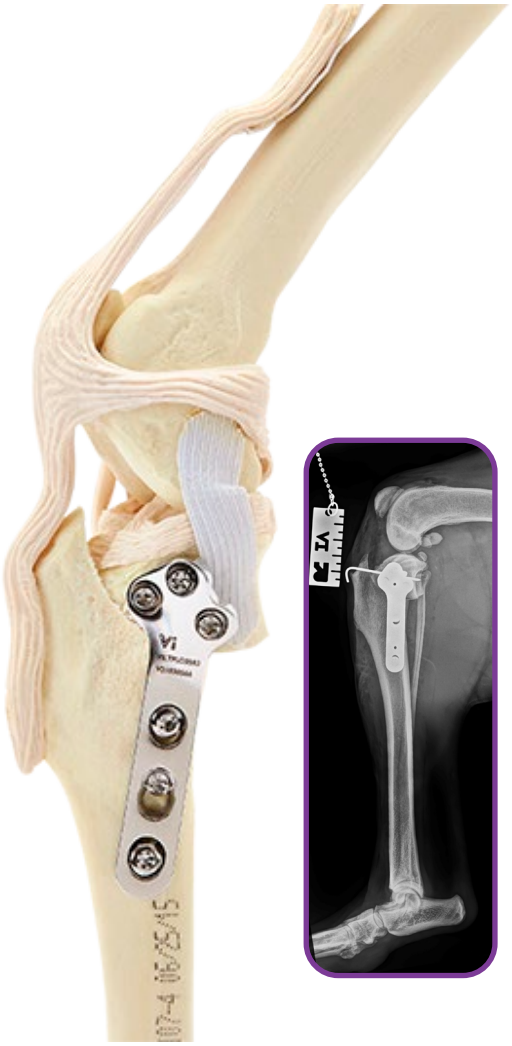
Veterinary Instrumentation

Surgery Guide

TPLO (Tibial Plateau Levelling Osteotomy)

Surgery Guide:
TPLO (Tibial Plateau Levelling Osteotomy)

Tibial Plateau Levelling Osteotomy (TPLO) is a surgical technique for the treatment of cranial cruciate ligament disease. TPLO was developed in the 1980s by an American surgeon, Dr Barclay Slocum. It was introduced in the 1990s and widely adopted in the 2000s; Since then, TPLO has gone through a series of evolutions and refinements, including a better understanding of how to perform the procedure as safely as possible, adoption of locking plates and screws, and the introduction of a range of anatomic-specific plate shapes and sizes specifically designed for TPLO and the proximal tibia.

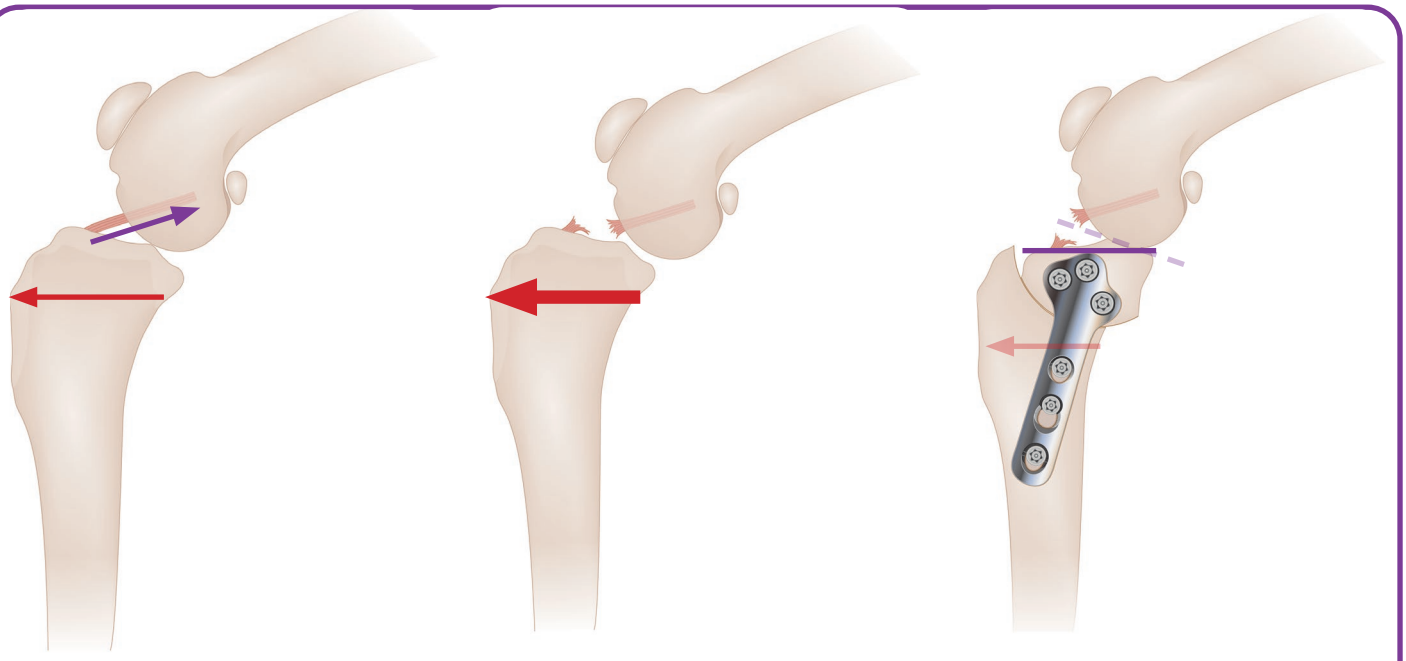


The tibial plateau is levelled, which neutralises the cranial tibial thrust forces in the stifle that are normally counteracted by the cranial cruciate ligament. This supersedes the need for an intact cranial cruciate ligament; the result is that the cruciate ligament deficient stifle no longer suffers active cranial tibial thrust.

Contents

Overview

TPLO is best achieved by a radial osteotomy of the proximal tibial metaphysis, rotation of the metaphysis so that the Tibial Plateau Angle (TPA) is levelled from an average of 26° to a target of 5°. The rotated tibial plateau is stabilised in the new position using an anatomically specific plate and screws, preferably a locking plate and screws.



Cranial tibial thrust (force represented by the red arrow) is neutralised by the intact cranial cruciate ligament (purple arrow). The tibia is stable; no cranial subluxation.

Ruptured cruciate ligament; the cranial tibial thrust force (red arrow) is no longer neutralised by the cranial cruciate ligament; the tibia has subluxated cranially.

TPLO surgery to address ruptured cranial cruciate ligament instability. The tibial plateau has been leveled from the inclined position (dotted line) to target 5° (solid purple line). Contact mechanics at the stifle no longer generate a cranial force, i.e. cranial tibial thrust is eliminated (muted red arrow) and the tibia no longer subluxates cranially.

Fig. 1

Fig. 1 shows how cranial tibial thrust is normally resisted by the intact cranial cruciate ligament, and how TPLO neutralises cranial tibial thrust following cruciate ligament rupture.

TPLO is arguably the best treatment option for all dogs with cranial cruciate ligament disease, in the author's opinion and according to multiple entries in the current veterinary peer-reviewed literature. It is the procedure that has the best outcomes in terms of limb function and stifle stability, and when executed properly it can have the lowest complication rates. It is, however, a technically demanding procedure that requires accuracy and precision, but with practice, experience, and precise attention to detail, it is a very safe and repeatable surgery that offers excellent outcomes for dogs and their owners.

Indications for TPLO

TPLO can be used to treat cranial cruciate ligament disease in all sizes and shapes of dog. It can be applied to any dog with cranial cruciate ligament disease, including partial tears and full tears, those with proximal tibial deformity, those with concurrent patellar luxation etc. It can be applied to a dog with almost any angle of tibial plateau.

