

Postoperative Complications Associated with Tibial Tuberosity Transposition Surgery for Medial Patellar Luxation in Dogs: 77 Cases (2007-2011)

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Abstract : This is a retrospective study describing postoperative complication encountered with surgery performed in dogs with medial patellar luxation (MPL). During the 4-year period, 77 operations had been performed in 66 dogs for correction of MPL. The patients were surgically treated with medial soft tissue release, lateral soft tissue tightening, trochlear block recession, and/or tibial tuberosity transposition (TTT). Their prognoses were periodically evaluated for 6 months postoperatively. The failure rate was higher in revision surgery than in the first surgery, and the most common postoperative complication was migration of the tibial tuberosity fragment. The causes for the migration of the tibial tuberosity fragment were identified as the downward insertion of a surgical pin, the eccentric position of an inserted pin in the tibial tuberosity fragment, and blunt angle formation of the tibial tuberosity. It is suggested that the appropriate methods for TTT could minimize complications and lead to a good prognosis.

Key words : dog, medial patellar luxation, tibial tuberosity transposition.

Introduction

Patellar luxation is a common orthopedic disease in dogs and could lead to pain, lameness, and degenerative joint disease (6,9). The condition has mainly been recognized in toy and miniature breeds but appears in large breed dogs. Patellar luxation is a developmental disorder associated with multiple anatomical abnormalities of the pelvic limb and medial luxation is more frequent than lateral luxation. If patients have mild clinical symptoms, non-steroidal anti-inflammatory drugs and exercise restraint are sufficient as treatment modalities, unless surgical treatment is required due to structural malformation of the stifle system (5). Until recently, many surgical methods have been described to stabilize the stifle joint (6,7, 11). Among these techniques, trochleoplasty, tibial tuberosity transposition (TTT), medial soft tissue release and lateral soft tissue tightening have been mainly used for medial patellar luxation (MPL) surgery in toy and small breed dogs (1). The purpose of this study is to investigate the prognosis and the postoperative complication of MPL surgery and to determine more appropriate techniques by analyzing the failure causes in cases.

Materials and Methods

Criteria for selection of cases

Medical records of all dogs admitted to the Veterinary

Medical Teaching Hospital of Seoul National University for surgery to correct a MPL from December of 2007 to March of 2011 were reviewed. A diagnosis of a MPL was determined on the basis of physical examination and radiographic findings. Inclusion criteria required preoperative, postoperative and follow-up (approximate 6 months after surgery) radiographs as well as detailed surgical reports, postoperative treatments, and descriptions of any treatment given for complications. Data obtained from the medical records included breed, age, sex, affected limb (left/right), pre-operative grades of MPL, surgical procedures, and post-operative lameness evaluation.

Grade of patellar luxation

Patellar luxations were graded as follows (6).

Grade 1: The patella was easily luxated with manual pressure but returned to the femoral trochlea when released.

Grade 2: The patellar luxation occurred with rotation of the paw and flexion of the stifle, and returned to the femoral trochlea.

Grade 3: The patella was permanently luxated but could be reduced with manual pressure.

Grade 4: The patella was permanently luxated and could not be reduced manually.

Surgical methods

Patients were surgically treated with the following techniques: soft tissue reconstruction (medial soft tissue release and lateral soft tissue tightening) (5), trochlear block recession

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(5,10), and TTT (5). The surgeon chose the appropriate technique(s) depending on the severity of the clinical symptoms and the structural malformation causing the malalignment of the stifle joint.

Post-operative care

A modified Robert Jones bandage was applied for 3 days after the operation and then leash walking for 4-6 weeks. Cephalosporin (Cefadroxil, Dae Woong Pharm., Korea; 22 mg/kg, bid) and tramadol (Tridol, Yuhan Corp., Korea; 2 mg/kg, bid) were administered orally for 10 days postoperatively. Depending on the symptoms, meloxicam (Metacam, Boehringer Ingelheim Vetmedica Inc., USA; 0.1 mg/kg, sid) was administered orally.

Subjective evaluation

Subjective weight bearing and lameness were evaluated (Table 1), which were modified from the subjective evaluation score of Bubenik (3).

Outcome

The dogs were clinically assessed at the 2, 4, 8, 12, 16, and 24 weeks after the stifle surgery. An orthopedic examination was done same as the preoperative evaluation. Full recovery was defined as cases with 0 scores for both weight bearing and lameness evaluations within 6 months. Partial recovery was defined as a 0 score for either weight bearing or lameness, and no recovery was defined as both evaluations having no 0 scores.

