TREATING EXCESSIVE TPA WITH TPLO

Brian S. Beale DVM, DACVS, ACVS Fellow MIS-Ortho
H-Town Veterinary Specialists
3015 S. Main ST, Stafford, TX 77477

CRANIAL CRUCIATE LIGAMENT (CCL) INJURY

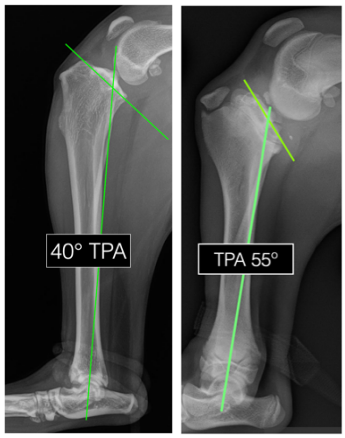
Cranial cruciate ligament tears are very common in dogs of all sizes. The instability associated with CCL tears causes pain, osteoarthritis and meniscal damage. The injury is thought to occur due to chronic repetitive trauma in most dogs leading to a progressive deterioration and tearing of the ligament. Types of CCL tears include partial and complete tears. Partial CCL tears can be further categorized as early and late. Early partial tears are associated with mild instability (cranial tibial translation) and have a majority of the CCL fibers intact and functional. Late partial tears are associated with moderate or severe instability (cranial tibial translation) and have a small number to no intact normal fibers. Surgical stabilization is recommended for most patients with complete or partial CCL tears. Many surgical options are available including TPLO, TTA, TTO, CCWO, CBLO, extracapsular ligament repair and intracapsular ligament repair.

TPLO RATIONALE

The basic premise of the TPLO procedure is that the caudo-distal slope of the canine tibia generates a cranially directed force known as cranial tibial thrust. Theoretically, leveling the tibial surface such that it is essentially perpendicular to the axial load applied during weight bearing (tibial functional axis) should neutralize the cranial tibial thrust force. In the normal stifle joint, the cranial tibial thrust force is neutralized by the intact cranial cruciate ligament. Once the cranial cruciate ligament begins to degenerate, the cranial tibial thrust force is no longer neutralized, and cranial tibial subluxation is the result. Following the TPLO procedure, functional stability is achieved in the cranial cruciate ligament deficient stifle joint by neutralization of the cranial tibial thrust force; in essence the cranial cruciate ligament is no longer needed to neutralize the cranial tibial thrust force following the TPLO procedure.

EXCESSIVE TIBIAL PLATEAU ANGLE (eTPA)

The tibial plateau angle in the dog is angled in relationship to the mechanical axis of the tibia. The tibial plateau is compressed against the oval-shaped femoral condyle when bearing weight on the limb. This creates a tendency for the tibia to translate cranially due to the development of a force acting on the joint known as cranial tibial thrust (CTT). Most dogs have a TPA of between 25-30º however the TPA can vary greatly in dogs. The TPLO procedure is the most common procedure used to treat CCL injury by eliminating CTT by leveling the tibial plateau to an angle of 5-6º. Some dogs have an extremely steep tibial plateau known as excessive TPA (ePTA). While there is not a specific TPA that is considered excessive, most surgeon would consider a TPA >38º excessive.

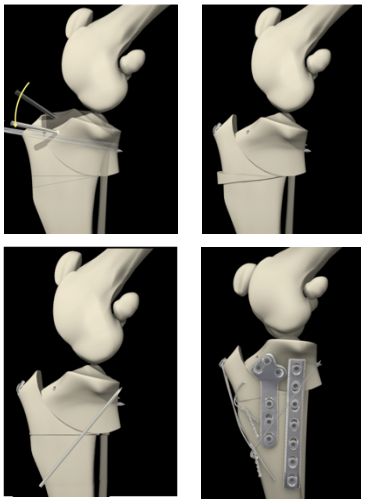


Two examples of dogs with an eTPA

SURGICAL DECISION-MAKING AND TPA LEVELING OPTIONS

It is often best to manage dogs having CCL tears and an eTPA with a modified TPLO or alternative procedure. A traditional TPLO is not ideal because the extreme rotation of the proximal tibial segment can result in an increased risk of tibial tuberosity fracture, reduced load-sharing at the osteotomy site, increased stress on the bone and bone screws and changes in cartilage pressure during weight bearing. The most common modifications of TPLO to treat CCL tears and eTPA include TPLO+CCWO, TPLO-double cut and modified CCWO (mCCWO). I tend to use the mCCWO technique in most dogs because it is simple to plan, perform, results in excellent stability and has minimal implants. This technique results in one osteotomy line requiring fixation. The double-cut TPLO also results in a single osteotomy line requiring fixation and no extra implants, but the width of the tibial plateau can be narrowed increasing the chance of TT fracture in some dogs. This is more likely to occur in dogs having a narrow proximal tibia as

viewed from the sagittal plane. A third option is TPLO combined with a CCWO. This technique requires stabilization of two osteotomy lines with additional implants. This technique is also more demanding because of the need to stabilize two osteotomies and place additional implants in appropriate locations.

