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Bilateral Patellar Groove Replacement in a Dog with Iatrogenic Trochlear Groove Damage

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Abstract : A 2-year-old, 1.94 kg spayed female Toy Poodle was referred for revision surgery for patellar reluxation following surgery for bilateral medial patellar luxation (MPL). Intermittent non-weight-bearing lameness of the right hindlimb and weight-bearing lameness of the left hindlimb were evident on general inspection. A physical examination revealed that there was a bilateral grade 4 MPL. On radiographs, the medial and lateral trochlear ridge was bilaterally worn out. Patellar groove replacement (PGR) was performed in two stages to replace the bilateral femoral trochlea that had a severely worn out groove. Corrective femoral osteotomy with increasing anteversion angle, tibial tuberosity transposition, medial releasing, lateral imbrications and PGR were performed on the right hindlimb. Six months after surgery on the right hindlimb, a PGR prosthesis was positioned medially on the frontal plane and tibial tuberosity transposition and lateral imbrications were performed on the left hindlimb. Two weeks after surgery, reluxation of the patella occurred on the left hindlimb. The tibial tuberosity transposition was performed to realign the patella more laterally than the previous surgery, and a patellar sling was applied. Two years after the last surgery, the patient showed no pain on the stifle joint and satisfactory weight-bearing ambulation. Reluxation did not recur. PGR maybe a successful treatment for dogs with iatrogenically damaged and/or worn out patellar grooves.

***Key words* :** medial patellar luxation, patellar groove replacement.

Introduction

Medial patellar luxation (MPL) is one of the most common orthopedic issues in small breed dogs. MPL is a congenital disorder that results from multiple musculoskeletal abnormalities of the pelvic limbs (3,9,12). MPL is classified based on severity: Grade 1, 2, 3 and 4. Surgical treatment is often recommended for grade 2, 3 and 4 patellar luxations. A Grade 1 patellar luxation is only considered for surgical treatment when lameness is evident (4,15,20). Many surgical treatment techniques have been described and focus on realignment of the quadriceps mechanism and reinforcement of the patella within the trochlear groove of the femur, such as trochlear block or wedge recession, retinacular imbrication, and tibial tuberosity transposition (10,16). Conventional surgery for, Grade 1, 2 and 3 MPL typically has good outcomes. Grade 4 MPL with conformational deformities, however, is associated with poor outcome (1). Therefore, recently, corrective femoral osteotomy has been reported to correct the deformity of the distal femur, which may make it easy to obtain proper alignment of quadriceps mechanism. The combination of corrective femoral osteotomy and conventional surgical treatment have shown good surgical outcome in patients who have a grade 4 MPL with bone deformity (8,14,18).

Trochleoplasty is a surgical technique that modifies the shape of the trochlear groove to obtain enough depth and width to allow approximately 50% of the patella to protrude above the trochlear ridges. Thus, this surgical technique provides optimal patellar depth through the full range of the stifle motion (2,19). Complications of this technique rarely occur, but include fracture of the trochlear ridge and iatrogenic trochlear groove damage. When complications occur, revision surgery proves to be challenging, especially in the presence of iatrogenic trochlear groove damage (1,5,13).

Patellar groove replacement (PGR) is the surgical technique that is used to replace the trochlear groove with an artificial prosthesis. This technique has recently been reported as having good prognosis in conditions where the trochlear groove has severe erosion and osteophytes due to luxation of the patella (6). However, few cases have been reported on the PGR technique. Furthermore, there have been no reports that address the simultaneous application of PGR with corrective femoral osteotomy on trochlear groove damage caused by complications of trochleoplasty.

The objective of this case report is to describe the surgical technique and long-term outcome of applying the PGR with and without femoral corrective osteotomy on the right and left hindlimbs, of patients with bilateral iatrogenic trochlear groove damage.

Case

A 2-year-old, 1.94 kg, intact female, Toy poodle was referred with lameness after correction of bilateral MPL at a local animal hospital eight months ago. Intermittent non-

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Table 1. Preoperative and postoperative measurement values for the range of motion of both stifle joint

		Postoperative			
	Preoperative	5 weeks	10 weeks	2 years	Reference
Right hindlimb					
Flexion	110º	74º	58º	70º	45º
Extension	140º	150º	165º	134º	160-170º
Left hindlimb					
Flexion	100º	ND	ND	60º	45º
Extension	150º	ND	ND	141º	160-170º

ND, not done.

