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Tibial Plateau Leveling Osteotomy Combined with Tibial Tuberosity Transposition in a Dog with Medial Patellar Luxation and Cranial Cruciate Ligament Rupture

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Abstract : A 30 kg, 6-year-old spayed female Samoyed dog was referred with a history of intermittent weight-bearing lameness in her right hindlimb for 3 weeks. The patient hadsurgery to correct a medial patellar luxation in the same limb 3 years prior. Based on the physical examination and radiographic findings, MPL and CCLR of the right hindlimb were diagnosed. Pre-surgical arthroscopy examination was performed, revealing a complete rupture of the cranial cruciate ligament, medial caudal meniscal tears and fibrotic cartilagechanges on the trochlear groove. An arthroscopy-assisted partial meniscectomy was used to repair themedial caudal meniscus. To correct the tibial plateau angle and medial patellar luxation, a tibial plateau leveling osteotomy (TPLO) was performed. A tibial tuberosity transposition (TTT) was performed to realignthe quadriceps mechanism with the trochlear block recession followed by soft tissue reconstruction. The post-surgical recovery was uneventful, and the patient was weight-bearing with normal ambulation on the repaired limb. There were no complications, and the implants were well positioned at the last follow-up. The clinical outcome of the caseindicates that combining TPLO with TTTis a good surgical option for treatingconcurrent CCLR and MPL.

Key words **:** Cranial cruciate ligament rupture, medial patellar luxation, Tibial plateau leveling osteotomy, Tibia tuberosity transposition.

Introduction

Cranial cruciate ligament rupture (CCLR) is a common musculoskeletal disorder that causes lameness and pain in dogs (15). If CCLR is left untreated, itleads to secondary meniscal injury (33.2%) due to instabilityin the stifle joint (10).

Medial patellar luxation (MPL) is another common orthopedic disease of dogs and is caused by skeletal abnormalities such as coxa vara, diminished anteversion angle, femoral varus and medial displacement of the tibial tuberosity (12,16). CCLR may occur secondary to MPL because MPL may cause chronic stress tothe cranial cruciate ligament fibers, leading to its rupture (12). Concurrent cranial cruciate ligament rupture with chronic MPL is present in 15 to 20% of middle- to older-age dogs (6).

Surgical techniques for stabilizing CCLR are divided into two groups, passive constraint and dynamic stabilization. Passive constraint methods include tight rope and lateral suture procedures, whereas dynamic stabilization methods use osteotomy techniques such as a tibial wedge osteotomy (TWO), a tibial tuberosity advancement (TTA), or a tibial plateau leveling osteotomy (TPLO). Passive constraint techniques are not a good choice for large dogs because of a high risk of suture material failure. Thus, osteotomy techniques like the TPLO and TTA have been proposed recently (3,4,5).

Many surgical treatment techniques, including trochleoplasty, tibial tuberosity transposition (TTT), and soft tissue reconstruction, are utilized to correct MPL. Especially in cases where the patient has MPL with medial displacement of the tibial tuberosity, a TTT may be necessary to realign the quadriceps mechanism (6).

When the patient has concurrent MPL and CCLR, a combination of procedures may be needed. Treatment could be accomplished by a tibial wedge osteotomy, a tibial plateau leveling osteotomy, a modified tibial plateau levelling, or by a tibial tuberosity advancement in combination with other procedures such as trochleoplasty or tibial tuberosity transposition (11,16).

However, tibial plateau leveling osteotomy includes a radial osteotomy procedure that may increase the risk of tibial tuberosity fracture, so combining a TPLO with a tibial tuberosity transposition technique was kwown as challanging procedures previously because the small tuberosity segment might be difficult to secure.

The purpose of this case report is to describe the surgical technique and the clinical outcome of a tibial plateau leveling osteotomy with tibial tuberosity transposition in a patient with cranial cruciate ligament rupture and concomitant medial patellar luxation.

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Case

A six-year-old, 30 kg, spayed female Samoyed dog presented with a history of right hindlimb lameness. The patient had surgery 3 years earlier to correct medial patellar luxation. On gait examination, the patient was weight-bearing with frequent intermittent grade 2 lameness (13).

Physical examination revealed positive tibial compression and cranial drawer tests in the right hindlimb. The patella was permanently luxated but could be reduced manually, indicating Grade 3 MPL disease. Additionally, the McMurray test was positive, so meniscal injury was suspected.

Radiographic evaluation involved mediolateral and craniocaudal views of the right hindlimb. These radiographs revealedmedial patellar luxation, synovitis, and degenerative joint disease.

