VETERINARY INSTRUMENTATION

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TTA SURGERY – A STEP BY STEP GUIDE

Introduction

In the 1980s Barclay Slocum reasoned that changing the angle of the tibial plateau would modify the forces acting upon the cruciate deficient stifle so that under load the stifle would be stable. Slobodan Tepic considered the Slocum model of stifle biomechanics too simplistic and factored in many other muscles and tendons acting on the stifle. He concluded that, rather than correcting the tibial plateau to any arbitrary angle, the relationship of the tibial plateau to the straight patella ligament was more significant. By bringing the tibial plateau to sit at 90 degrees to the straight patella ligament the resultant forces acting on the stifle were effectively neutralised when the stifle was loaded.

Tepic and Montavon in Zurich have devised a procedure which, rather than rotating the tibial plateau, makes the necessary adjustment by advancing the tibial tubercle until the 90 degree relationship is achieved. The resulting construct is stabilised using a system of cages, plates and screws. This procedure is known as Tibial Tubercle Advancement (TTA).

More recently modifications to the technique using forkless plates and no plates at all (Modified Maquet Technique, MMT) have been described. The step by step guide illustrated here describes the standard TTA technique. Sections on forkless plates and the MMT technique are included at the end of the brochure.

In addition to the dedicated instrumentation described a standard range of orthopaedic equipment will be necessary including a flat bladed oscillating saw.

Implants are available in either Titanium or 316LVM. Although significantly more expensive Titanium offers much better biocompatability and fatigue strength. Both factors are important. The biocompatability encourages bone growth through the cage and the fatigue strength gives support until this happens.

Some surgeons are using titanium plates and cages and stainless screws. Until this has been proved to be safe it is recommended that surgeons choose either stainless steel or titanium.

The step by step guide which follows details the management of a cruciate deficient stifle by TTA. A video presentation of the case described is available on line at www.vetinst.com or as a higher quality hard copy by e-mailing info@vetinst.com

Preoperative assessment

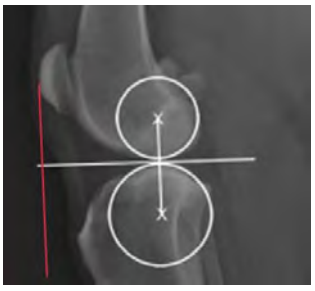
Using good quality radiographs it is necessary to calculate the degree of tibial tubercle advancement which will bring the tibial plateau to sit at 90 degrees to the straight patella ligament. There are two methods of making this calculation. The original method involves identifying a line representing the tibial plateau. More recently 'the common tangent' method involves identifying the centres of rotation of the femur and tibia.

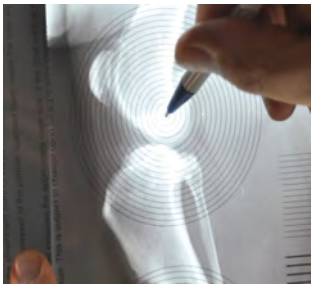
Free overlays detailing how this is done are available for Veterinary Instrumentation. Both methods are shown on the video. It is not part of this practical guide to explain the rationale behind both techniques. There are papers published in VCOT and Vet Surgery. There is no published data showing different outcomes for the two methods but it is recommended that surgeons adopt one or the other and stay with it. Cages for advancement are available in 3, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0 and 15mm widths in a range of lengths.

Traditional method

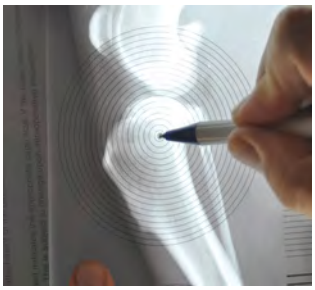
Using the traditional overlay place line B along the tibial plateau. Move the overlay so that line A just touches the cranial margin of the patella. It will now become clear from the scale how far the tibial tubercle must be advanced to bring it into line with the patella ligament. The TTA surgery will then realign the patella ligament to an angle of 90 degrees with the tibial plateau.

Common Tangent Method





Using the common tangent overlay identify the centre of rotation of both femur and tibia. If the femur radiograph shows both condyles mark the centre of rotation of both and find a spot between the two marks.

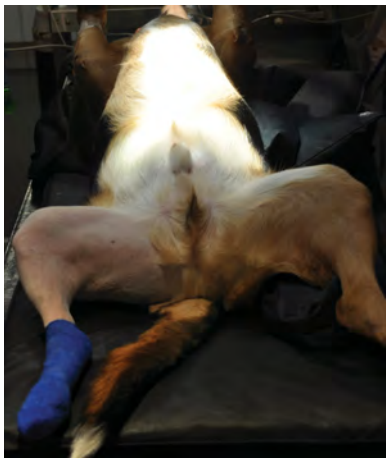


Using the calibration of the overlay align point zero against the cranial margin of the patella. Adjust the overlay so that the marked points on the femur and tibia sit on the same guide line and measure the degree of advancement required.

Using the TTA plate overlay an appropriate plate is selected. The forked area should overlay the tibial crestand the hole for the tibia should sit centrally or a little cranially on the tibial shaft.