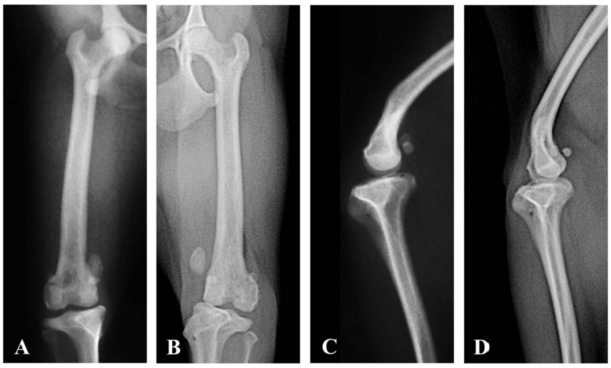

Fig 1. Preoperative craniocaudal and mediolateral radiographs of both stifle joints. Severely worn out femoral trochlear groove is observed in both stifle joints. Right stifle joint (A, C). Left stifle joint (B, D).

weight-bearing lameness of the right hindlimb and weight-bearing lameness of the left hindlimb was evident on general inspection. Physical examination revealed a bilateral grade 4 MPL and decreased range of motion at the stifle joint (Table 1). On radiographs, the medial and lateral trochlear ridge was worn out (Fig 1). The anatomic lateral distal femoral angle (aLDFA) was 107º and 106º in right and left hindlimbs, respectively. The anteversion angle was 10º and 12º in the right and left hindlimbs, respectively.

To correct this condition, surgery was performed in two stages. During the first stage, MPL correction was performed by femoral corrective osteotomy and PGR on the right hindlimb. Prior to surgery, premedication was carried out with atropine (0.02 mg/kg SC, Atropine Sulfate Daewon®; Dae Won Pharm, Korea) and butorphanol (0.3 mg/kg IM, Butophan Inj®; Myung Moon Pharm, Korea). Anesthesia was induced with propofol (4 mg/kg IV, Provive®; Myungmoon Pharm, Korea) and maintained with isoflurane (Forane soln®, JW pharmaceutical, Korea) delivered in oxygen. Cephalexin (22 mg/kg IV q 2 hours, Methilexin Inj®, Union Korea Pharm, Korea) was administered prior to induction of anesthesia. The patient underwent epidural anesthesia with 2% lidocaine (1 ml/4.5 kg, Lidocaine Hcl Dalhan Inj®, Dai Han Pharm, Korea).

A cranio-lateral approach was made to the right stifle joint and lateral arthrotomy was performed. Intraoperatively, the femoral trochlear groove was flat (Fig 2A). The flat surface

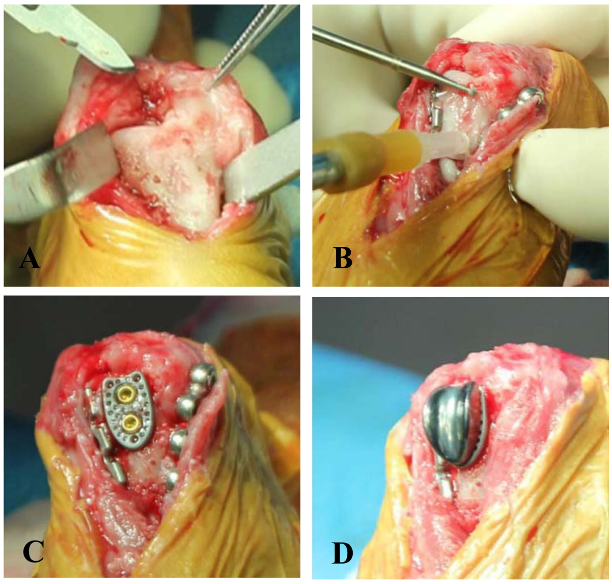

Fig 2. Intraoperatively, femoral trochlear groove was flat and the level of flat surface was just below the origin of the long digital extensor tendon (A). A high speed burr was used to make a flat surface on the femoral groove (B). The base plate was attached to the bone with two titanium cortical screws (C). The final prosthesis is attached to the base plate by means of three conical pegs fitted into receiving conical holes (D).