Specific considerations:

- **Dog breed/size**: Does not influence the decision for TPLO surgery other than in small dogs the operation is more difficult and technically demanding, and in big dogs the complication rates are higher. There is an old theory that smaller dogs do better with lateral fabella suture but there is no evidence to support this. The prevailing opinion of specialist surgeons including the author, is that TPLO surgery is the procedure of choice for any dog with cranial cruciate ligament disease regardless of size. Smaller dogs usually have a higher-than-average Tibial Plateau Angle (TPA) and therefore a more cranially subluxated tibia. Arguably, this is the patient that a lateral fabella suture would be least effective for, and a TPLO most appropriate for. Experience would indicate that like all dogs, small dogs respond much better to a TPLO than extracapsular suture and do extremely well.
    - Getting started: for beginner TPLO surgeons, a 20-30kg Border Collie to Labrador Retriever is suggested as the easiest.
- **Age**: Most dogs present for TPLO surgery between 1 and 8 years of age.
    - Old dogs are not a contradiction to TPLO surgery per se, but few dogs present with cruciate disease above 10 years of age.
    - Young dogs less than 10 months of age with open proximal tibial physes; here the risk is of avulsion fracture of the tibial tuberosity post-TPLO so the decision for TPLO surgery has to be taken cautiously and sometimes delayed until the tibial tuberosity physis has mineralised at 8 to 12 months of age.
- **Partial cruciate ligament rupture** is an indication for TPLO and not a contraindication. TPLO has been shown to be protective for partial cruciate ligament rupture for progressing to full cruciate ligament rupture, and to be protective for development of subsequent meniscal injury in cruciate deficient stifles.
- **Bilateral presentations**: The relatively rapid return to function makes TPLO an excellent choice for bilaterally affected dogs. For those that are mildly affected, the surgery can be staged, usually at least 6 weeks apart. Single session bilateral TPLO is described with good outcomes, but is usually reserved for those dogs that are severely affected i.e., recumbent, or for owners who are on a tight budget where bilateral staged TPLO surgery is otherwise not affordable.

Contraindications to TPLO would include:

- The cost of the procedure and affordability to the client.
- Inability of the client to accept or cope with post-op complications (albeit very unlikely).
- Inability to rest and restrict the dog post-operatively.
- Any contraindication for sedation or general anaesthesia.
- Conditions that could increase the chance of surgical site infection, such as pyoderma, concurrent treatment with immunosuppressive drugs, or conditions such as hyperadrenocorticism.

Outcome: TPLO is widely accepted to give the best functional outcome compared to TTA and extracapsular/lateral fabella suture. TPLO is arguably more predictable and with lower complication rates. It enables all dogs including working/performance animals to return to high functional standards.

A variation on the radial TPLO technique is the Cranial Closing Wedge CWO-TPLO technique. This is technically simpler than the radial TPLO and outcomes are similar, but the potential for complications is greater with the CWO-TPLO as the osteotomy is less stable, and it results in a more pronounced tibial anatomic deformity.

TPLO Procedure

Pre-Operative Assessment

- Physical examination: dog with hindlimb lameness. Lameness may be mild or severe, may be acute, subacute or chronic.
- Orthopaedic examination: signs attributable to cranial cruciate ligament rupture i.e. hindlimb muscle atrophy, stifle effusion and thickening including medial buttress, cranial drawer or tibial thrust positive, and/or pain on stifle extension, performing stability testing, or apparent pain on hip extension.
- Imaging requirements: Orthogonal (caudocranial and a mediolateral) view of the tibia. Radiographs should be excellent quality i.e. straight (not rotated), well centred, well collimated, and well exposed. For the mediolateral views, the stifles and hocks should each be close to 90° of flexion.

Fig. 2

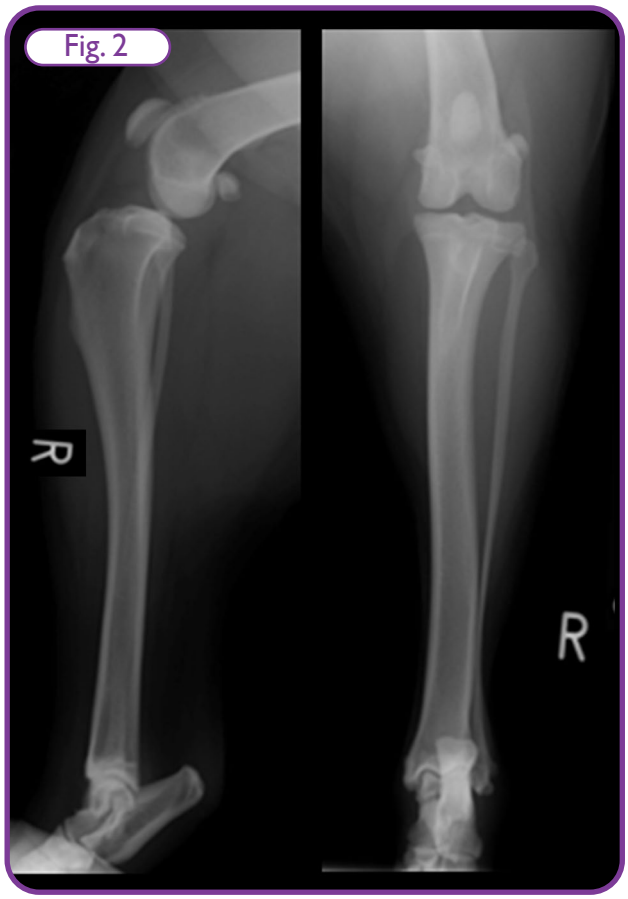


Fig. 2 shows good quality straight orthogonal radiographs of the tibia for pre-op TPLO assesment.

Fig. 3

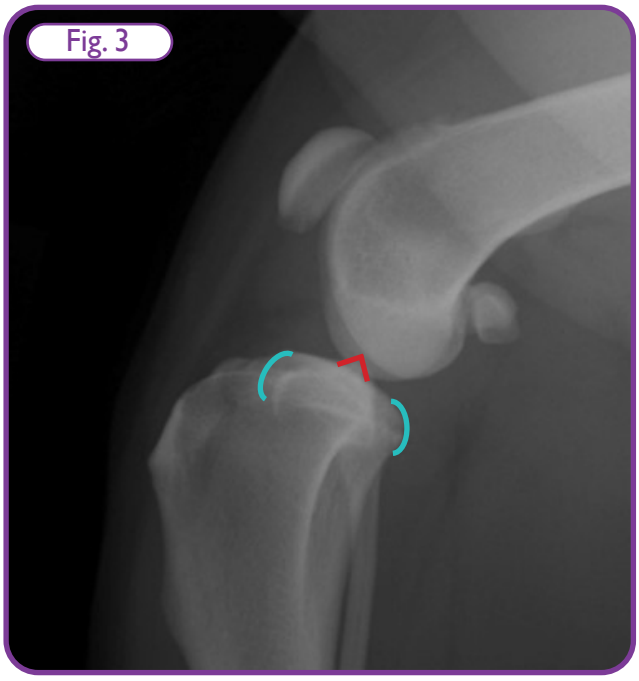


Fig. 3 indicates the intercondylar eminences (in red) and the cranial and caudal edges of the tibial plateau (light blue).

Measuring the Tibial Plateau Angle (TPA)

1.

Define the long axis of the tibia: the centre of the talus to intercondylar eminences of the tibial plateau – this is relatively straightforward as the points are easy to identify.

Fig. 4

Fig. 4 shows the tibial long axis marked with the light blue line.

2.

Define the perpendicular to the tibial long axis; this is the 0° mark for the TPA.

Fig. 5 shows the 0° (light purple line) perpendicular to the tibial long axis (light blue line).

3.

Define the tibial plateau; the cranial and caudal points of the tibial plateau: this is the harder bit of the measurements as the cranial parts of the tibial plateau are sometimes not easy to define, particularly where lots of degenerative joint disease is present.

Fig. 6 shows the tibial plateau marked in light blue

4.

Finally, the Tibial Plateau Angle (TPA) is the angle between measurements 2 and 3.

Fig. 7 shows the tibial plateau in light blue and the perpendicular to the long axis in light purple; the TPA is the angle between these lines. Digital software can calculate this automatically.