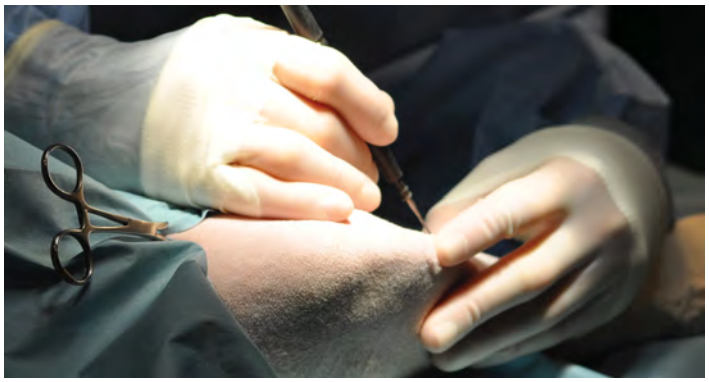
SURGICAL TECHNIQUE STEP-BY-STEP

Initial approach and preparation of the tibia

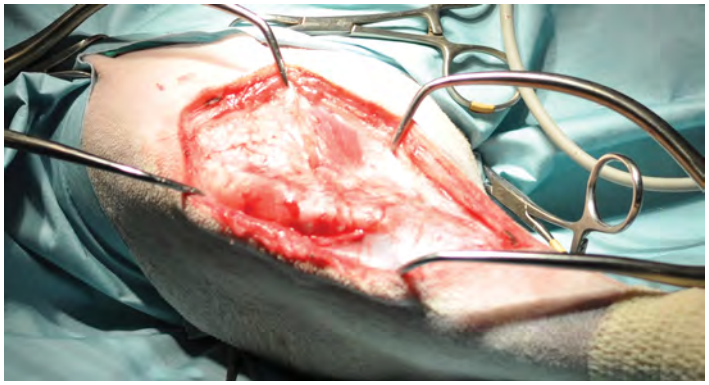


1 Start with the dog in dorsal recumbency

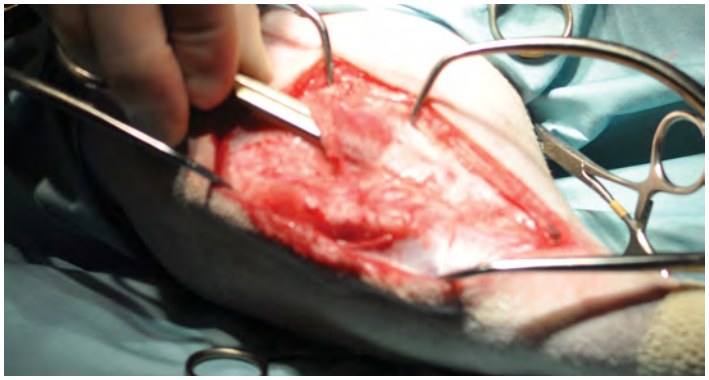
2 Make a skin incision on the medial aspect of the stifle and proximal tibia starting at about the level of the patella, extending distally parallel and medial to the straight patellar ligament, distally over the medial tibial tuberosity and then gently curving caudally to extend over the proximal tibial diaphysis



3 Use diathermy and haemostats to control bleeding.



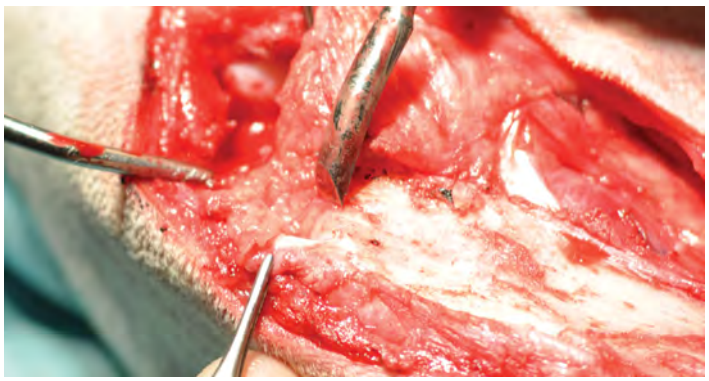
4 Sharply dissect (then blunt) through the subcutaneous fascia and fat to expose the medial retinaculum and patellar ligament, the proximal tibial tuberosity, the caudal Sartorius muscle and its continuation distally as the pes anserinus

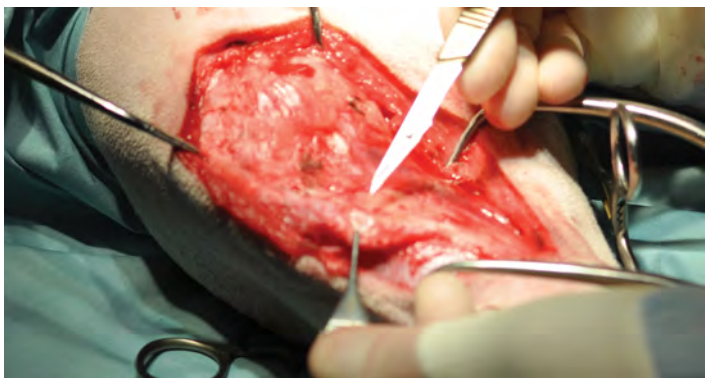


5 Sharply dissect under the proximal cranial leading edge of the caudal Sartorius muscle

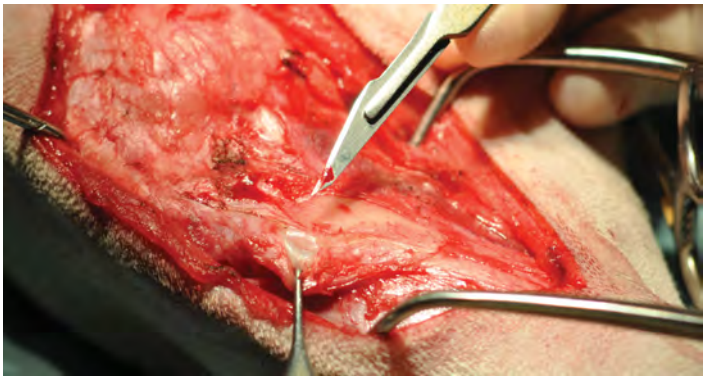
6 Using a Mayo scissor, insert under the caudal Sartorius and run distally under the leading (insertion) edge of the pes anserinus.