was just below the origin of the long digital extensor tendon. Medial capsulotomy and releasing the sartorius and vastus medialis muscle at the point of insertion of the proximal patella were performed. Femoral closing wedge osteotomy was performed using an oscillating saw. To increase the anteversion angle, the distal fragment was internally rotated 20º and the bone fragment was fixed by a double-locking plate. And then, a high speed burr was used to remove fibrous tissue and osteophytes to make a flat surface in the femoral groove (Fig 2B). To increase osteointegration, multiple holes were made using a Kirschner wire and cancellous bone graft was performed prior to applying the PGR prosthesis. A trial prosthesis was positioned on the surface of the femoral trochlear groove to ensure that the size was correct and the patella was reduced in the prosthesis to assess the stability of the reduction with flexion and extension. After proper positioning of the trial prosthesis was found, the base plate of the final PGR prosthesis was fixed on the same position with two titanium cortical screws (Fig 2C). The final prosthesis is attached to the base plate by means of three conical pegs fitted into receiving conical holes (Fig 2D). Finally, the patella was reduced to fit the PGR prosthesis and tibial tuberosity transposition was performed for proper alignment of the quadriceps mechanism. The operative field was irrigated and the surgical incision was closed in layers.

Postoperative radiography revealed proper limb alignment and implant positioning (Fig 3A and B). The femoral anteversion angle increased from 10º preoperatively to 30º postoperatively (Fig 3H and I). The patient performed exercise restriction and gentle passive range of motion for six weeks. Five months after surgery, the lateral bone plate and screws were removed from the right hindlimb. Six months after sur-

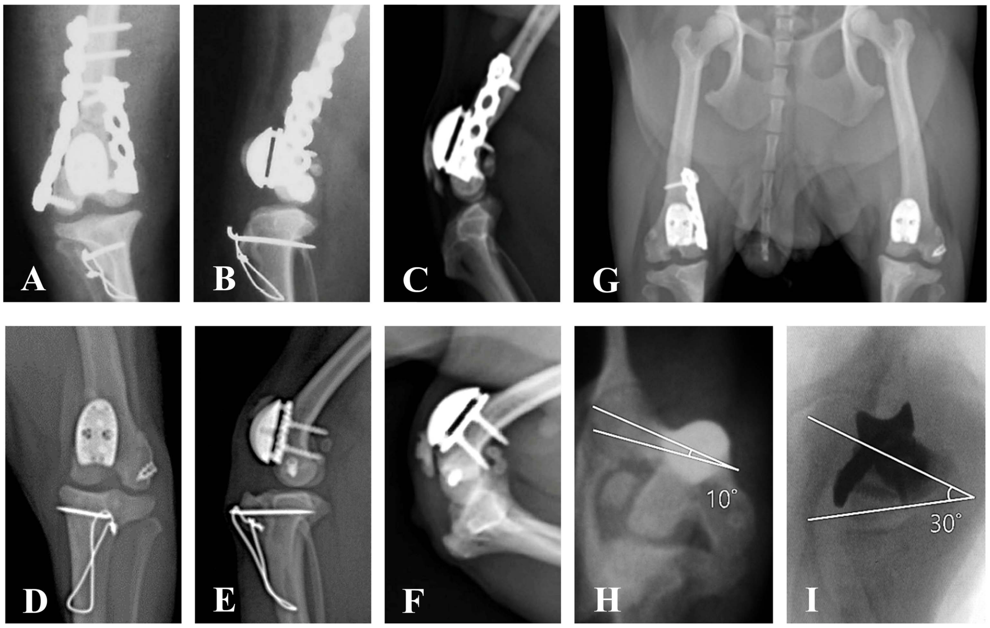

Fig 3. Postoperative craniocaudal and mediolateral radiographs of both stifle joints at three and six weeks after surgery in right hindlimb (A, B) and left hindlimb (D, E). At two years postoperative radiography, appropriate limb alignment without reluxation of patella (G) and enthesophytes are observed on patellar articular surface in both stifle joints. (C, F). Anteversion angle increased from 10º into 30º on the right hindlimb (H, I).

gery, the clinical function of the right hindlimb was significantly improved without lameness and there were no complications associated with surgery (Table 1). A staged surgery was performed on the left hindlimb. Instead of a femoral corrective osteotomy, a PGR prosthesis was placed medially in the frontal plane. Tibial tuberosity transposition and lateral imbrications were performed on the left hindlimb. At two weeks post-surgery, reluxation occurred on left hindlimb. The rectus femoris muscle was released and tibial tuberosity transposition was performed to realign the patella more laterally than when the previous surgery was performed. In addition, a patellar sling was applied using a bone anchor. The patient recovered well and had a good functional outcome without luxation of the patella or lameness associated with activity.