Statistical analysis

Statistical analysis was performed by a statistical software program (SPSS version 19.0, SPSS, Inc., Chicago, IL, USA). Nonparametric methods (Chi-squared and Fisher's exact tests) were used for univariable associations between categorical variables (breed, sex, age, lameness, weight bearing, affected

limb, luxation grade, surgical method, complication and follow-up evaluation). The *P*-value was less than 0.05.

Results

Signalment

During the 4-year study period, 77 operations were performed for correction of MPL in 66 dogs. Eleven dogs underwent bilateral MPL surgery. Thirteen breeds were represented, with the most common being Maltese ($n = 20$, 30.3%) and Yorkshire terrier ($n = 18$, 27.3%). There were also Poodle ($n = 8$), Miniature pincher ($n = 4$), Pomeranian ($n = 3$), Chihuahua ($n = 3$), Bichon Frish ($n = 2$), Cocker spaniel ($n = 2$), Alaska malamute ($n = 2$), Papillon ($n = 1$), Pug ($n = 1$), Labrador retriever ($n = 1$), and 1 mixed breed. The patients' age ranged from 1 to 15 years (mean age 6.3 years). Thirty-four dogs were male (including castrated ones) and 32 dogs were female (including spayed ones).

Grade of luxation

In the affected stifles ($n = 71$, except for unknown grade), there were 3 cases (4.2%) with grade 1, 12 cases (16.9%) with grade 2, 36 cases (50.7%) with grade 3, and 20 cases (28.1%) with grade 4.

Surgical techniques

The following techniques were used: soft tissue reconstruction (medial soft tissue release and lateral soft tissue tightening) only ($n = 3$, 3.8%), soft tissue reconstruction with trochlear block recession ($n = 3$, 3.8%), soft tissue reconstruction with TTT ($n = 8$, 10.3%), and soft tissue reconstruction with trochlear block recession and TTT ($n = 63$, 81.8%).

Prognosis

The full recovery rates for MPL grades 1 to 4 were 100%, 91.7%, 80.6%, and 50.0%, respectively. The partial recovery rates for grades 2 to 4 were 8.3%, 11.1%, and 30.0%, respectively. The no recovery rates for grades 3 and 4 were 8.3% and 20.0%, respectively (Table 2). Compared with the prognosis among the MPL grades, higher grades of MPL had the lower recovery rates after surgery. Especially, the prognosis for grade 4 was significantly lower than those of grades 2 and 3 ($P < 0.05$).

Table 1. Subjective evaluation score

Subjective evaluation list		Score
Weight bearing	Full weight bearing	0
	Almost full weight bearing	1
	Weight bearing on 2, 3rd footpad	2
	Toe-touching	3
	Intermittent weight bearing	4
	Non-weight bearing	5
	Lameness	No lameness
Lameness after exercise		1
Slight lameness at a walk		2
Moderate lameness at a walk		3
Reluctance to walk		4

Table 2. Recovery rate focused on grade ($n = 71$)

Grades of luxation	Full recovery	Partial recovery	No recovery
Grade 1	100% (3/3)	0%(0/3)	0% (0/3)
Grade 2	91.7% (11/12)	8.3% (1/12)	0% (0/12)
Grade 3	80.6% (29/36)	11.1% (4/36)	8.3% (3/36)
Grade 4	50.0% (10/20)	30.0%(6/20)	20.0% (4/20)
Total	74.6% (53/71)	15.4% (11/71)	10.0% (7/71)

Table 3. Complications after medial patellar luxation surgery

Complications	Number of cases
Migration of tibial tuberosity fragment	7
Patella instability	5
Pain caused by pin irritation	3
Pin migration (after tibial tuberosity union)	2

Complication and revision surgery

Major and minor complications occurred in 17 cases (22.1%) out of 77 MPL surgeries. Major complications involving migration of the tibial tuberosity fragment ($n = 7$, 9.1%) and pain caused by pin irritation ($n = 3$, 3.9%) occurred in 10 of 77 stifle joints. Minor complications, including patella instability ($n = 5$, 6.5%) and pin migration ($n = 2$, 2.6%) occurred in 7 of 77 stifle joints (Table 3). Patellar instability means mild relaxation of patella which do not need the revision surgery. Age, breed, sex and limb affected were not significantly associated with complications. Patients who had major complications required revision surgeries, such as re-TTT or pin removal procedures.

Of the 10 stifle joints with major complications, 6 (60%) underwent a revision surgery. The number of failure cases for the first MPL surgery was 1 case (1/68, 1.5%) and 5 cases (5/9, 55.6%) for the second surgery. The causes of TTT failure were identified as a downward insertion of the surgical pin, an eccentric position within the tibial tuberosity fragment of the inserted pin, and blunt angle formation of the tibial tuberosity (Fig 1).