7 As close to the tibia as possible, cut the insertion of the pes anserinus from the tibia using cutting diathermy or a #11 blade. M. Popliteus and medial collateral ligament are visualised beneath

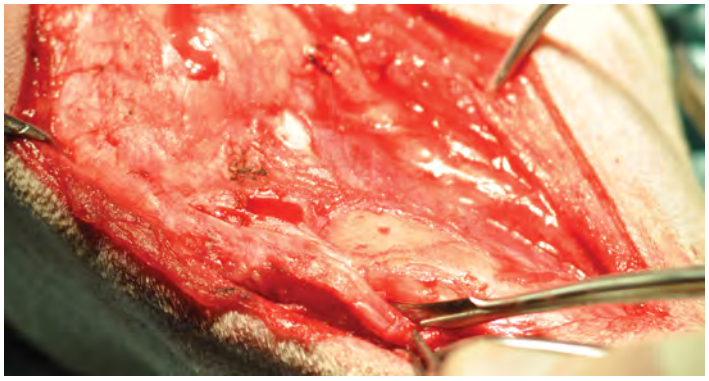




8 Prepare the tibial tuberosity on the medial aspect by reflecting and incising the periosteum cranially to expose the tibial tuberosity. This is best achieved by a combination of cutting diathermy, #11 blade and periosteal elevator. This soft tissue should be elevated and reflected sufficiently cranially until the following features are identified; the distal medial extent of the patellar ligament, the lateral curving surface of the cranial tibial tuberosity, and the transversely oriented ligamentous tissue that is visualised at the distal aspect of the tibial tuberosity



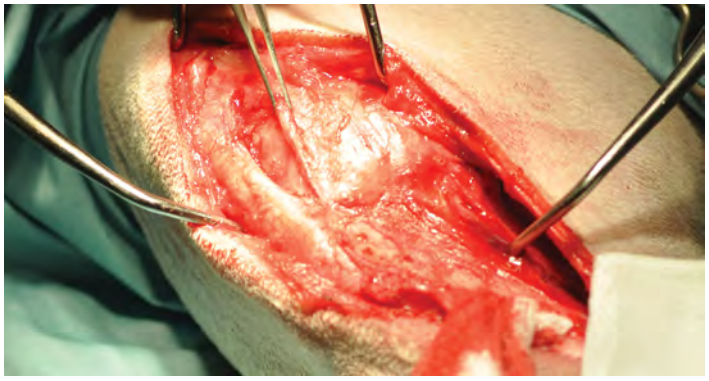
9 This elevation is continued just distal to the tibial tuberosity and a #11 blade is used to create a <2cm incision on the cranial aspect to allow elevation of the cranial tibial muscle.



10 A periosteal elevator is inserted into this hole and directed proximally – this is used to elevate the cranial tibial muscle from the lateral aspect of the proximal tibia.

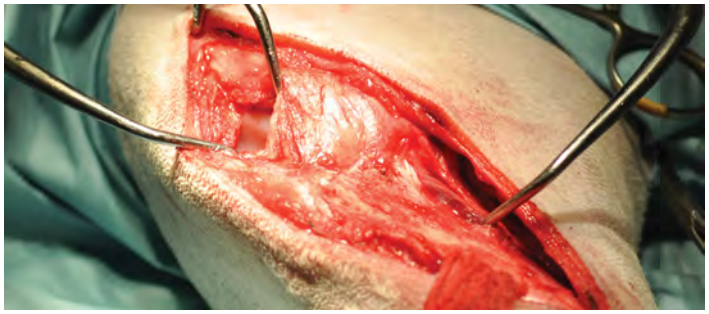
11 On the medial aspect of the tibia, elevation is continued distally along the proximal tibial diaphysis to remove the periosteum from beneath the predicted position of the plate.

Medial stifle arthrotomy

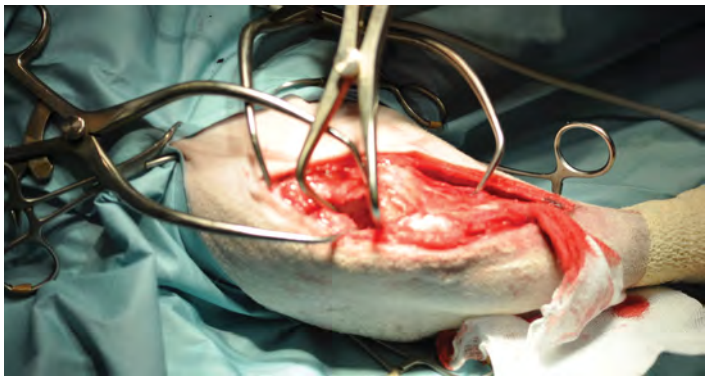


12 Use sharp dissection (#11 blade of cutting diathermy) to make a parapatellar incision through the medial retinaculum a few millimetres medial to the patellar ligament. This incision should extend from the distal pole of the patella down onto the proximal tibia – distally this will join up with the previously exposed proximal cranial aspect o the tibail tuberosity.

13 Blunt dissection is used to separate the cut edges of the medial retinaculum from the underlying exposed joint capsule.