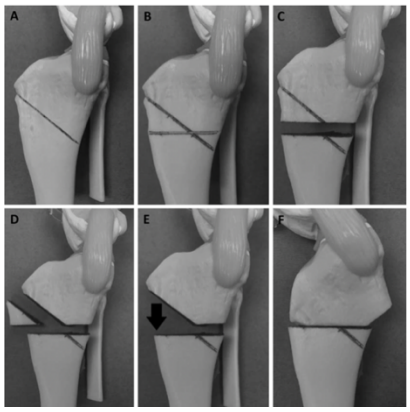


TPLO and CCWO used to level the TPA to 5º.

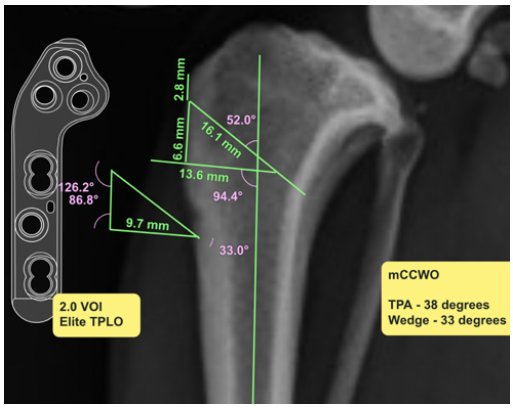
TPLO WITH CRANIAL CLOSING WEDGE OSTEOTOMY (CCWO)
A traditional TPLO can be combined with a CCWO to treat dogs with eTPA. Presurgical planning is used to plan each osteotomy such that a portion of the TPA is removed by each technique. The combined technique results in more normal stifle mechanics compared to traditional TPLO in dogs having eTPA. The amount of slope removed by the TPLO is variable but should be a comfortable amount of rotation as is typically used with the traditional TPLO. The remaining portion of the tibial plateau slope is removed with a standard CCWO. Let's look at an example of how this technique might be used. An acceptable way to treat a dog with a 42º TPA would be to perform a TPLO based on a TPA of 30º first followed by a CCWO based on 12º. The combined techniques would leave a final TPA of 5º. The TPLO is stabilized with a standard TPLO plate. The CCWO is stabilized with a double pin and tension band and 2 small pins. Alternatively, the CCWO can be stabilized with a small locking plate on the cranial surface of the tibia.

TPLO USING DOUBLE CRESENTRIC OSTEOTOMY
This technique is often called a double-cut TPLO. Barclay Slocum described a double cresentric osteotomy cranial closing wedge technique to treat dogs having eTPA. A traditional TPLO crescentric osteotomy is performed using the smallest practical blade, making sure to keep the blade appropriately proximal and caudal. The goal is to preserve adequate bone stock caudal to the tibial tuberosity. A second crescentric osteotomy is made cranial to the first, keeping the distal portion of the osteotomy coplanar with the first osteotomy at the caudal cortex of the tibia. The proximal portion of the osteotomy exits the tibia cranial to the first osteotomy. The saw blade for the second cut is usually the same radius as the first cut. This technique removes a curved segment of bone from the proximal tibia just caudal to the patellar tendon attachment. A portion of TPA is reduced when the gap is closed. The remaining portion of the slope is reduced with the normal TPLO technique. The amount of slope removed by the TPLO is variable but should be a comfortable amount of rotation as is typically used with the traditional TPLO. The osteotomy is stabilized with a standard TPLO plate. A recent study (Curuci et al. 2024) showed this technique to be effective for treating dogs with a TPA between 34 and 43°.

MODIFIED CRANIAL CLOSING WEDGE OSTEOTOMY (mCCWO)
A simple and effective method to treat dogs with CCL tear and eTPA is the modified cranial closing wedge technique. This technique is similar to the traditional CCWO except the apex angle of the wedge is not based at the caudal tibial cortex, but instead, is shifted cranially a third of the width of the tibia at the level of the osteotomy. Shifting the wedge cranially reduces the base height of the wedge. This results in removal of a smaller segment of bone and less displacement of patella distally. The gap is closed and the cranial tibial cortex is aligned. The osteotomy is stabilized with a pin and tension band. A standard TPLO plate is then placed to complete the construct. This technique requires careful preoperative planning preoperatively.



Modified CCWO technique as described by Frederick and Cross to treat CCL tear and eTPA



Preoperative planning for modified CCWO technique using vPOP surgical planning application

Modified CCWO performed on an 11 y.o., 8 kg, male WHWT

REFERENCES

1. Talaat M, Kowaleski MP, and Boudrieau RJ: Combination Tibial Plateau Leveling Osteotomy and Cranial Closing Wedge Osteotomy of the Tibia for the Treatment of Cranial Cruciate Ligament-Deficient Stifles with Excessive Tibial Plateau Angle. Vet Surg 2006; 35(8): 729-739
2. Frederick SW, Cross AR. Modified cranial closing wedge osteotomy for treatment of cranial cruciate ligament insufficiency in dogs with excessive tibial plateau angles: technique and complications in 19 cases. Veterinary Surgery 2017;46:403-411.
3. Slocum B, Slocum TD. Tibial plateau leveling osteotomy for repair of cranial cruciate ligament rupture in the canine. Vet Clin North Am Small Anim Pract 1993;23(04):777–795
4. Curuci EHP, Minto BW, Magalhaes TV et al: Double-Cut Tibial Plateau Leveling Osteotomy for the Management of Cranial Cruciate Ligament Insuffciency in Dogs with an Excessive Plateua Angle: Early Clinical Results in 16 Dogs. Vet Comp Orthop Traumatol 2024;37:297-303.