Based on the results of the evaluations, the dog was diagnosed with cranial cruciate ligament rupture and medial patellar luxation of the right hindlimb. The possibility of a meniscal injury could not be excluded. Therefore, the following surgical procedures were planned: arthroscopy for evaluation and treatment of the meniscus and cranial cruciate ligament, trochlear block recession to correct the MPL, tibial plateau leveling osteotomy to correct the CCLR, and tibial tuberosity transposition for realigning the quadriceps mechanism.

Prior to the surgery, the dog was premedicated with Midazolam (0.2 mg/kg IV, Midazolam®; Bukwang, Korea), hydromorphone (0.1 mg/kg IV, Dilid®; Hana, Korea), and cefazolin (22 mg/kg IV, Cefazolin®; Jong-keundang, Korea). Anesthesia was induced with protocol treatment (6 mg/kg IV, Provive®; Myungmoon, Korea) and maintained by inhalation anesthesia with isoflurane (Ifran®; Hana Pharm, Korea). An epidural with bupivacaine (Bupivacaine HCL 0.5%®; Myungmoon, Korea) combined with morphine (Morphine sulfate, BC, Korea) was utilized for analgesia. General perioperative analgesia was managed withremifentanil HCl (0.1~0.6 μg/kg IV CRI, Ultiva®; Glakso, Korea).

The patient was positioned in dorsal recumbency, and surgery began with the stifle arthroscopy. Severe synovitis, medial meniscal injury on the caudal pole, and complete cranial cruciate ligament rupture were observed. The meniscal injury was similar to a bucket handle tear. To prevent further meniscal damage, a partial meniscectomy of the injured meniscus was done, and the cranial cruciate ligament remnant was debrided with a burr. Next, a trochlear block recession was performed to reposition the patella into the trochlear groove. The tibial plateau leveling osteotomy followed, using a 24 mm TPLO saw blade (© Synthes; Swiss) for the radial osteotomy, and a 3.5 mm TPLO plate (© Synthes; Swiss) to fix osteotomy fragments.

After the TPLO, the oscillating observed was used to perform a tibial tuberosity transposition because the quadriceps mechanism was not aligning correctly. The starting point was the level of patellar tendon insertion, near the most proximal and cranial aspect of the radial osteotomy for the TPLO. Then, the cutwas extended to the distal extent of the tibial crest, with the distal part of the periosteal attachment left intact (12). Then, the tibial tuberosity was transposed laterally, and two Kirschner wires and two Steinmann pins were used to reattach the tibial tuberosity. The tibial tuberosity was transposed until the patella was positioned in the trochlear groove and the mechanism of the quadriceps was corrected (Fig 1).

Postoperative analgesia was managed with a fentanyl patch (Matriphen patch®; Daewoong, Korea) and cefazolin (Cefazolin®; Jong-keundang, Korea) was used for an antibiotic. The patient had a bandage on the surgical site, and activity was limited by cage rest.

In postoperative radiographs, thepatella was located in the trochlear groove and the implants were also positioned well. The tibial plateau angle (TPA) was changed from a preoperative measurement of 26.5° to a postoperative TPA of 5.5° (measured in the TPLO view).

When the patient was rechecked on the 300th day aftersurgery, the patient showed an improvement in lameness on gait examination. The bone was completely healed at the osteotomy site, the patella had not reluxated, and no complications were found (Fig 2).