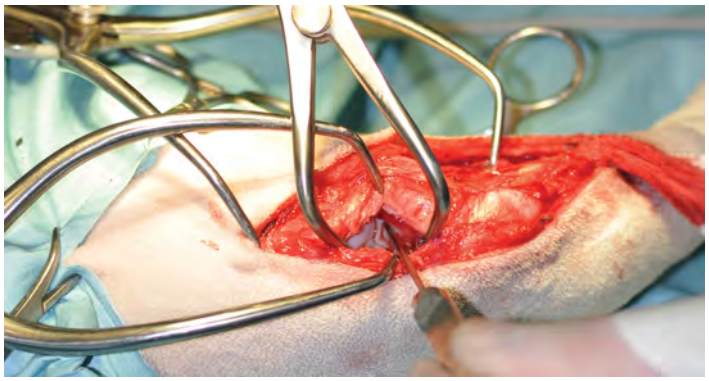
14 Starting proximally, at the level of the distal pole of the patella, sharp dissection (#11 blade or cutting diathermy) is used to incise into the joint capsule, initially entering the joint proximally; this releases a variable amount of fluid from the joint. The incision is continued distally as far as the proximal tibial tuberosity.



15 Stifle distractors are carefully inserted into the joint (to avoid damaging the menisci, articular cartilage or remaining cruciate ligament), rotated by 90 degrees and opened to distract the joint proximo-distally

16 Gelpi retractors are placed medio-laterally to aid exposure.

17 Flush / suction / swabs are used to clean the joint and maximise visualisation



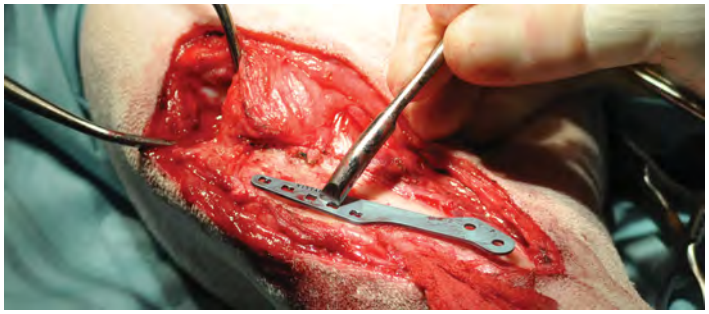
18 The joint is inspected methodically so as to not miss important lesions. Specifically check:

- Lateral and medial femoral condyle articular cartilage for erosion / osteochondrosis
- Cranial cruciate ligament for integrity – resect torn and damage parts
- Caudal cruciate ligament – probe to check integrity / damage
- Lateral meniscus – visualise and probe for damage
- Medial meniscus – visualise and probe for damage, use a Dandy Nerve hook to probe above and below the meniscus to demonstrate tears. Resect any damaged areas using a small haemostat and #11 blade or Beaver blade. If severe damage is present consider a partial menisectomy, but only if absolutely necessary.

19 The joint surgery / inspection is now complete and the joint should be flushed thoroughly but not closed at this stage.

20 Return the dog to lateral recumbency

Picking the correct plate size and position

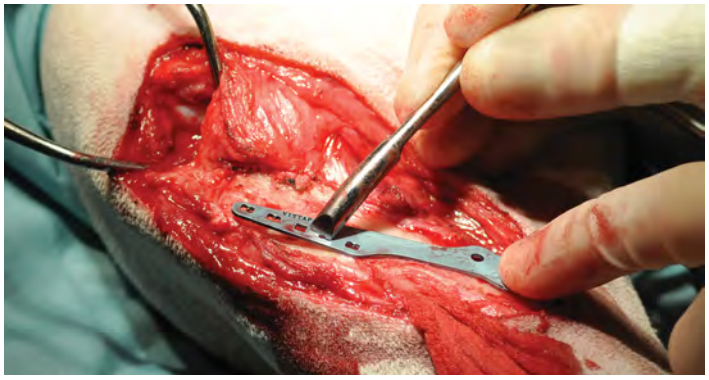


21 Use the plate size originally predicted from templating.

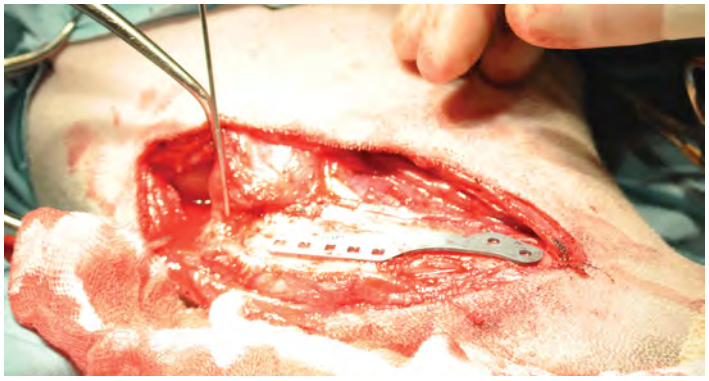
22 Palpate the distinct tip of the most cranial part of the tibial tuberosity, just under the insertion of the patellar ligament

23 Place the plate on the tibial tuberosity such that the most proximal hole / fork of the plate is 5mm caudal to this tip of the tibial tuberosity

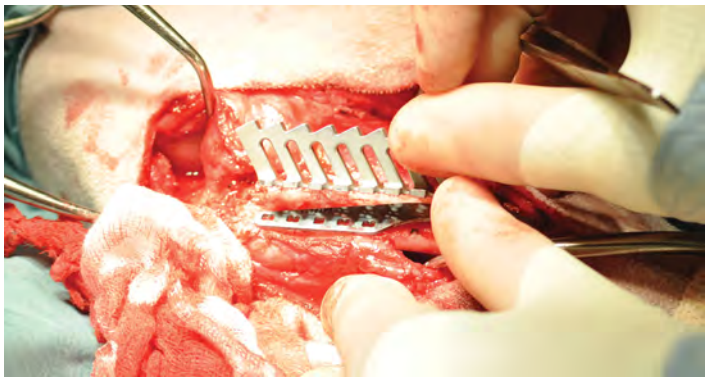
24 Align the cranial aspect of the plate with the cranial cortex of the tibial tuberosity. Check that this position ensures that good quality bone is present beneath the most distal fork hole If this is not the case, consider either a larger or a smaller plate.