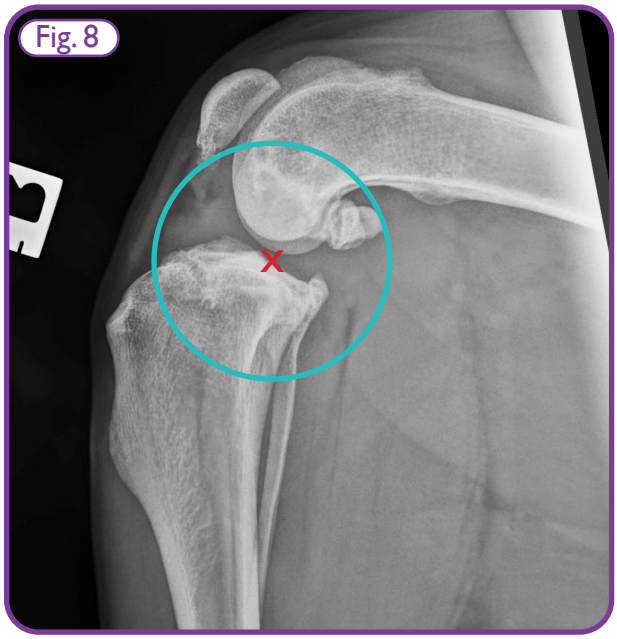
Average TPA is 20-30° and most are 24-28°

Excessive tibial plateau angle (TPA):
There is a technical "safe-point" for dogs with TPA of 30°, where TPLO rotation beyond this point was thought to increase the risk of tuberosity fracture; however this is unproven and is thought to be an invalid concern unless the TPA is very high (more than 45-50°). For such cases either a standard TPLO can be done at the surgeon's discretion or a radial TPLO is combined with a cranial closing wedge CWO-TPLO but this double osteotomy technique is technically much more challenging.

Excessive TPA>30° is an advanced TPLO procedure and is only recommended for experienced TPLO surgeons.

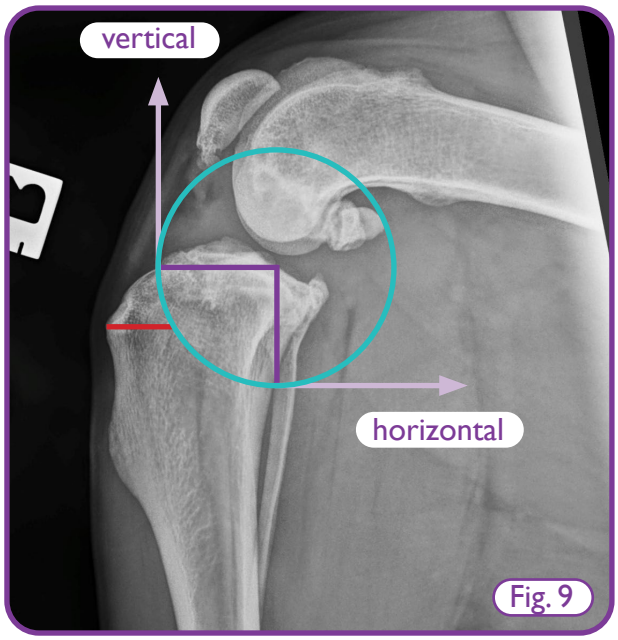
Planning the Osteotomy

The first point to identify is the centre of the stifles represented by the tip of the intercondylar eminences (Fig. 8, indicated by the red cross). Using this centring point, a circle is then overlaid on the proximal tibia; this represents the curved osteotomy in the tibia (Fig. 8, indicated by the light blue circle). Saw blade sizes are typically in 3mm radius increments i.e. 12, 15, 18, 21, 24, 27, 30mm; these are represented by circles with double these numbers as a diameter.

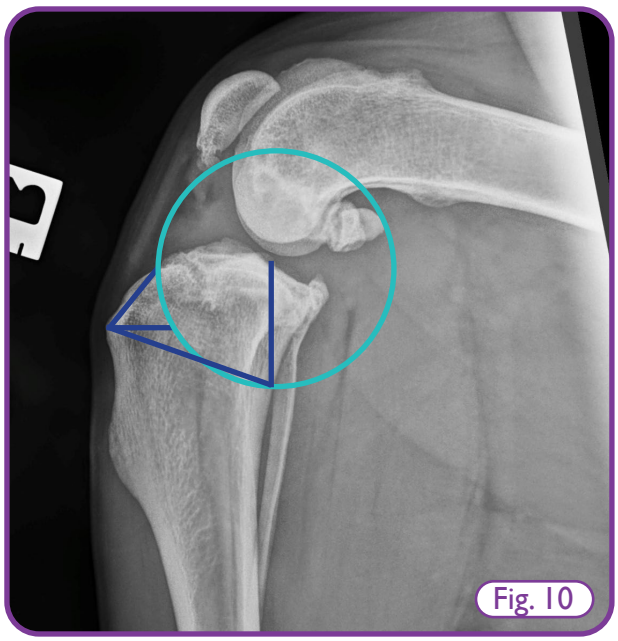


Important points to ensure that the osteotomy is planned in the correct position and the correct size, thus both safe and appropriate (Fig. 9):

- Enough tibial plateau should be available for safe placement of the plate and not be cut too small. Approximately one quarter of the surface area of the circle should encapsulate the tibia (purple lines).
- The tibial tuberosity should not be too thin otherwise it is at risk of fracture. In dogs more than 20kg, this should be at least 10mm thick cranial to caudal (red line).
- The tibial tuberosity should not be thinned below the insertion point of the patellar ligament (red line).
- The exit point of the osteotomy proximally should be vertical and not "cutting cranial or caudal" (vertical light purple arrow).
- The exit point of the osteotomy caudally should be horizontal and not "cutting up or down" (horizontal light purple arrow).



Once the osteotomy is planned as correct (light blue circle) and the size of the blade (radius) is recorded, four further measurements (blue lines, Fig 10) can be recorded. These measurements are taken to theatre and mapped onto the tibia to ensure the osteotomy position is as planned.



From the size of the TPLO blade, and the measured tibial plateau angle, the amount of rotation required can be calculated by using the TPLO rotation chart (Appendix 1).

To summarise: at the end of the TPLO planning you will have determined:

- The tibial plateau angle.
- The size of TPLO blade.
- The amount of rotation required for that blade.
- The position of the TPLO blade on the tibia to ensure that neither the tibial tuberosity or the tibial plateau are cut too small.
- Anatomic measurements to ensure the osteotomy position on the tibia is correct.

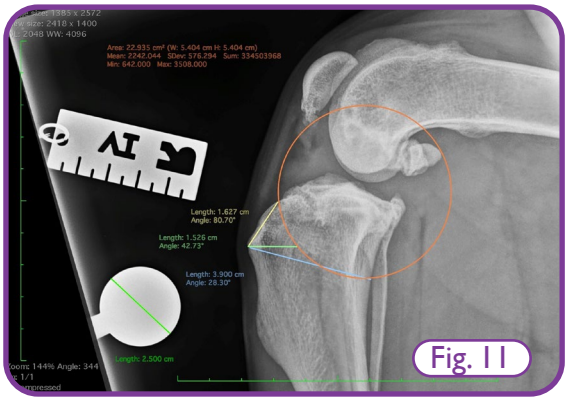


Fig. 11 shows an example of a TPLO plan with measurements to take into theatre.

Tibial Plateau Levelling Osteotomy Surgical Technique

1. Surgical Preparation

- Positioning: dorsal recumbency
- Clip: full hindlimb clip from dorsal midline, over the hip and down to the toes.
- Analgesia: epidural or local nerve block are recommended for multimodal analgesia.
- Limb: standard hindlimb prep i.e. draped in with foot draped out, giving full surgical access to the limb from mid femur to mid tarsus.
- Full sterile surgical preparation of the patient and surgeon.

Fig. 12 shows a TPLO patient fully draped and ready for surgery.

2. Surgical Approach

- Medial approach to the stifle and proximal tibia giving access for a mini-medial arthrotomy and the proximal third of the tibia. Proximal point is the distal pole of the patella. Distal point is proximal to the medial saphenous artery vein nerve bundle.
- Skin incision (Fig. 13).

- Subcutaneous fascia and fascia incision (often several layers) (Fig. 14).


Fig. 14

- Caudal sartorius and pes anserinus identified. Small incision made at cranial proximal caudal sartorius at attachment point to the tibia and extended proximally for 1-3cm along leading edge of caudal sartorius. Then blunt dissection under caudal sartorius extending distally and separating caudal sartorius and pes anserinus from the tibia; use a periosteal elevator or similar. Length of elevation = length of plate (Fig. 15).

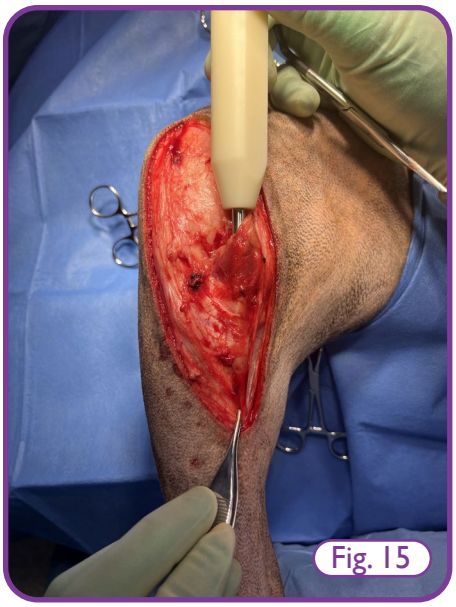


Fig. 15

- Sharp dissection (as close to the tibia as possible) of the cranial aspect of elevated tissue allows the sartoris/pes bundle to be reflected caudally. Popliteal muscle and medial collateral ligament are exposed beneath (Fig. 16).