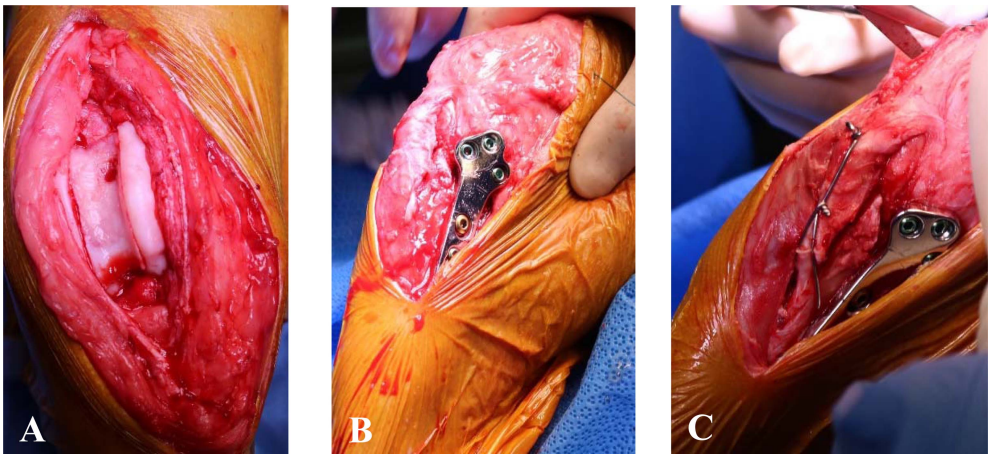

Fig 1. Surgical procedure; trochleoplasty, tibial plateau leveling osteotomy (TPLO) and tibial tuberosity transposition (TTT). (A) Block recession to relocate the patella onto the trochlear groove. (B) Tibial plateau leveling osteotomy to neutralize the shear force. (C) Tibial tuberosity transposition for realignment of the quadriceps mechanism.

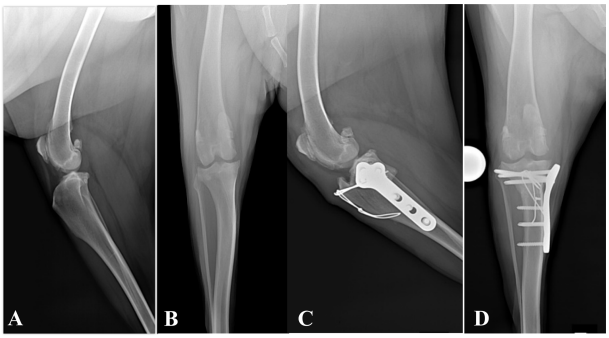

Fig 2. Preoperative and postoperativecraniocaudal and mediolateral radiographs of right stifle joint. Loss of infrapatellar fat pad opacity (A), Medial patellar luxation is present and osteophytes are observed near femoral condyle (B). Osteotomy line was healed properlyon 54th day after the surgery (C) and apparatus was in position (D).

Discussion

TPLO and TTA are popular procedures for correction of cranial cruciate ligament rupture. These methods alter the geometry of the stifle joint to neutralize the tibiofemoral shear forceas an alternative surgical repair technique for large breed dogs with high body weight (2,5).

Following the Slocum and Tepic model, the TPLO and TTA surgeries take different approaches to achieve stability. TPLO neutralizes shear force by changing the angle of the tibial plateau slope (TPS) to ~5^{o} whereas TTA neutralizes shear force by changing the angle between the tibial plateau and the patellar tendon (PTA) to < 90^{o}. It is controversial to say which technique is better (2,9).

Multiple procedures for treating CCLR with concomitant MPL can be used. The tibial tuberosity transposition-advancement (TTTA) has recently been introduced. This technique is a simple method to reconstruct the stifle joint by changing the stifle geometry and to relocate the tibial tuberosity simultaneously, with only one osteotomy of the tibial tuberosity (16).

In the TTA technique, decreased patellofemoral contact pressure may induce mobility of the patella in the medial direction so patellar reluxation can occur (7,8). The patellar-reluxation rate has been reported at approximately 10%, and patellar baja has been reported in approximately 79% as a side effect when using the TTTA technique (16). One of the major side effects of TTA surgery is meniscus injury, reported in 27.8% of patients, which is more than is seen with TPLO patients (reported as 12.3%) (4). While initially superior, longterm, the TTA surgery did not appear to control pain as well as the TPLO, with owners assessing pain after TPLO and TTA at 47.7% and 61.1% of original pain levels, respectively. Although TTA patients showed less lameness in the early postoperative period and return to normal use earlier, post-surgical full function after TTA (44.4%) was inferior to function after TPLO (76.9%) and TPLO patients showed better functional outcomes than TTA patients at the trot in long-term follow-up (4,10).

TPLO-TTT is a technically demanding procedures because the tibial tuberosity is isolated when a TPLO is performed, which can lead to a tibial tuberosity fracture (14). This technique also needs an additional osteotomy for the tibial tuberosity transposition, which could decrease the stability of the proximal portion of the tibia. As such, previous studies did not recommend TPLO-TTT due to concerns that the tibial tuberosity fragment might be difficult to secure. Comparing with large breeds, since there is a relatively narrower width of tibial tuberosity for those of small breeds, to perform additional osteotomy would fail to offer appropriate fixation of bone segments.

However, a recent report offered suggestions to reduce complications during TPLO-TTT surgery associated with the osteotomy rotation level and TTT technique (1,12). Following these criteria, for this patient, the tibial plateau segment was not rotated below the patellar tendon insertion to support the osteotomy segment, and the tibial tuberosity transposition was performed leaving the distal periosteal attachment intact with tension band wire application (2).

