

## **Breaking Bones to Fix a Ligament - Tibial Tuberosity Advancement**

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Cranial cruciate ligament rupture is one of the most common orthopedic conditions seen in dogs, and is estimated to cost over one billion dollars a year, in the USA alone. However, despite a huge amount of research, we still do not understand what the underlying cause of canine cruciate insufficiency is.

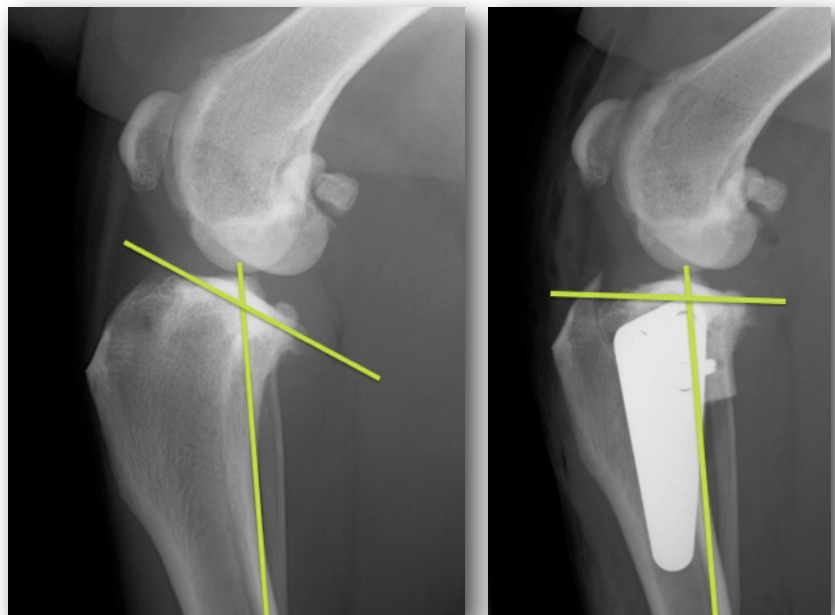
With the plethora of surgical techniques described over the past 50 years it is also clear that the “perfect” method of treatment has probably not been determined yet. We are hopefully getting closer though.

Unlike similar conditions in people, cranial cruciate ligament rupture is almost always a chronic degenerative process in the dog, rather than a traumatic injury. This means that it is frequently a bilateral condition (in approximately 50% of cases). Also, it means simply reconstructing the ligament is not possible, as it will continue to break down over time, rather than go on to heal.

Traditionally techniques have been based on trying to prevent cranial drawer - the instability that is present and detectable on examination of most dogs with cranial cruciate rupture. However, as the condition is almost invariably degenerative, “repairing” the ruptured ligament itself is not possible. A variety of intra- and extra-capsular methods have been tried, using a host of different natural and synthetic materials, all placed to counteract cranial drawer. There is no question that at least some of these techniques improve the comfort and activity level of affected dogs, but there are some caveats.

- Firstly, all the stifles operated (irrelevant of how stable they seem immediately post-operatively) have cranial drawer return within a matter of weeks. Though it may not bother them quite as much, these knees are unstable once again, at least to some degree.
- Secondly, though there is improvement, dogs treated in this way generally do not return to normal athletic activity - especially larger breeds.
- Thirdly, arthritic changes already present within the stifle continue to worsen with time despite surgical attempts to stabilize.