Fig. 16

- Use electrocautery and a moist swab to free up any remaining fascial attachments.

3. Mini Medial Arthrotomy

It is important to know the meniscal anatomy.

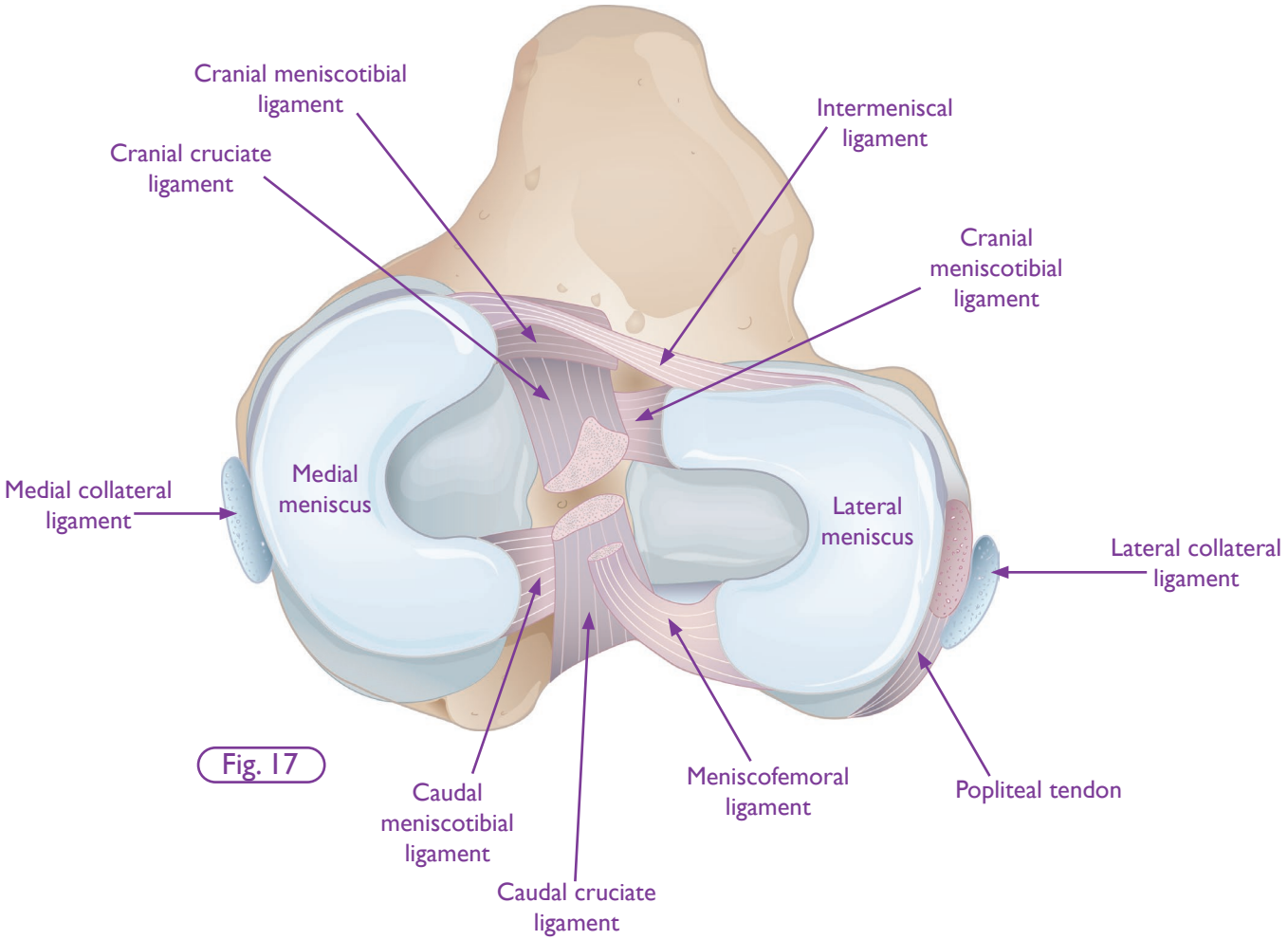


Fig. 17

Fig. 17 shows the anatomy of the proximal tibia including menisci and meniscal attachments.

The intra-articular structures of the stifle, particularly the menisci, should be examined, either by arthroscopy or arthrotomy. The text that follows is a description of how to do this by mini-medial arthrotomy.

- Identify patellar tendon between the distal patella and the tibial tuberosity; work medial to it.
- Use sharp dissection (#11 blade or cutting diathermy) to make a parapatellar incision through the medial retinaculum a few millimetres medial to the patellar ligament. This incision should extend from the distal pole of the patella down onto the proximal tibia (Fig. 18).


Fig. 18

- Starting proximally, at the level of the distal pole of the patella, sharp dissection (#11 blade or cutting diathermy) is used to incise into the joint capsule, initially entering the joint proximally; this releases a variable amount of fluid from the joint. The incision is continued distally as far as the proximal tibial tuberosity.
- The thick medial patellar fibrocartilage medial to the patella is not transected.
- Stifle distractors are carefully inserted into the joint (to avoid damaging the menisci, articular cartilage or remaining cruciate ligament), rotated by 90° and opened to distract the joint proximo-distally.
- Gelpi retractors are placed media-laterally to aid exposure (Fig. 19).

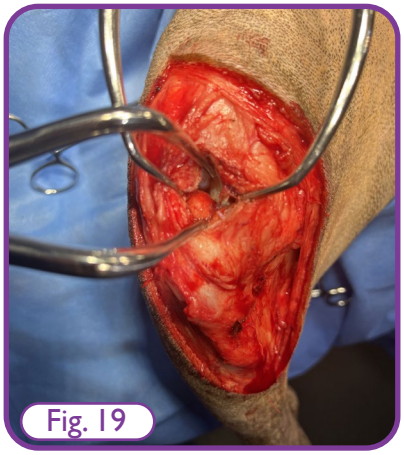


Fig. 19

- Flush/suction/swabs are used to clean the joint and maximise visualisation.
- The joint is inspected methodically in order not to miss important lesions. Specifically check:
  - Lateral and medial femoral condyle articular cartilage for erosion/ osteochondrosis.
  - Cranial cruciate ligament for integrity - debride mechanically incompetent portion; leave any mechanically competent portions.
  - Caudal cruciate ligament - probe to check integrity/damage.
  - Medial meniscus - visualise and probe for damage, use a Dandy Nerve Hook to probe above and below the meniscus to demonstrate tears. Resect damaged areas and tears using a small haemostat and no.11 blade or Beaver blade. Leave any undamaged areas alone (Fig. 20).
  - Lateral meniscus - visualise and probe as described for the medial meniscus above.

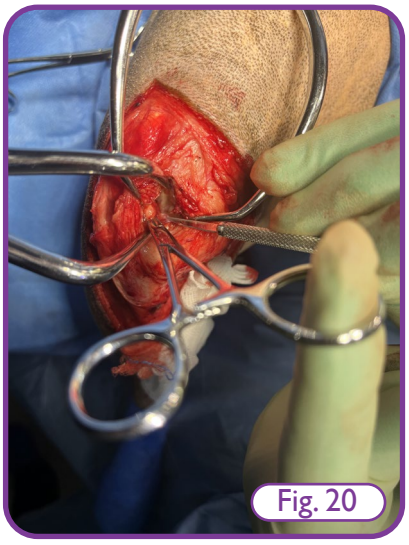


Fig. 20

- Flush joint thoroughly, remove retractors and leave arthrotomy open.
- Return the dog to lateral recumbency or remain in dorsal recumbency, dependent on preferred position for the osteotomy; lateral recumbency and having the tibia parallel with the table surface is recommended for the beginner.

It is normal for the axial (medial) thin edge of the medial meniscus to have a folded undulating appearance; this is **normal and not a meniscal tear**.

