incision site was delayed, the site was opened, and treatment took longer than expected. In a 35 kg dog with bilateral medial patellar luxation (3.12%), the tibia was fractured on the 3rd postoperative day (FIG. 2).

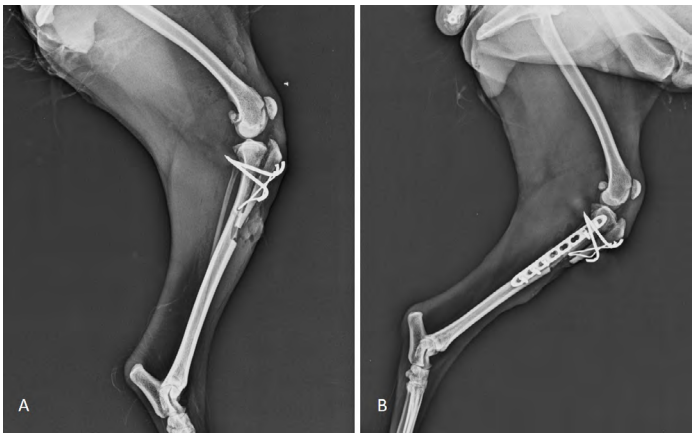

FIGURE 2. Radiograms of the case with complication with K wire and tension band. A. Radiogram of patella luxation after K wire and tension band application in operative surgery. B. Radiogram of plate osteosynthesis treatment of tibia fracture after patellar luxation surgery. In tuberositas tibia transposition technique, it is important not to weaken the proximal tibia

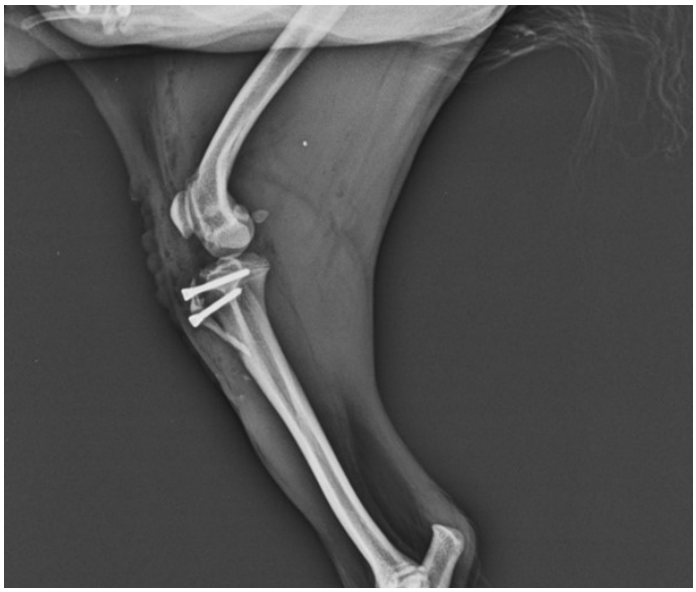

FIGURE 3. A radiogram of one of the cases in which two cortical screws were used for tibial tuberosity transposition in patella luxation

Those with grade 4 patellar luxation (5 medial, 5 lateral) could not fully recover in the long term, these dogs (31.25%) had moderate lameness despite using their legs. No recurrence was observed in terms of patellar instability in any of the cases.

A population of dogs with patellar luxation was not looked at in this study. Only dogs with 3rd and 4th degree patellar luxation were included in the study. The technique applied in all of these patients was performed by the same team. Postoperative complications were evaluated in the follow-up phase of the study after the operations. As the first detection, lateral luxation of the patella was seen in large breeds (5 dogs, ≥ 50.50 kg), while medial luxation was common in small breeds (27 dogs, ≤ 19.54 kg) (TABLE II).

It has been reported that the prognosis of medial patellar luxation is more favorable than that of lateral patellar luxation, but it has not been scientifically confirmed. It has also been associated with excess body weight and the presence of postoperative complications [21]. It is already known that lateral dislocations are more common in large breed dogs [4]. Many studies have reported an association between cranial cruciate ligament (CCL) rupture [20] and postoperative complications, depending on excess body weight (>20) and the degree of patellar luxation [6, 21, 23].

Shaver *et al.* [21] reported that lateral patella luxation is more common in large dogs with a large body weight and that high body weight in these dogs poses a greater risk for postoperative complications. In this study, CCL rupture was not encountered, complications were seen in only one case. A tibial fracture was encountered in this 35 kg patient with bilateral medial luxation. This may be attributed to the weakening of the tibia with the load on the tibia or when transposition of the tuberositas tibia.

It has been reported by some authors that patellar dislocation is more common in male dogs in general [1, 2] However, different authors have reported that it is more common in males among large dogs and in females among small breed dogs [4]. The data obtained in this study support the opinion of the authors in the second group in terms of gender. The age of the dogs in this study was not different from previous studies [1, 2, 4]. The ages of the dogs with patella dislocation were 8–22 months.

