Tibial tuberosity advancement technique explained

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Shirley Simpson RVN, CertSAN, DipAVN(surgical), discusses a method for joint stabilisation in dogs with cranial cruciate ligament rupture

Summary

TIBIAL tuberosity advancement (TTA) is one of the many surgical treatment options for dogs with cranial cruciate ligament (CrCl) damage. This major cause of hindlimb lameness in dogs can be due to degenerative changes or, more commonly, traumatic causes such as the patient jumping. Rupture of the CrCl leads to abnormal craniocaudal motion of the tibia and excessive internal rotation of the stifle joint and increases predisposition to degenerative joint disease (DJD). TTA is a dynamic stabilisation technique that changes the biomechanics of the stifle joint and neutralises cranial-tibial femoral thrust – the force that causes the femur to slide cranially over the tibial plateau. TTA is often compared to tibial plateau levelling osteotomy (TPLO) as both techniques involve performing an osteotomy and aim to reduce cranial-tibial thrust in order to stabilise the stifle after CrCl rupture. TTA is considered to be less invasive than TPLO and surgically simpler, but not simple. The operation, instrumentation and titanium implants were developed in Switzerland in 2001 and have gained recognition through training courses held worldwide.

Key words

cruciate ligament, CrCl rupture, lameness, canine implants, TTA

THIS article aims to offer nurses an insight into one of the newer techniques used to stabilise the stifle joint in dogs with cranial cruciate ligament rupture (CrCl). It is the

surgeon’s preference how the cruciate ligament is repaired. This may be based on their experience and training or the animal owner’s preference and budget.

Cranial cruciate ligament rupture

The function of the cranial cruciate ligament is to prevent cranial displacement of the tibia relative to the femur and to limit internal rotation. It is made up of a craniomedial and caudolateral band. Patients with cruciate rupture will show a sudden onset of pain or partial weight-bearing. Degenerative causes of cruciate ligament rupture are commonly due to conformational abnormalities. In many cases the underlying pathology for the condition is present in both stifles and, in a high percentage of patients, this will develop into bilateral cruciate disease. Traumatic cases can be due to the hyperextension and internal rotation of the limb, commonly due to the patient jumping.

Alternative techniques for CrCl repair include:

• intracapsular “over-the-top” technique;

• extracapsular tibio-fabellar suture;

• tibial plateau levelling osteotomy (TPLO);

• closing wedge osteotomy;

• triple tibial osteotomy;

• tibial wedge osteotomy; and

• fibular head transposition.

Technique development

Tibial tuberosity advancement (TTA) was developed by Slobodan Tepic and Pierre Montavon, at the University of Zurich, Switzerland. Controlled clinical release was initiated in 2004 and involved 50 surgeons in the US, Europe and Japan. The technique is now well recognised due to specific TTA training courses, which are held worldwide. TTA is a dynamic surgical stabilisation of the CrCl and involves changing the biomechanics of the stifle joint and neutralising cranial-tibial thrust. This is the force by which the femur slides down the tibial plateau and pushes the tibia cranially.

Tibial plateau levelling osteotomy

TPLO was the first widely accepted technique to advocate changing the geometry of the stifle joint and is the technique most commonly compared with TTA. The technique was developed more than 20 years ago, but remains a complex procedure. TPLO requires a radial osteotomy to bisect the proximal tibia. The tibial plateau is then rotated to reduce its angle and a specialised bone plate is placed to secure the fixation.

TTA versus TPLO

• TTA moves the joint force to meet the tibial plateau, whereas TPLO moves the plateau to meet the joint force.

• TPLO increases internal joint forces, whereas TTA reduces them by lengthening the “lever arm” to the patellar tendon.

• TTA is less invasive than TPLO and surgically less complex.

TTA implants

These implants were developed and are made in Switzerland. They consist of titanium, which causes minimal tissue reaction, and are osteoconductive to provide a scaffold for new bone growth. Titanium implants are lightweight and require minimal force in order to contour (Figure 1).

Instrumentation

Specific instruments are required to perform a TTA. These are used in conjunction with the implants (Figure 2). A saw is needed for the frontal osteotomy and a drill and screwdriver for the screws. General orthopaedic instrumentation, such as Gelpi retractors, Frear perioteal elevator, stifle distractor, a size-11 scalpel blade and diathermy cautery, may be advantageous when carrying out the procedure.

Preoperative preparation

Preoperative lateral radiographs are needed to plan the surgery. A transparency is used over the radiograph to determine the degree of TTA required and the size of plate and cage needed.

The affected limb is clipped circumferentially from the pelvis to just below the tarsal joint, and to midline on the ventral abdomen. The paw is covered with a bandage to avoid contamination. The surgical site is aseptically prepared using an antimicrobial solution (Figure 3).