If the cranial cruciate ligament is mostly intact, it may be very difficult to inspect much of the medial meniscus as the cruciate ligament is directly in front of this; inspect as much of the meniscus as you safely can and if no damage is seen, it can be assumed that the meniscus is not torn/damaged given the cruciate ligament is present and competent.

Do not make a meniscal release or transection; this procedure is outdated and no longer performed by most surgeons. Releasing or cutting the meniscus means it loses its mechanical integrity and induces DJD in the stifle.

The lateral meniscus and caudal cruciate ligament are almost never affected, other than some fibrillation of the visible portion caudal cruciate ligament.

4. Identify the Centre of the Stifle

- Look at the mediolateral radiograph of the stifle and understand the anatomy including the relative positions of the bone landmarks of the proximal tibia; specifically the position of the plateau and intercondylar eminences relative to the tibial tuberosity.
- Place a short hypodermic needle, (1 inch 21G or 23G) into the stifle joint, just cranial to the medial collateral ligament. The needle should pop in straight and easily (Fig. 21).


Fig. 21

- This needle will act as the centre of your TPLO osteotomy. It is the equivalent of the centre of the circle from the planning radiographs.
- With practice, the needle can be inserted directly through the medial collateral ligament but do not do this until you are well-practiced otherwise you will make numerous stabs through the MCL.

5. Reposition the Dog

- Roll the dog into lateral recumbency for the osteotomy (recommended for beginners; more experienced surgeons may choose to keep the patient in dorsal recumbency).
- If in lateral recumbency, the index limb is downward i.e. for a left TPLO, roll into left lateral recumbency.
- Use swabs under the operated limb (more under the hock than the stifle) to make sure the tibia is positioned perfectly horizontal and parallel to the operating table with no internal or external rotation.

6. Prepare for the Osteotomy

- Select the TPLO blade as per your pre-operative plan.
- Place the blade over the proximal medial tibia; the centre point of rotation should be centred over the needle (Fig. 22).

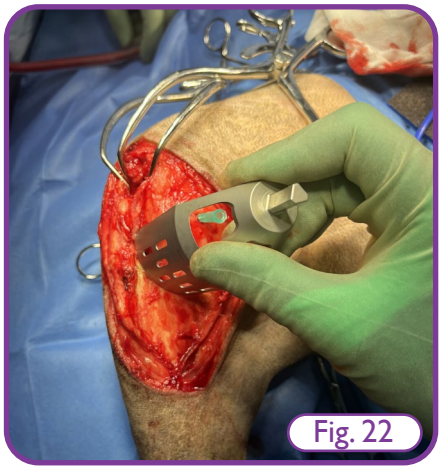


Fig. 22

- Check the blade position against the tibial and landmark measurements as per the pre-op plan.

Double-check the most important points:

- Enough tibial plateau should be available for safe placement of the plate – take the TPLO plate to the bone and check this.
- The tibial tuberosity should not be too thin otherwise it is at risk of fracture.
- The tibial tuberosity should not be thinned below the insertion point of the patellar ligament.
- The exit point of the osteotomy proximal should be vertical and not "cutting cranial or caudal".
- The exit point of the osteotomy caudal should be horizontal and not "cutting up or down".

- Adjust blade size or position as necessary.

Tip: If in doubt between 2 blade sizes, it is usually better to use the smaller blade size.

- Once you are happy, provisionally mark the osteotomy onto the bone; either by lightly scoring with the TPLO blade, using diathermy, or using a bone scribe (Fig. 23).

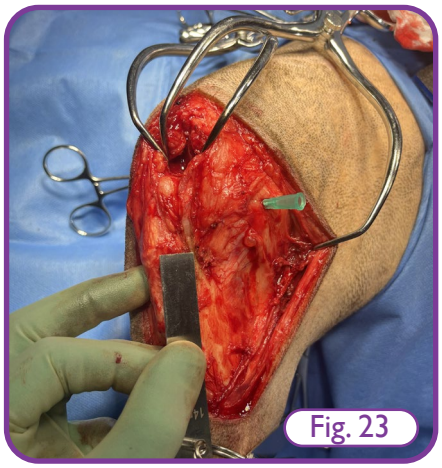


Fig. 23

- **Double check** the position of the osteotomy with reference to all the above landmark measurements.

Optional: Place a jig prior to performing the osteotomy. The jig was an integral part of the TPLO procedure when the surgery was first introduced. As the procedure has evolved, use of the jig has become less popular because using the jig has been shown to increase surgical time, has the potential for iatrogenic trauma including placement of pins in the joint, or iatrogenic fracture, and with no clear benefit. Many surgeons no longer use the jig, including the author.

Optional: Elevate the caudal soft tissue (popliteus) and the cranial soft tissue (lateral cranial tibial) and place moist swabs between the muscles and the bone. The purpose is to prevent iatrogenic soft tissue trauma from the TPLO blade, including vessel damage and severe haemorrhage. However, use of swabs increases iatrogenic soft tissue trauma, possibly leads to greater incidence and severity of post-operative distal limb swelling and has been shown to make no difference to the rate of haemorrhage. It also leaves swab debris after being cut by the TPLO blade. Most surgeons no longer elevate the soft tissues or pack with swabs, including the author.

7. Making the Osteotomy

- Using the oscillating TPLO blade, make the osteotomy **half** tibial thickness, gently rotating the blade back and forth along the direction of the circumference of the blade.

Tip: The oscillating TPLO saw can be unwieldly and difficult to control for the inexperienced surgeon. Hold the blade as close to the bone as you can, with a finger/hand that spans between bone and blade hand.

Tip: Hover the blade at full power over the bone then gently bring it down into contact.

- Ensure that the TPLO blade is oriented perpendicular to the tibia i.e. the TPLO saw blade and handle are held **vertically** if the tibia is **horizontal** on the operating table. It can be helpful to ask an assistant to look and check saw alignment.
- Use sterile saline and suction to cool the TPLO blade and prevent over-heating/necrosis of the bone.
- Mark the rotation distance on the tibia bone using a small osteotome and mallet. Direct at 45° to the cut surface of the tibia i.e. into the edge of the bone. Make one mark proximal and cranial, and the other mark caudal and distal (Fig. 24a). Separate them by the same distance as your rotation distance calculation.
- Double check the bone marks are separated by the correct distance (Fig. 24b).

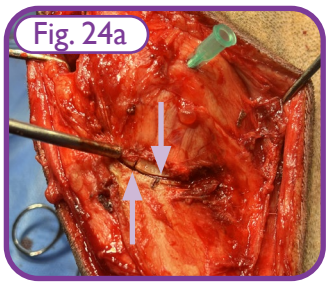


Fig. 24a

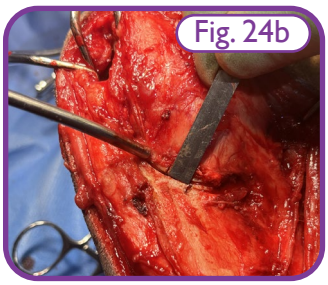


Fig. 24b

- Complete the tibial osteotomy full thickness medial to lateral (Fig. 25).

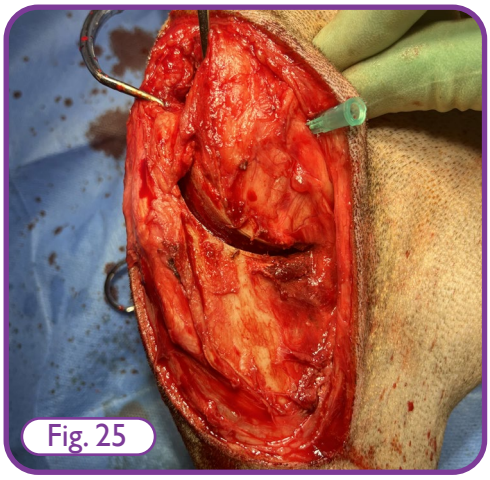


Fig. 25

Tip: Gently oscillate the TPLO saw along its circumference but take care not to go too far and cut into the soft tissues particularly caudally.

Tip: Be careful to anticipate the end of the osteotomy, and do not let the TPLO saw blade "fall" or travel too far laterally.

Tip: One trick to avoid falling too deep laterally is: **do not push** the TPLO saw blade through the bone as the motor/power tool should do the work; the surgeon's jobs is to hover/guide the blade and prevent it from going too far; in short, **do not push**.