There are authors who argue that there is a relationship between patella luxation and rupture of the cranial cruciate ligament. It is thought that the risk of cranial cruciate ligament rupture is increased in dogs with medial patellar luxation due to incorrect alignment of the extensor mechanism of the knee joint and internal rotation of the proximal tibia [1, 8, 16]. Contrary to this information, Hayes *et al.* [2] reported that they did not find a difference in the prevalence of cranial cruciate ligament rupture with patellar luxation. Remedios *et al.* [1] also argued that dogs with chronic patellar luxation are old animals and that cranial cruciate ligament lesions develop due to the increase in age.

In this study, all patients were routinely evaluated for cruciate ligament rupture during clinical examination. No cruciate ligament rupture was found in the dogs included in the study, but if it had been ruptured, the treatment would have changed. In addition to sulcoplasty, a different surgical procedure such as the fishing line method or tibial plateau level osteotomy would be required for cruciate ligament rupture. The reason why cruciate ligament rupture was not observed in this study may be related to the fact that the age of the cases was less than 22 months and their etiology was not traumatic.

Although the surgical plan varies according to the degree of patellar luxation, proximal tibia or distal femur deformities are also effective on the surgical plan [3, 4, 15, 24, 25]. In this study, only grade 3 and grade 4 dogs were used among dogs with patellar luxation. Therefore, a combination of femoral trochleaplasty (trochlear block recession), tibial tuberosity transposition, and soft tissue surgery (to create tension without patellar instability) was used in each dog. These techniques have been described in previous studies [3, 4, 8, 15, 19] and are known in practice, and are often used in combination depending on the case.

Postoperative complications in these techniques include reluxation, femoral trochlea and tibia fracture, osteoarthritis, meniscus tear, pin migration, implant failure, delayed healing or no healing. In present study, no significant complication related to the techniques developed. Most importantly, patellar luxation did not recur. Wound formation was observed in one case in which K wire and stretching tape were applied. The most serious postoperative complication was fracture of the tibia in only one case. Therefore, the tuberosity tibia should not be taken too deep during tibial tuberosity transposition. Thus, the proximal tibia is not weakened.

In the tibial tuberosity transposition technique, two K wires and a tension band are also recommended. The compatibility of the patella is achieved very quickly. It is easy and practical during operation. This procedure was performed very easily in cases where K wire and tension band were applied, and no problems were detected in the intraoperative stage [15, 26]. In this technique, pin migration and associated seroma formation are among the minor complications in the postoperative period. Although this pin migration requires a minor surgical procedure to remove Kirschner wires, it is classified as a minor complication [6, 22, 27].

Fullagar *et al.* [20] emphasized that the use of a single K-wire and screw in the tibial tuberosity transposition technique may result in fracture of the tibia as a postoperative complication or implant failure. In this study, two K-wire and tension band techniques were used in 14 cases. In only one case, a wound occurred on the skin and

healing was delayed. In addition, in some of the 18 cases, the tibial tuberosity transposition technique was achieved with two cortical screws. Among the cases fixed with cortical screws were dogs with a body weight greater than 50 kg. No complications related to screw use were observed. Therefore, two screw applications are more practical than K wire and tension band. With this study, screw application can be recommended for both small breed dogs and large breed dogs.

It was noteworthy that the hip joint was also affected in the cases presented in this study. While 6 of these cases had medial luxation of the patella, 2 had lateral luxation. In lateral or medial patellar luxation, the involvement of the hind leg changes with the disruption of the quadriceps mechanism. In other words, the caput femoris is pulled out of the acetabulum. Therefore, it is thought to cause subluxation or joint incompatibility.

Dogs with grade 4 patellar luxation (5 medial, 5 lateral) could not fully recover in the long term. These dogs had moderate lameness despite better use of their legs. This situation can be associated with the development of patellar luxation, anatomical deformation of the joints and bones with stifle, or further complications such as osteoarthritis.

Di Dona *et al*. [6] reported in a study they conducted in Pomerians that there was 100% success in the treatment of dogs with second degree patellar luxation, 11% reluxation and complications in those with third degree luxation, high reluxation and complications in fourth degree cases, and skeletal deformities in 36% of these dogs.

CONCLUSION

In conclusion, femoral trochleoplasty, tibial tuberosity transposition (extremely practical and easy with cortical screw) and imbrication techniques can be used in patellar luxation cases (especially in non-traumatic ones) in terms of postoperative complications. In addition, it is easier and more compatible to apply two screws in the fixation of tuberosity tibia transposition, especially in large and small breed dogs. Since it is not always possible to correct permanent damage in grade 4 patellar luxations, early detection and time of surgery were found to be important.

Availability of data and materials

The data that support the findings of this study are available on request from the corresponding author (EÇ).

Conflict interests statement

The authors declare that they have no conflicting interests.

Informed consent

It is declared that this study, whose information is given above, is among the studies that do not require ethics committee approval, since it is a retrospective study.

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