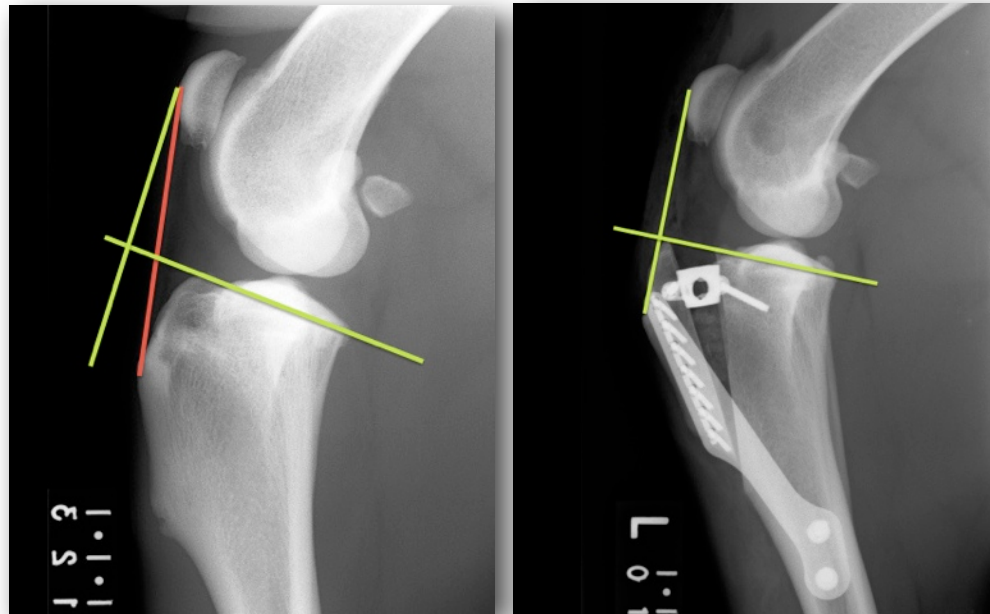
These perceived short-comings have resulted in a rethink over the past 15 years about how best to treat cruciate deficiency, and were the basis for Dr Barclay Slocum developing the Tibial Plateau Levelling Osteotomy (TPLO). Rather than attempting to prevent cranial drawer, the TPLO alters the mechanics of the stifle, by rotating the



tibial plateau so that it is parallel to the ground at a standing angle. This eliminates the cranial tibial thrust force that occurs due to the angled slope of the unoperated stifle. Outcomes have been very pleasing, and the majority of Small Animal Surgeon Specialists adopted this or similar techniques rapidly as their method of choice.

More recently a group of orthopaedists and biomechanical engineers from the University of Zurich have developed the Tibial Tuberosity Advancement procedure (TTA). This builds on the original idea by Slocum, but rather than looking at the bones of the stifle in isolation, also considers the

contribution from muscular forces. The theory proposed by TTA is that in the weight-bearing leg the quadriceps mechanism represents the most powerful force acting on the stifle. Due to the direction of the patella ligament (caudo-distal to cranio-proximal orientation), upon muscle contraction, the quadriceps not only provides a proximal pull on the tibia, but also a cranially-directed force, and this is what results in cranial tibial thrust. By advancing the tibial tuberosity slightly



(usually between 6-15 mm depending on the size of the patient), the patella ligament is shifted to a position at 90 degrees to the tibial plateau. Upon weight-bearing the muscles around the stifle contract, and with the quadriceps pull directed perpendicular to the plateau, there is no longer any tibial thrust.

Just as with the TPLO, patients are usually weight-bearing on the operated leg within 48 hours after a TTA procedure. The outcomes are very impressive with a rapid return to normal athletic activity.

Reported complication rates are similar to TPLO, and range from 5-20%. Only a small number of these constitute cases that require additional surgery however. Similar to TPLOs the main concerns are excessive activity in the early post-operative period, and implant infection.

While there has been a rapid acceptance of osteotomy for treatment of cranial cruciate ligament rupture by Veterinary Surgeons worldwide, there is little published evidence to prove them as superior to extracapsular techniques. The confidence in recommending them largely stems from anecdotal impressions, and client reports of much greater satisfaction and return to activity.

The only study that I am aware of comparing the clinical efficacy between TTA and TPLO is unpublished research completed at Virginia Tech. In that randomized, prospective study it was determined that there was no difference in outcome between dogs who received a TPLO, and those that underwent TTA.

How can two techniques with different theories both work so similarly and effectively? It turns out that performing a TPLO also results in the patella ligament becoming 90 degrees to the tibial plateau, but is achieved by rotating the plateau itself, rather than advancing the tibial tuberosity (as in the TTA). This suggests that the Zurich model is perhaps a more accurate representation of what actually happens to the cruciate-deficient stifle with weight-bearing.

Given the similar outcome overall, recommendation of TTA over TPLO (and vice versa) for a specific patient is dependent on factors such as conformation, and any other orthopedic abnormalities that may be present. As TTA does not require osteotomy through the weight-bearing long-axis of the tibia (compared with TPLO), some clients are more comfortable with it as a procedure, even though this has not been shown to translate to any more or less problems. Surgical time and post-operative care is very similar for both techniques, and client satisfaction continues to be high.

TTA, like TPLO, provides us with another way to effectively treat dogs with cranial cruciate ligament rupture, and get them back to normal pre-injury levels of exercise and activity.