As a result of adhering to the suggested criteria, the patient had no complications, showed an improvement in lameness, and healed uneventfully until the last follow-up.

Conclusion

The tibial plateau leveling osteotomy (TPLO) and tibial tuberosity transposition (TTT) surgical procedures were combined to treat a patient with cranial cruciate ligament rupture and concomitant medial patellar luxation. In this case report, the patient has had an excellent outcome without any complications. Therefore, combining TPLO and TTT techniques could be a successful treatment for CCLR with concomitant MPL.

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References

1. Bergh MS, Rajala-Schultz P, Johnson KA. Risk factors for tibial tuberosity fracture after tibial plateau leveling osteotomy in dogs. Vet Surg 2008; 37: 374-382.
2. Boudrieau RJ. Tibial plateau leveling osteotomy or tibial tuberosity advancement? Vet Surg 2009; 38: 1-22.
3. Case J, Hulse D, Kerwin S, Peycke L. Meniscal injury following initial cranial cruciate ligament stabilization surgery in 26 dogs (29 stifles). Vet Comp Orthop Traumatol 2008; 21: 365-367.
4. Christopher SA, Beetem J, Cook JL. Comparison of long-term outcomes associated with three surgical techniques for treatment of cranial cruciate ligament disease in dogs. Vet Surg 2013; 42: 329-334.
5. Ferreira MP, Ferrigno CR, de Souza AN, Caquias DF, de Figueiredo AV. Short-term comparison of tibial tuberosity advancement and tibial plateau levelling osteotomy in dogs with cranial cruciate ligament disease using kinetic analysis.

Vet Comp Orthop Traumatol 2016; 29: 209-213.
6. Gibbons S, Macias C, Tonzing M, Pinchbeck G, McKee W. Patellar luxation in 70 large breed dogs. J Small Anim Pract 2006; 47: 3-9.
7. Hoffmann D, Miller J, Ober C, Lanz O, Martin R, Shires P. Tibial tuberosity advancement in 65 canine stifles. Vet Comp Orthop Traumatol 2006; 19: 219-227.
8. Kim SE, Pozzi A, Banks SA, Conrad BP, Lewis DD. Effect of tibial tuberosity advancement on femorotibial contact mechanics and stifle kinematics. Vet Surg 2009; 38: 33-39.
9. Kim SE, Pozzi A, Kowaleski MP, Lewis DD. Tibial osteotomies for cranial cruciate ligament insufficiency in dogs. Vet Surg 2008; 37: 111-125.
10. Krotscheck U, Nelson SA, Todhunter RJ, Stone M, Zhang Z. Long term functional outcome of tibial tuberosity advancement vs. tibial plateau leveling osteotomy and extracapsular repair in a heterogeneous population of dogs. Vet Surg 2014; 43.6: 176-177.
11. Langenbach A, Marcellin-Little DJ. Management of concurrent patellar luxation and cranial cruciate ligament rupture using modified tibial plateau levelling. J Small Anim Pract 2010; 51: 97-103.
12. Leonard KC, Kowaleski MP, Saunders WB, McCarthy RJ, Boudrieau RJ. Combined tibial plateau levelling osteotomy and tibial tuberosity transposition for treatment of cranial cruciate ligament insufficiency with concomitant medial patellar luxation. Vet Comp Orthop Traumatol 2016; 29: 536-540.
13. Monk ML, Preston CA, McGowan CM. Effects of early intensive postoperative physiotherapy on limb function after tibial plateau leveling osteotomy in dogs with deficiency of the cranial cruciate ligament. Am J Vet Res 2006; 67: 529-536.
14. Priddy NH, Tomlinson JL, Dodam JR, Hornbostel JE. Complications with and owner assessment of the outcome of tibial plateau leveling osteotomy for treatment of cranial cruciate ligament rupture in dogs: 193 cases (1997-2001). J Am Vet Med Assoc 2003; 222: 1726-1732.
15. Witsberger TH, Villamil JA, Schultz LG, Hahn AW, Cook JL. Prevalence of and risk factors for hip dysplasia and cranial cruciate ligament deficiency in dogs. J Am Vet Med Assoc 2008; 232: 1818-1824.
16. Yeadon R, Fitzpatrick N, Kowaleski M. Tibial tuberosity transposition-advancement for treatment of medial patellar luxation and concomitant cranial cruciate ligament disease in the dog. Vet Comp Orthop Traumatol 2011; 24: 18-26.