8. Haemorrhage

- It is normal to get mild bleeding from the soft tissue and bone towards the end of the osteotomy, and on completion; usually it is monitored and stops quickly.
- Occasionally, the bleeding can be vigorous to pulsatile; it is thought this is caused by laceration of the cranial tibial artery. The bleeding can be stopped by:
  - Finger pressure over the artery just proximal to the surgical site.
  - Packing caudal and deep to the osteotomy adjacent to popliteus muscle; either with swabs or haemostatic agents such as Lysostypt.
  - Very rarely, the cranial tibial artery may need to be exposed, identified and ligated.

Tip: Rotation and stabilisation of the fragment (see below) will stop any bleeding in most instances.

9. Rotating the Tibial Plateau

- Use a negative threaded Ellis pin; see Table 1 for sizing guidelines. If the pin is too small, it will bend during rotation.
- Using a drill or K-wire driver, place the Ellis pin in the tibial plateau (Fig. 26). Entry point is cranial, just under the cut surface of the joint capsule. Aim from cranial towards the caudal tibial cortex with the pin angled about 30-40° to the horizonal i.e. slightly downwards.

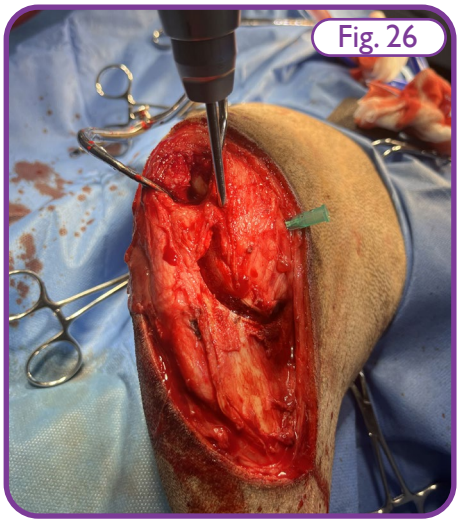


Fig. 26

- Once placed, use the pin as a handle to rotate the tibial plateau (Fig. 27). Be careful to only rotate along the arc of the osteotomy. Do not push up or down on the handle as this will cause internal or external rotation of the tibial plateau.

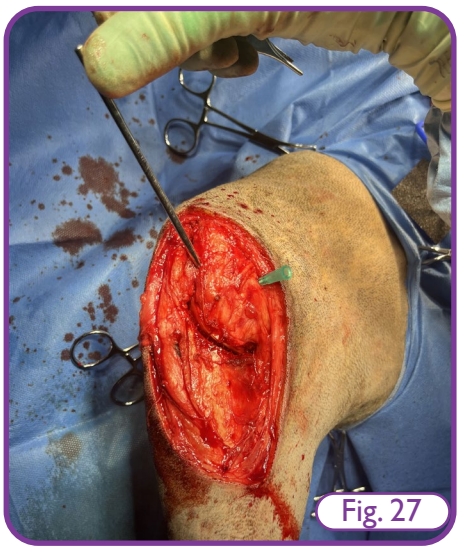


Fig. 27

- Rotate until the previously placed rotation marks line up; this ensures you have rotated the correct amount.
- **Alternative**: grasp the entire free segment of the tibial plateau with a large pair of bone holding forceps. Use the bone holding forceps

to rotate the tibial fragment as just described, being careful not to induce a rotational or any other deformity.

Tip: Over-rotate by 0.5-1mm as you will sometimes lose a small amount of rotation when you apply bone holding forceps to compress the osteotomy.

10. Stabilising the Rotated Plateau

- Once the plateau is in the correct position, stabilise with a K-wire.
- Size of the K-wire depends on size of patient see Table 1 (see next page) for sizing guidelines.
- The K-wire is placed cranial to caudal using a K-wire driver (Fig 28).

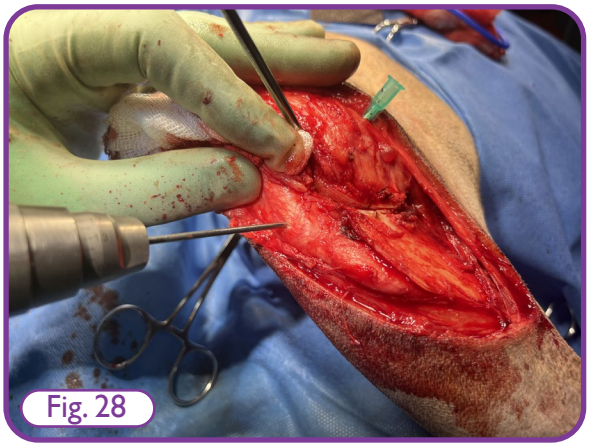


Fig. 28

- The entry point is in the tibial tuberosity just on or above the insertion point of the patellar ligament i.e., through the centre of the most distal part of the patellar ligament; just enough to see the distal fibres of the patellar tendon deform.
- The exit point is the caudal tibial cortex; the tip of the K-wire should just exit the bone but not further.

Warning: Placing the K-wire below the insertion point of the patellar ligament predisposes to tibial tuberosity fracture. **This must be avoided**.

11. Compress the Osteotomy and Check Reduction

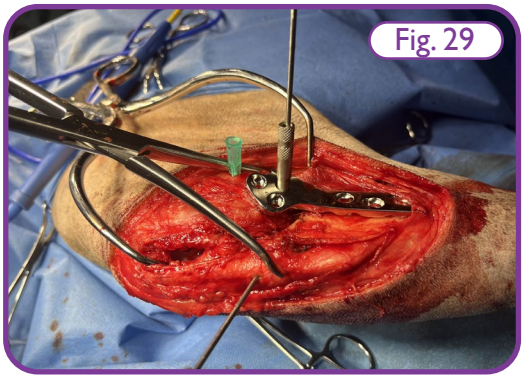
- Place a large pair of bone holding forceps from tibial tuberosity (cranially) to caudal tibial plateau cortex (caudally). Compress the osteotomy with hand pressure, then hold with the spinlock or ratchet.
- This will often result in a small "click" movement forward of the plateau relative to tibia, and slight loss of rotation; hence the over-rotation suggested at the previous step.
- The osteotomy should be perfectly reduced with no gap; test with a no. 11 scalpel blade. This is a very thin blade; it should be impossible to slide this into the compressed osteotomy.
- Carefully remove the Ellis pins once the plateau is rotated and secured in position; care is required as this may vibrate if bent during rotation.

12. Place the Locking TPLO Plate

Important: Use of correct drilling technique is essential i.e. use of correct pilot drill sizes, locking and non-locking drill guides, depth gauges, screw lengths etc.

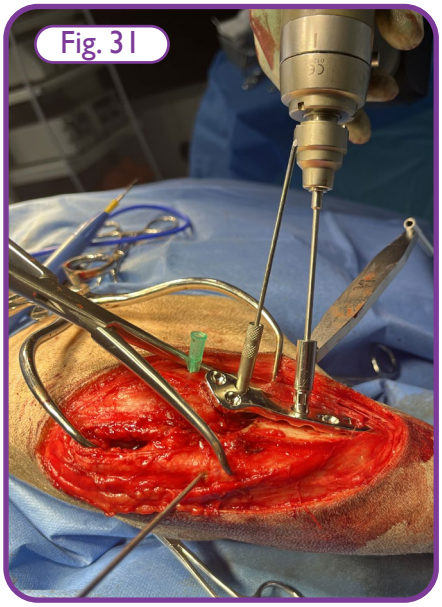
- Refer to Table 1 (see next page) for implant sizing guidelines.
- The Vi locking TPLO plate is pre-contoured to fit the shape of the tibia post-TPLO, so further contouring should only be required infrequently.
- Check that the plate fits the proximal medial tibia. The plate should sit flat on the tibia with the head being over the centre of the tibial plateau segment, and the shaft of the plate extending down along the proximal tibial diaphysis.
- The plate may not sit well if there is too much medial buttress causing the plate to stand off the tibial diaphysis. If this occurs there are two options:
  - Contouring the plate is preferable, but risks directing the proximal locking screws into the stifle joint, so the most proximal screw must be placed with extra care.
  - Alternatively, remove medial buttress to accommodate the head of the plate. This is less biological and causes bleeding. Be very careful not to be too aggressive and accidentally damage or transect the medial collateral ligament.

- Make sure there is bone under the plate where screws will be placed. Use a K-wire to palpate for bone if it is covered by soft tissue and cannot be visualised.
- The plate can be temporarily stabilised in the correct position using a K-wire in a locking drill guide (Fig. 29).