Discussion

In the present study, toy and small breeds, especially Malteses, Yorkshire terriers and poodles were over-populated

(71.4%). Compared to other studies, this percentage of toy breed dogs was extremely high. However, it is a reasonable result considering the trend for favoring smaller breeds of dogs in Korea. A distribution of the onset age less than 5 year old was identified in a majority of the patients, although dogs of any age can have MPLs (5).

Like other outcomes from retrospective studies on MPL surgery (1,4,6), a lower full recovery rate for grade 4 was observed in the present study. The reason for a lower recovery rate for grade 4 is probably due to increasing anatomical deformities. Therefore more surgical techniques, such as transplantation of the origin of the rectus femoris muscle and corrective osteotomy, as well as trochleoplasty, TTT, medial soft tissue release and lateral soft tissue tightening, is needed to correct the MPL grade 4.

The tibial tuberosity can be transposed to improve quadriceps alignment (8). Failure to do so will result in a high incidence of re-luxation of patella following surgery. In the present study, a major complication associated with this technique was the migration of the tibial tuberosity fragment, and it required a second surgery (1,2,6). Therefore, the potential for complications with this technique should not be underestimated. Some cases had complications of patellar instability, which was caused by forming too wide of a patellar groove, but it did not have an effect on clinical symptoms. However, these cases should be monitored for over a year for their long-term prognosis.

Revision surgery had a significant higher probability of failure than single surgery since the anatomical structures were mostly transformed due to the former surgery or malformation of the stifle structure compared with normal structures. Moreover, because of disuse atrophy in the affected limb after the first MPL surgery, it takes more tension to fix the contracted patellar tendon in the second operation. In the



Fig 1. Representative figures of postoperative complications associated with tibial tuberosity transposition for medial patellar luxation. (A, B) Surgical pin was inserted downward from the tibia and the end of the pin did not be bent in the post-operative radiograph of the TTT surgery. Proximal migration of the tibial tuberosity fragment was identified in the radiograph 2 weeks after the surgery. (C, D) Inserted pin was located in the rim of the tibial tuberosity fragment in the postoperative radiograph of the TTT surgery. Migration of the tibial tuberosity fragment was identified in the radiograph 2 weeks after the surgery. (E, F) In the pre-operative radiograph, the relative blunt angle of the tibial tuberosity was identified. Proximal migration of the tibial tuberosity fragment was identified in the radiograph 4 weeks after the surgery.

higher grade cases, the medially luxated patella transposed larger distances to the groove. These factors might be the causes for increasing the failure rate in the revision surgery.

Considering the cases that required additional surgery, four precautions are suggested when performing the TTT method. First, the surgical pin should be inserted in the “medio-proximo-caudal” direction from the somewhat lateral area of the tibial tuberosity. If pin was inserted distally, the tibial tuberosity fragment could easily migrate proximally by the axial force mechanism of patellar ligament. Second, the pin should be into the exact point, the middle of the thickest area of the osteotomized tibial tuberosity. The thin area of the bone fragment can easily crack. Third, after inserting the pin, the end of the cut pin should be bent. The end of the bent surgical pin prevents the fragment from coming out. Lastly, the tibial tuberosity angle should be checked before the surgery. If the angle is blunt, the tibial tuberosity fragment should be intentionally osteotomized larger. Performing TTT with the above cautions, the surgery will be expected to have a successful outcome.

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개에서 내측 슬개골 탈구 교정을 위한 경골 조면 이식술과 관련된 수술 후의 합병증: 77 증례 (2007-2011)

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요 약 : 이 연구는 개에서 내측 슬개골 탈구 수술 후에 발생할 수 있는 합병증을 후향적으로 분석한 연구이다. 4년 동안 내측 슬개골 탈구를 교정하기 위해 66마리의 개에서 77건의 수술이 시행되었다. 수술은 내측 연부 조직 이완, 외측 연부 조직 긴장, 활차구 사각 성형술, 경골 조면 이식술을 이용하여 실시되었다. 수술 후 6개월 동안 정기적으로 예후를 평가하였다. 실패율은 처음 수술을 한 경우보다 재수술을 한 경우에 더 높았고, 가장 흔한 수술 후 합병증은 경골 조면 조각의 변위였다. 경골 조면 변위는 편이 아래쪽으로 삽입되거나, 편이 경골 조면 조각의 가장자리에 삽입된 경우 혹은 경골 조면이 둔각인 경우에 발생했다. 따라서 경골 조면 이식술을 주의하여 실시하면 합병증을 최소화 할 수 있으며 좋은 예후를 기대할 수 있을 것으로 사료된다.

주요어 : 개, 내측 슬개골 탈구, 경골 조면 이식술