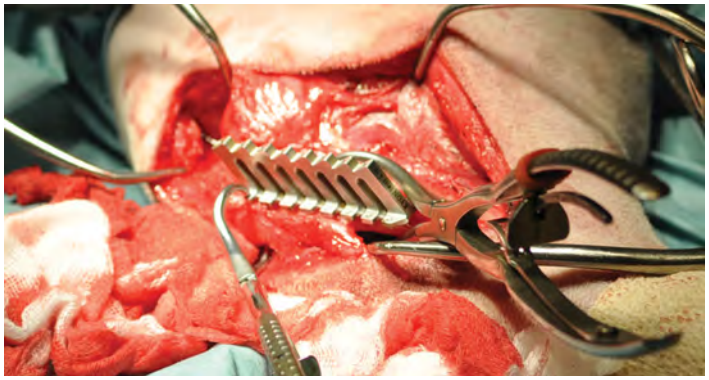
25 Check also that this plate position ensures that the plate screw holes are positioned over the mid to cranial tibial cortex. This is because when the tibial tuberosity advancement is performed, these screw holes migrate caudally – if they start too caudal and subsequently migrate further caudally they may no longer be positioned over the tibial cortex. Small adjustments in plate position and / or size may be necessary to ensure this.



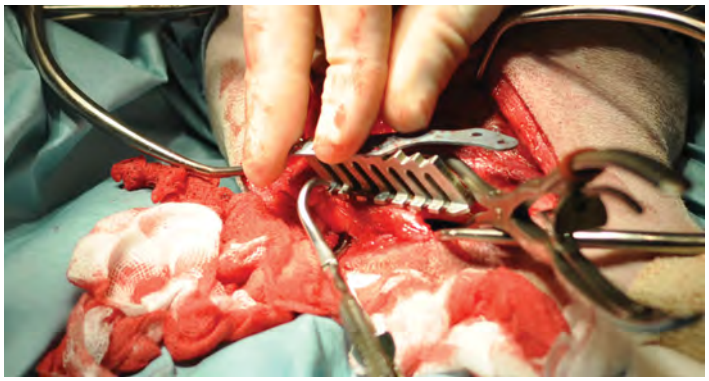
26 Once you are happy with the plate size and positioning, contour the plate. The T-handle is used to hold the proximal plate and the oval plate bender for the distal plate. Most plates require a gentle bend and twist to match the shape of the tibia. It is better to use small increments rather than over-contouring and then having to correct – this is because Titanium is quickly fatigued by repeated bending.



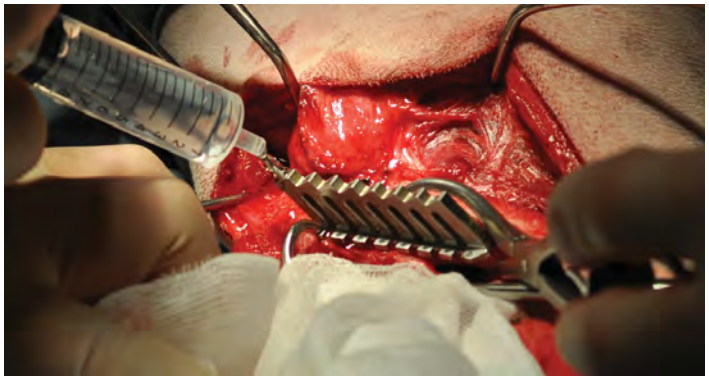
27 Place the TTA drill guide jig (with the holes pointing distally) over the tibia tuberosity in the same place as the plate was. Use a finger tip to feel the cranial cortex of the tibial tuberosity; the feet of the jig should be at the same level.



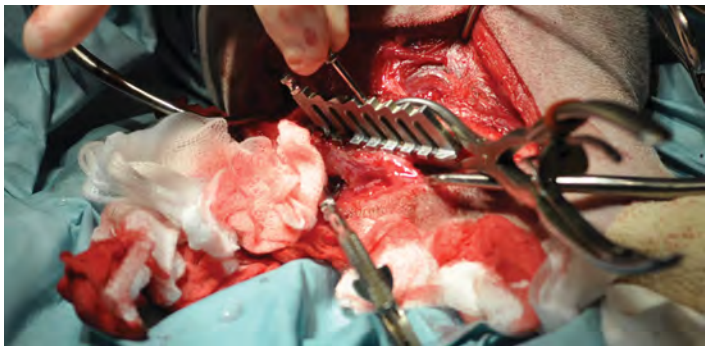
28 Use small and medium sized pointed bone holding forceps to immobilise the plate onto the tibial tuberosity