As this surgery involves the placement of implants perioperative antibiotics are indicated. Epidural analgesia is an option as it will provide postoperative pain management. The patient is draped to

allow full limb access.

Positioning

The patient is positioned in dorsal recumbency with the forelimbs tied cranially. The unaffected hindlimb is tied caudally. Once the joint and meniscus have been examined by the surgeon, and the joint capsule closed, the forelimbs can be released and the dog rotated to lateral recumbency on the affected side. This will give access to the medial stifle.

Surgery

Evaluation of the joint is performed by the surgeon to assess the degree of damage to the CrCl, menisci and the presence of degenerative joint disease. Partial or complete meniscectomy may be required.

The craniomedial aspect of the stifle is exposed and an eight-hole drill guide is positioned parallel to the cranial margin (Figure 4). The holes are drilled in accordance with preoperative planning. A frontal plane osteotomy of the tibial crest is started distally to advance the patella tendon perpendicular to the tibial plateau. A TTA tension band plate is contoured before a fork (designed to fit into the plate) is locked in position. The plate-fork combination is secured into the tibial crest into predrilled holes in the bone.

Once the osteotomy is completed and the tibial crest is moved cranially, a cage is placed in the osteotomy and screwed into the caudal margin of the tibia. The tension band plate is secured distally to the tibia. The cage is also secured into the tibial tuberosity (Figure 5). The limb is evaluated to confirm the absence of cranial tibial thrust. A bone graft is placed in the osteotomy to facilitate healing. This can be an autograft or a commercially available product. The incision is then closed.

Postoperative radiographs should be obtained to assess implant positioning.

Osteoallograft

This is morselised cancellous bone that has been processed to remove soft-tissue cells and marrow elements. It provides ideal conditions for osteoconduction when added to an osteotomy. It is supplied freeze dried in volumes of 0.5 to 3.0cc and requires reconstitution with an equal volume of sterile saline (Figure 6).

Recovery

The wound should be covered with an adhesive film dressing to avoid contamination. A Robert Jones support dressing is optional to reduce postoperative swelling. Patients will normally weight-

bear 24 to 48 hours after surgery. A non-steroidal antiinflammatory drug should be prescribed for pain management. Exercise should be gradually increased during the first eight weeks after surgery, starting with five to 10-minute lead walks on flat, non-slip surfaces. This can then be increased to 10 to 15 minutes after two weeks. Boisterous activity, stairs or hillclimbing should be avoided. The patient should attend routine wound-check appointments to assess healing. The stifle should then be radiographed at eight weeks to assess healing of the fracture. This will dictate the level of exercise permitted. The patient should also be examined to determine if there is any lameness or complications.

Complications

Lafaver et al (2007) looked at complications in 114 stifle joints that had undergone a TTA. Of these, 14 (12.3 per cent) developed a major complication and 22 (19.3 per cent) had minor complications. The major complications constituted seven meniscal tears, two tibial fractures, two lick granulomas and one each of the following: implant failure, septic arthritis and medial patellar luxation. One problem associated with new techniques is a lack of data to demonstrate the long-term incidence of osteoarthritis in the joint that has been operated on.

Case study

Lacey, a five-year-old, female neutered bulldog, was presented for assessment of moderate left hindlimb lameness. The dog demonstrated slight discomfort on full stifle extension. Radiographs under sedation demonstrated bilateral stifle effusion and osteophytes on the left stifle. Cranial drawer was present, indicating suspect ligament rupture. Lacey was prescribed a non-steroidal anti-inflammatory for pain management.

Once anaesthetised and in theatre, the surgeon made a standard medial approach to the left proximal tibia and stifle joint. The subpatella arthrotomy revealed complete rupture of the CrCl and a partial-thickness tear affecting the caudal medial meniscus. The damaged meniscus was resected and a meniscal release performed. A tibial tuberosity osteotomy was made with a gentle distal curve. A four-long plate was secured in position with 2.4mm screws. The tuberosity was advanced using a 9/25 cage. The osteotomy and cage were packed with 1ml cancellous autograft. The joint was closed and the leg was bandaged to reduce postoperative swelling.

The dog was administered a partial opioid intravenously every six to eight hours for pain relief while she was receiving intravenous fluids. Once fluids were stopped, she was administered Tramadol 50mg BID. Two days after surgery, Lacey was able to walk with moderate weight-bearing lameness on the affected left. She was able to go home three days after surgery, with instructions that she must be kept calm and her exercise restricted. At eight weeks postsurgery, radiographs demonstrated progression towards bony integration of the implants.

References and further reading

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