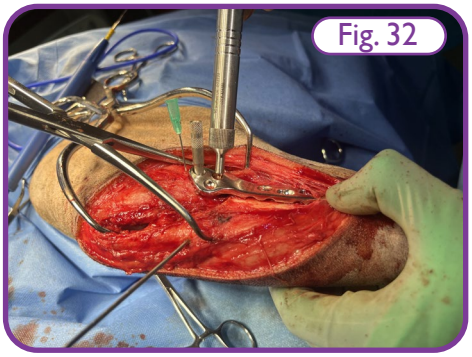


- Once the plate is positioned against the proximal tibia, the screws are placed in the following order (Fig. 30).

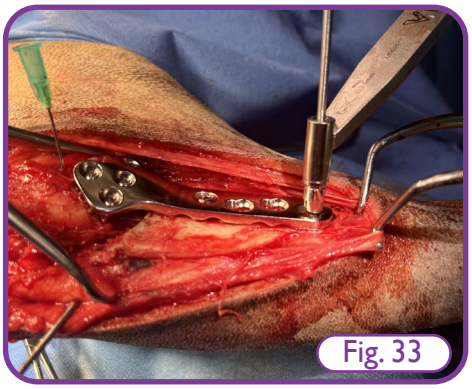
1. Place the most proximal screw in the distal segment. This is a non-locking screw, placed in the neutral position (Fig. 31).



2. Place all proximal screws as locking screws (3 or 4, depending on plate size) (Fig. 32). Take care that each of the screws is in bone. Take particular care that the most proximal screw is not intra-articular.



3. Place the most distal screw in the plate: non-locking axial compression screw (Fig. 33).



4. Place the remaining screws in the distal segment as locking screws (1 or 2, depending on plate size).

Tip: If any of the proximal locking screws hit the K-wire, there are 3 choices:

- Often the drill/screw will go past the K-wire.
- Withdraw the K-wire just enough to allow the screw to pass.
- Place a monocortical screw.

- Once the last screw is placed, removed the bone-holding forceps.

Table 1: Implant selection according to patient bodyweight. **Please note, this chart is for guidance only. Appropriate implant selection is at the discretion of the veterinary surgeon.**

Weight of Dog	Size of Locking TPLO Plate & Screw	Size of Ellis Pin to Rotate	Size of K-Wire to Stabilise
1-3kg	1.5mm	1.6mm	0.9mm
3-7kg	2.0mm	2.0mm	1.1mm
5-12kg	2.4mm	2.4mm	1.2mm
10-20kg	2.7mm	2.7mm	1.4mm
20-40kg	3.5mm 3.5mm Short for Bulldogs	3.2mm	1.6mm
40-80kg	3.5mm Broad	4mm	2.0mm
>80kg	3.5mm Broad + Second Plate*	4mm	2.0mm

A second plate may be added in larger patients (>80kg) at the surgeons' discretion. A straight 3.5mm broad DLP is suggested, placed just cranial or caudal to the TPLO plate.

- The K-wire that was placed to hold the tibial plateau in position can be left in position: bend the end over the tibial tuberosity using a K-wire bender and cut flush against the tibial tuberosity so no sharp ends are protruding (Fig. 34). This is the authors' preference as it should bring additional stability to the construct.

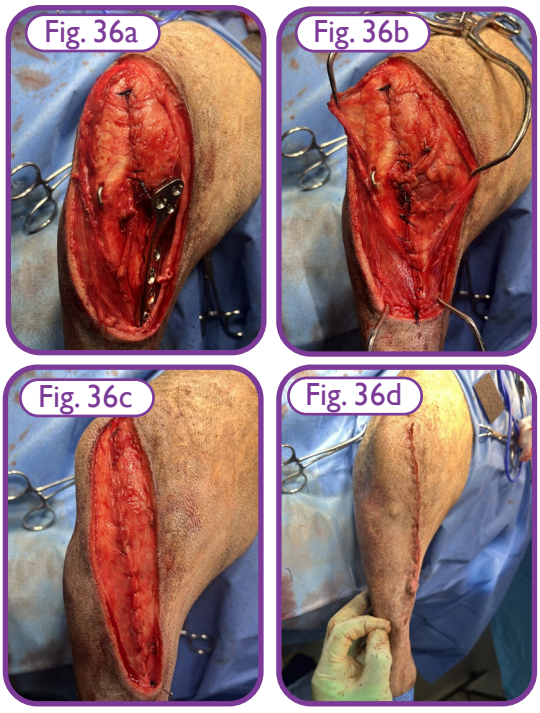
Checks: These are more easily done if the dog is rolled back into dorsal recumbency.

- Check limb alignment is good, normal and with no iatrogenic deformity.
- Check full range of stifle movement is possible with no crepitus or restriction.
- Check patellar tracking is normal i.e. no patellar luxation.
- Check cranial tibial thrust is now negative (cranial drawer will still be positive).

Fig. 35 shows a completed TPLO prior to closure.

13. Finish and Close

- Flush the entire surgical site thoroughly prior to closure.
- Joint capsule and medial retinaculum, ideally closed as two separate layers, PDS simple continuous (Fig. 36a).
- Pes anserinus and caudal sartorius: reflect cranially over the TPLO plate and close to the cranial tibial fascia using PDS simple continuous. Pay attention to position the sartorius/pes layer correctly proximally. Start distal and finish over the proximal tibia, just covering the TPLO plate (Fig. 36b).
- Close the deep fascia with PDS simple continuous (Fig. 36c). Close the superficial fascia with PDS simple continuous.
- Close the sub-dermal and intra-dermal layers with Monocryl simple continuous (Fig. 36d).
- Place tissue glue or skin sutures e.g. nylon interrupted cruciate sutures.



14. Post-Operative Radiographs

- Take good quality caudocranial and mediolateral radiographs of the tibia, as per the pre-op images. Check:
  - Alignment: of the tibia is correct including corrected TPA; the new TPA should be measured.
  - Apposition: no gap at the osteotomy.
  - Apparatus: appropriate positioning of the implants.
  - Osteotomy position and direction is correct and as planned.

Fig. 37 shows post-operative TPLO radiographs showing good alignment and corrected TPA, excellent apposition of the osteotomy, appropriate implant positioning and appropriate/good positioning of the osteotomy.

15. Post-Operative Management

- Hospitalisation for 1-2 days post-op; 50% of patients are weight bearing within 24 hours of surgery, and 95% within 2 days of surgery.
- Opioids for 12 to 48 hours post-op e.g., methadone or fentanyl; most dogs need about 24 hours.
- Peri-operative antibiotics only i.e., intravenous at time of induction to end of surgery; post-operative antibiotics are not indicated.
- NSAIDs; perioperatively and for 1-2 weeks post-op.
- Paracetamol; perioperatively and 7-10 days post-op.
- Tramadol: consider for 5 days post-op.
- Primapore dressing to cover the wound for 1-5 days post-op.
- Physiotherapy immediately post-op.
- Hydrotherapy/water treadmill once the skin incision has healed i.e. 10-14 days post-op
- **Strict** exercise restriction for 8 weeks postop; lead walks only, no running, jumping or climbing.
- Re-examination and check X-rays at 6-8 weeks post-op.

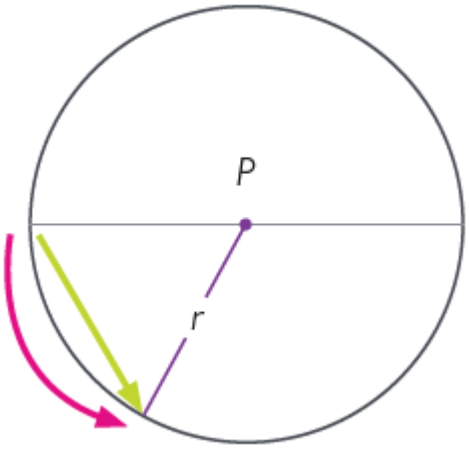
With thanks to Gareth Arthurs PGCertMedEd MA VetMB CertVR CertSAS DSAS(Orth) FHEA FRCVS RCVS Recognised Specialist in Small Animal Surgery (Orthopaedics) for his invaluable assistance with this Surgery Guide, new for 2023.