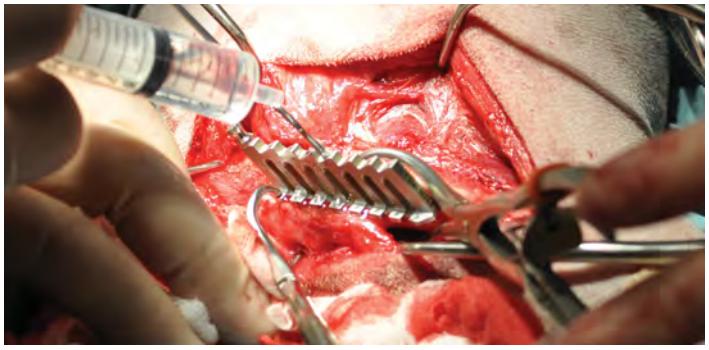


29 Before drilling, double check that the position of the jig is correct - put the plate on top and assess its position

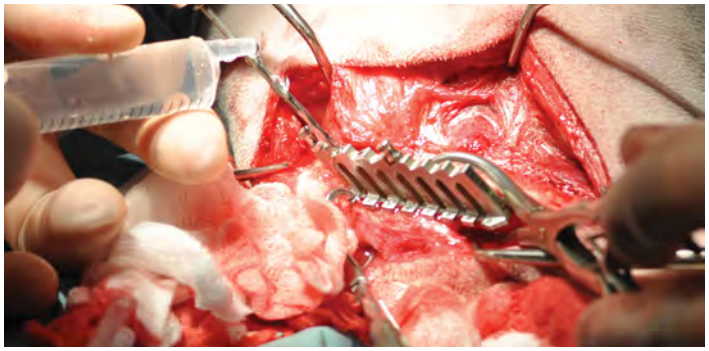


30 Using a 2mm drill bit with flush and suction, drill the most proximal plate hole. Once drilled, place the anchor peg.





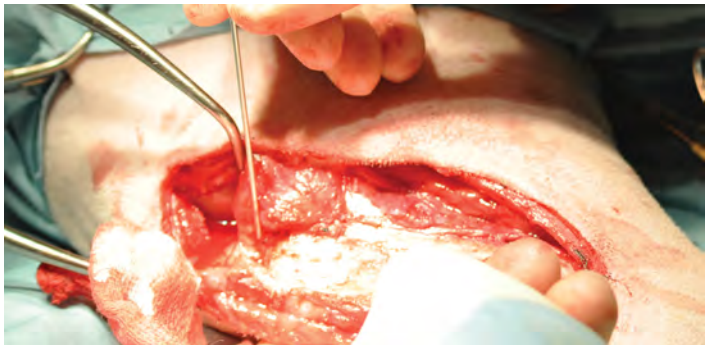
31 Then drill the most distal hole, and place the anchor peg.



32 Drill the remaining holes.

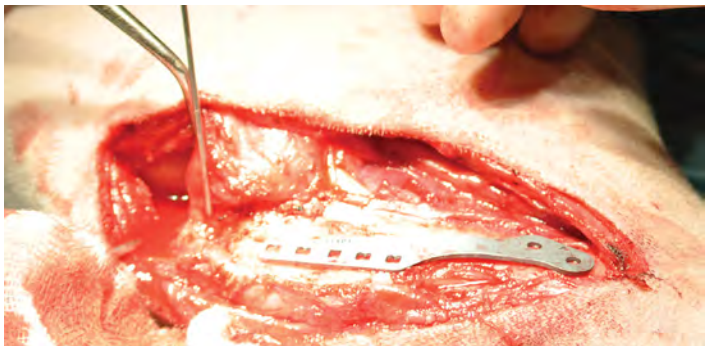
33 Remove the pegs, the drill guide and the bone holding forceps.

Templating and making the tibial osteotomy

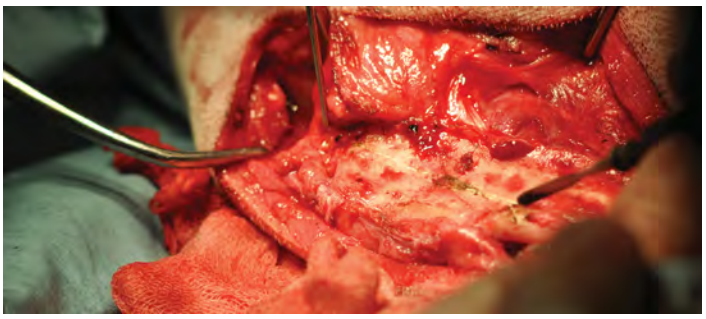


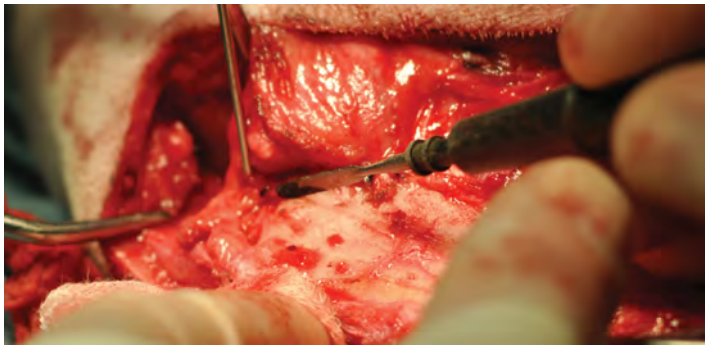
34 Palpate and identify Gerdy's tubercle on the proximolateral aspect of the tibial tuberosity - this is the protrusion at the cranial aspect of the fossa in which the long digital extensor tendon runs

35 Place a K-wire (1.6mm or similar) vertically from medial to lateral at the most proximal aspect of the tibia / distal aspect of the stifle arthrotomy so that it exits laterally over Gerdy's tubercle. Adjust if not correct. On the medial aspect the position of the K-wire now identifies the location of the proximal tibial tuberosity osteotomy. This should equate to a position approximately 30% across the cranio-caudal dimension of the tibia



36 Place the plate on the tibia overlying the holes that have been drilled. Using cutting diathermy or a bone scribe, mark on the cranial tibial cortex a point halfway between the most distal fork hole and most proximal screw hole. This marks the distal aspect of the tibial tuberosity osteotomy.