Two years after the last surgery, there were no complications associated with infections or loosening of the implant (Fig 3G). Radiography showed an enthesophyte on the patella bilaterally on the hindlimb (Fig 3C and F). The excursion angles of the stifle joints had decreased over the past two years after they had initially significantly increased at six months after surgery (Table 1). However, the patient showed no pain in the stifle joints and exhibited satisfactory weight-bearing ambulation without lameness.

Discussion

The surgical treatment for iatrogenic trochlear groove damage is very challenging. In this situation, total knee replacement or fresh frozen osteochondral allograft can be considered as alternative surgical treatments. Total knee replacement, however, is an aggressive surgical method that removes the normal part of the femoral condyle, while fresh frozen osteochondral allograft has a high risk of graft failure due to the immune response and difficulty of getting a proper fit for the patient (7,11,17). Therefore, PGR may be a suitable method for patients who having iatrogenic trochlear groove damage. In this case, by applying the PGR in a patient with iatrogenic trochlear groove damage, satisfactory weight-bearing ambulation was achieved and reluxation did not occur during the long-term follow up.

During the application of the PGR, the osteointegration of the PGR prosthesis with native bone tissue is important. In this case, osteotomy of the trochlea for exposing the fresh cancellous bone was impossible because the trochlear groove was almost worn out iatrogenically. Furthermore, the patient was a small toy breed dog weighing 1.9 kg. Therefore, the fibrous tissue and osteophyte was removed, and the trochlea was flattened using a high speed burr. Multiple holes were made by using a Kirschner wire, and a cancellous bone graft was performed before applying the PGR prosthesis. Two years after surgery, osteointegration of the PGR prosthesis with bone was observed to be successful.

Surgical correction of MPL with bone deformity is difficult to achieve an appropriate alignment of the quadriceps mechanism by the conventional surgical treatments (21). Recently, corrective femoral osteotomy has been introduced as a method to achieve an appropriate alignment of the quadriceps mechanism as a correction of bone deformity (14,18). In this case, corrective femoral osteotomy was performed and the anteversion angle increased from 10º into 30º on the right hindlimb. As a result, the alignment of the quadriceps mechanism was appropriate and the patient had a good prognosis. However, it was a challenge to reduce the bone fragments using bone plates and screws. That is because the PGR prosthesis should be placed on area of femoral trochlear groove.

In this case, therefore, double plates had to be used to make a space for placing the PGR prosthesis. For the surgery of the left hindlimb, the PGR prosthesis was placed medially in the frontal plane without corrective femoral osteotomy. Although reluxation of the patella occurred 2 weeks postoperatively, correction of reluxation of patella was possible by performing tibial tuberosity transposition to a more lateral position along with a patellar sling. The patient had no reluxation and has been shown improvement in gait without lameness. Corrective femoral osteotomy is necessary to correct bone deformity; however, the quadriceps mechanism can be aligned by adjusting the position of the PGR prosthesis without corrective femoral osteotomy. However, more research is necessary to determine whether patients with bone deformity may benefit from this technique without corrective femoral osteotomy.

Thirty-five cases with femoro-patellar instability in association with severe femoro-patellar osteoarthritis have been reported to exhibit normal walking at approximately 90% by replacing the femoral trochlear with PGR prosthesis (6). In the present case, the patient had a condition of intermittent non-weight-bearing lameness of the right hindlimb and weight-bearing lameness of the left hindlimb before surgery. However, when the patella was stably positioned on the prosthesis using PGR, the patient showed functional recovery through two years of follow-up. Although the patient was shown to achieve acceptable ambulation without pain in this case, enthesophytes were observed at the patellar articular surface in the two year postoperative radiographs, and the range of motion in the stifle joint was decreased by progressive osteoarthritis. The arthritis is believed to be caused by a pressure imbalance between the PGR prosthesis and the patellar articular surface. The height of the prosthesis groove after performing PGR was higher than the normal trochlear groove in a dog of similar size. This has the potential to induce osteoarthritis by increasing the prosthesis - patellar contact pressure. Therefore, it is believed that a lower height implant is required for application to the small patient.

Conclusion

In this case report, PGR was performed for the treatment of MPL with iatrogenic trochlear groove damage following trochlear block recession for treatment of MPL in a dog. PGR can be used as a successful treatment for dogs with iatrogenically damaged and/or a worn out patellar groove.

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