Appendix 1

TPLO Rotation Chart

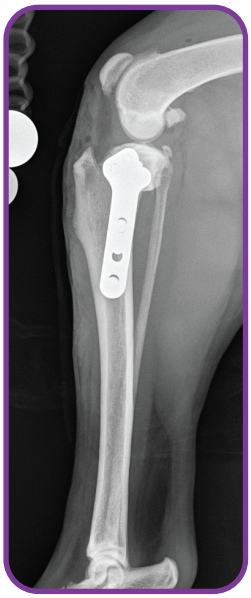
Tibial Plateau Angle (Degrees)		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Linear Translation (mm) Required to Achieve Post-Op TPA of 5 Degrees																	
Blade size (mm)	12	1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.2	3.4	3.6	3.8	4	4.2
	15	1.3	1.6	1.8	2.1	2.4	2.6	2.9	3.2	3.4	3.7	3.9	4.2	4.5	4.8	5	5.3
	18	1.6	1.9	2.2	2.5	2.8	3.1	3.5	3.8	4.1	4.4	4.7	5.1	5.4	5.7	6	6.3
	21	1.8	2.2	2.5	2.8	3.1	3.5	3.8	4.1	4.4	4.8	5.2	5.9	6.3	6.7	7	7.4
	24	2.1	2.5	3	3.4	3.8	4.2	4.6	5	5.5	5.9	6.3	6.7	7.2	7.6	8	8.4
	27	2.4	2.8	3.3	3.8	4.2	4.7	5.2	5.7	6.2	6.6	7.1	7.6	8.1	8.6	9	9.5
	30	2.6	3.1	3.7	4.2	4.7	5.2	5.8	6.3	6.8	7.4	7.9	8.4	9	9.5	10	11
	34	3	3.6	4.2	4.8	5.4	5.9	6.5	7.1	7.7	8.3	9	9.6	10	11	11	12

Tibial Plateau		26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Linear Translation (mm) Required to Achieve Post-Op TPA of 5 Degrees																
Blade size (mm)	12	4.4	4.6	4.9	5.1	5.3	5.5	5.8	6	6.2	6.4	6.7	6.8	7.1	7.3	7.6
	15	5.6	5.8	6.1	6.4	6.7	6.9	7.2	7.5	7.8	8	8.3	8.6	8.9	9.2	9.5
	18	6.7	7	7.3	7.7	8	8.3	8.6	9	9.3	9.6	10	10.3	10.7	11	11.4
	21	7.8	8.2	8.5	8.9	9.3	9.7	10.1	10.5	10.9	11.3	11.6	12	12.4	12.8	13.2
	24	8.9	9.3	9.8	10.2	10.6	11.1	11.5	12	12.4	12.9	13.3	13.8	14.2	14.7	15.1
	27	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5	17
	30	11.1	11.7	12.2	12.8	13.3	13.9	14.4	15	15.5	16.1	16.6	17.2	17.8	18.3	18.9
	34	12.6	13.2	13.8	14.5	15.1	15.7	16.3	17	17.6	18.2	18.9	19.5	20.1	20.8	21.4



r = Radius (size) of TPLO blade
Pink = Arc of physical rotation
Green = Linear rotation in mm

Pre-Op



Post-Op

Radiographs and surgery images courtesy of Prof Gareth Arthurs, PGCertMedEd MA VetMB CertVR CertSAS DSAS(Orth) FHEA FRCVS RCVS Recognised Specialist in Small Animal Surgery (Orthopaedics). Images may not be downloaded, used or reproduced without express permission.

Featured Products

Please note, the following featured products are only a selection of those available in the range.

Vi Locking TPLO Starter Kits

VILTPLOKITNP	Vi TPLO Locking Starter Kit With No Power Equipment
VILTPLOKITBAT	Vi TPLO Locking Starter Kit With Battery Saw Power
VILTPLOKITBATXS	Vi TPLO Locking Kit With 1.5mm/2.0mm/2.7mm Plates
VILTPLOKITXSNP	Vi TPLO Locking Starter Kit With No Power Equipment

Please contact a member of the Vi team for a list of the contents of these kits.

VILTPLO Locking TPLO Plates

VILTPLO15L3	Locking TPLO Plate For 1.5mm Screws 3 Holes Left
VILTPLO15R3	Locking TPLO Plate For 1.5mm Screws 3 Holes Right
VILTPLO20L	Locking TPLO Plate For 2.0mm Screws 3 Holes Left
VILTPLO20R	Locking TPLO Plate For 2.0mm Screws 3 Holes Right
VILTPLO24L	Locking TPLO Plate For 2.4mm Screws 3 Holes Left
VILTPLO24R	Locking TPLO Plate For 2.4mm Screws 3 Holes Right
VILTPLO27L3	Locking TPLO Plate For 2.7mm Screws 3 Holes Left
VILTPLO27R3	Locking TPLO Plate For 2.7mm Screws 3 Holes Right
VILTPLO35SL3	Locking TPLO Plate Small For 3.5mm Screws 3 Holes Left
VILTPLO35SR3	Locking TPLO Plate Small For 3.5mm Screws 3 Holes Right
VILTPLO35L3	Locking TPLO Plate For 3.5mm 3 Holes Left
VILTPLO35R3	Locking TPLO Plate For 3.5mm 3 Holes Right
VILTPLO35BL4	Locking TPLO Plate Broad For 3.5mm Screws 4 Holes Left
VILTPLO35BR4	Locking TPLO Plate Broad For 3.5mm Screws 4 Holes Right

Locking Screw Sets

LS20STARKITMPB	2.0 Star Drive Locking Screw Set
LS24STARKITMPB	2.4 Star Drive Locking Screw Set
LS27STARKITMPB	2.7 Star Drive Locking Screw Set
LS35STARKITMPB	3.5 Star Drive Locking Screw Set

TPLO Instrumentation

Standard Slocum Style TPLO Jig

TPLOJIG/S.	Slocum Style Jig Standard (3.2mm Pin)
TPLOJIG/SS.	Slocum Style Jig Small (2.4mm Pin)
TPLOJIG/ROD35	Replacement Alignment Bars (Set of 2) Standard
TPLOJIG/ROD27	Replacement Alignment Bars (Set of 2) Small
TPLO32	Slocum Guide Pin 3.2mm Thread 25mm
BCNET24	2.4mm Bicortical Negative End Thread Pin 100mm Long

TPLO Jig

TPLOJIG	TPLO Jig 120mm
TPLO32	Slocum Guide Pin 3.2mm Thread 25mm

XS TPLO Jig

TPLOJIGXS.	XS TPLO Jig 60mm

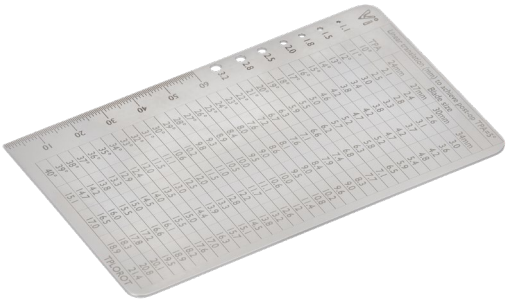
Slocum Rotation Gauges

001492	Slocum Rotation Gauges

TPLO Rotation Gauge Divider Type

001499 TPLO Rotation Gauge Divider Type 90mm

TPLO Rotation Chart



TPLOROT TPLO Rotation Chart

Very Large Fragment Forceps

001202 Very Large Fragment Forceps 205mm Long
001203 Very Large Fragment Forceps With Spinlock 215mm Long

Vi Battery Powered TPLO Saw

VITPLOSAW Vi Battery Powered TPLO Saw
VITPLOSAW-SC Vi TPLO Sterilisation Case
VITPLOCHGUK Vi TPLO Saw Conditioning Charger (UK Plug)
VITPLOCHGEU Vi TPLO Saw Conditioning Charger (EU Plug)
VITPLOCHGUSA Vi TPLO Saw Conditioning Charger (US Plug)
VITPLOBAT Vi TPLO Saw Replacement Battery

TPLO Saw Blades Vi Pattern

TPLOVI12 TPLO Blades Vi Pattern 12mm
TPLOVI15 TPLO Blades Vi Pattern 15mm
TPLOVI18 TPLO Blades Vi Pattern 18mm
TPLOVI21 TPLO Blades Vi Pattern 21mm
TPLOVI24 TPLO Blades Vi Pattern 24mm
TPLOVI27 TPLO Blades Vi Pattern 27mm
TPLOVI30 TPLO Blades Vi Pattern 30mm
TPLOVI34 TPLO Blades Vi Pattern 34mm

Vi®
Veterinary
Instrumentation

Exclusively distributed by

PROVET®

A covetrus Company

Visit Provet Vi Online

www.vetinst.com.au

www.vetinst.co.nz