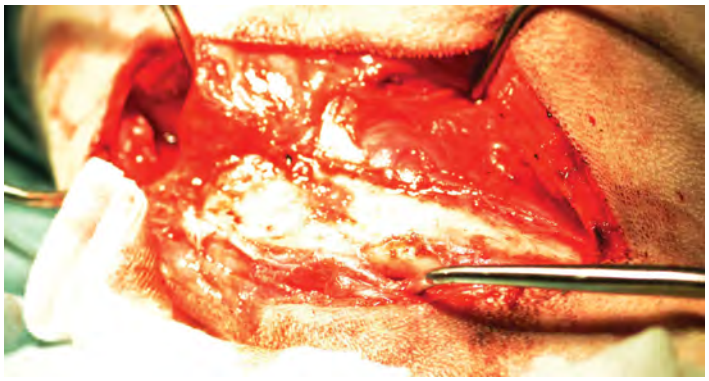




37 Using cutting diathermy or a bone scribe, mark on the medial tibia in a straight line from the K-wire proximally directing distally towards the mark on the cranial tibial cortex. As you approach the distal mark, make a gentle curve so that the cortical exit point is a few millimetres proximal to the mark on the cranial tibial cortex. This is to ensure that the osteotomy exits the cranial tibial cortex more proximally than the final position of the plate screw holes. This is to minimise the effect of having 2 stress risers in too close proximity.

38 Remove the K-wire

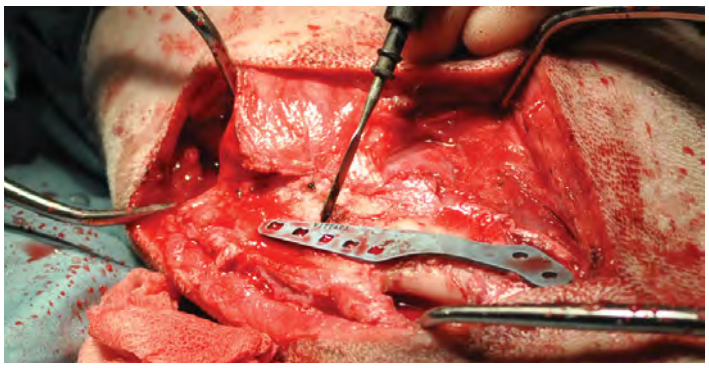
39 Ensure that the tibia is parallel to the table (otherwise the osteotomy cut will not be straight). This can be achieved by placing lap sponges or swabs under the hock and/or asking an assistant to hold the foot.



40 Place Gelpi retractors in the stifle joint - to reflect the patellar ligament cranially away from the blade

41 Place Gelpi retractors to reflect the elevated cranial tibial muscle

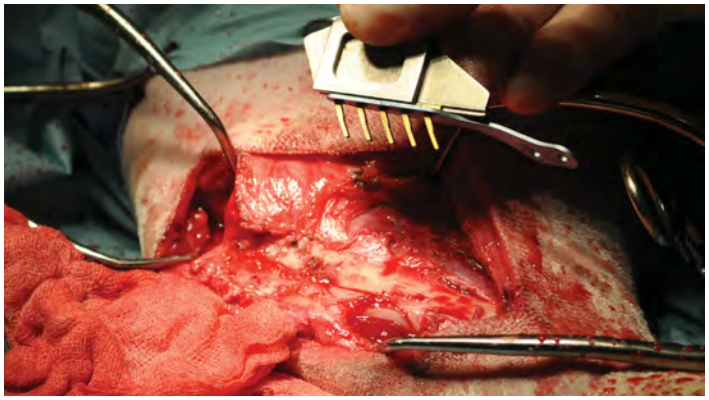
42 Place the plate over the tibia and mark the point at which the plate no longer covers the osteotomy scribe line.



43 With plenty of flush and suction, use an oscillating saw to make the osteotomy along the pre-scribed line - the osteotomy should be monocortical proximally and bicortical distally for the section that will be covered by the plate. A narrower blade should be used to make the gentle curve of the osteotomy distally.

Placing the plate and forks

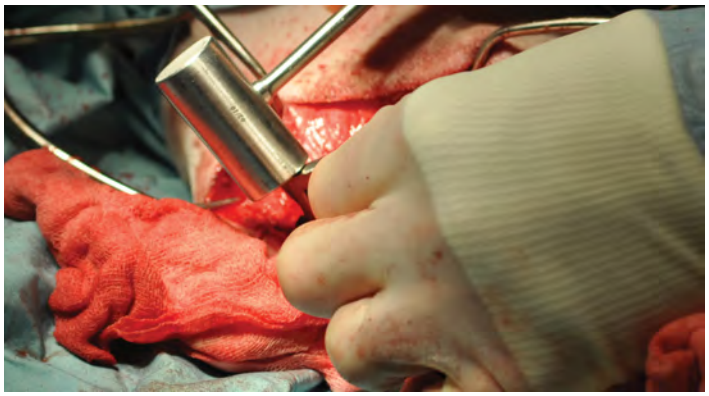
44 Once the osteotomy is completed bicortical distally and monocortical proximally, you are ready to place the plate



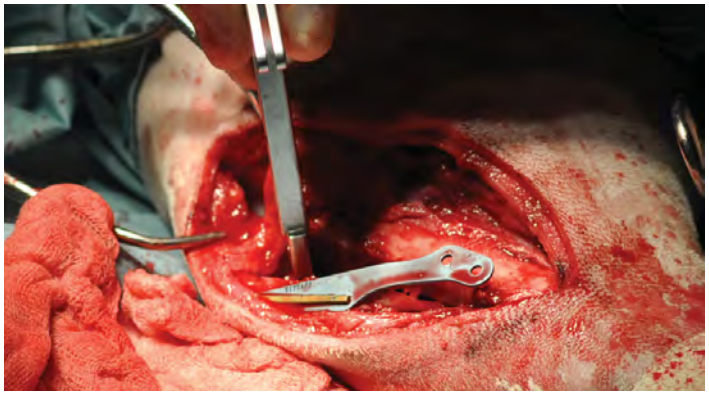
45 Insert the forks into the plate – a subtle click should be appreciated.

46 Hand insert the forks into the prepared holes in the tibial tuberosity – usually the forks will go in about 50% of the way.

47 Ensure that all periosteum is cleared from the distal tibia in the region underlying the distal plate



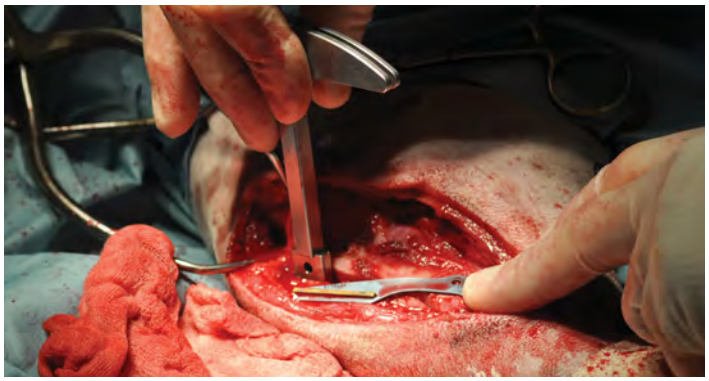
48 Supporting the lateral aspect of the tibial tuberosity with fingers or some swabs and use the mallet and impacting tool to drive home the forks and plate onto the tibial tuberosity. The plate and fork should fit snugly and ideally with no residual movement. If a little bit of wiggle movement is still present, hit more with the mallet and impactor tools. If there is still mild instability, consider placing a swab over the exposed fork and striking directly with a mallet.

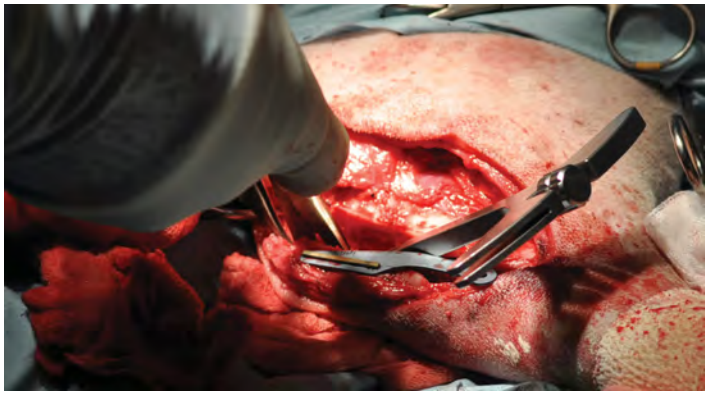


49 Complete the osteotomy by making the cut bicortical proximally

50 The tibial tuberosity will now be free and unstable.

51 Remove the Gelpi retractors.



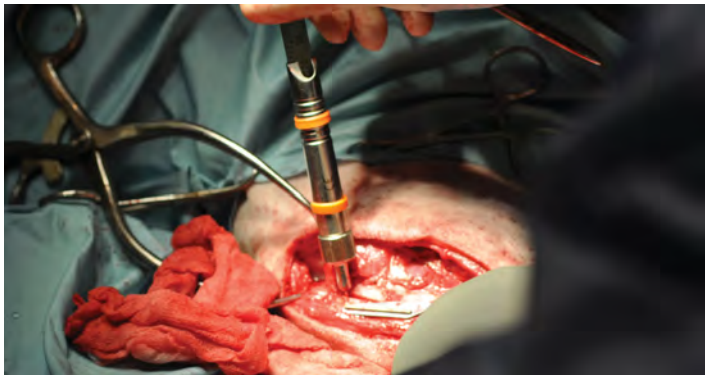


52 Place the appropriate sized (previously calculated advancement) spacer in the osteotomy – frequently the tuberosity will spin laterally along its long axis. Using suction and swab, use straight Mayo scissors to cut the fibrous tissue at the proximal lateral aspect of the osteotomy – do not do this blind for fear of cutting the long digital extensor tendon.

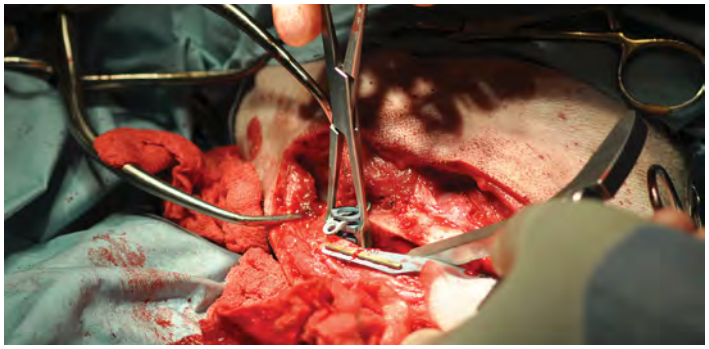
53 Once this soft tissue is released, the tibial tuberosity should advance easily without spinning laterally along its long axis

54 Check (visualise or palpate with periosteal elevator) that the forks exit the lateral cortex of the tibial tuberosity.

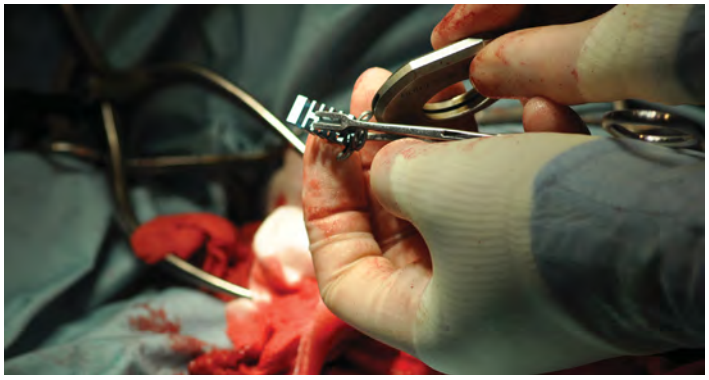
Cage assessment / placement



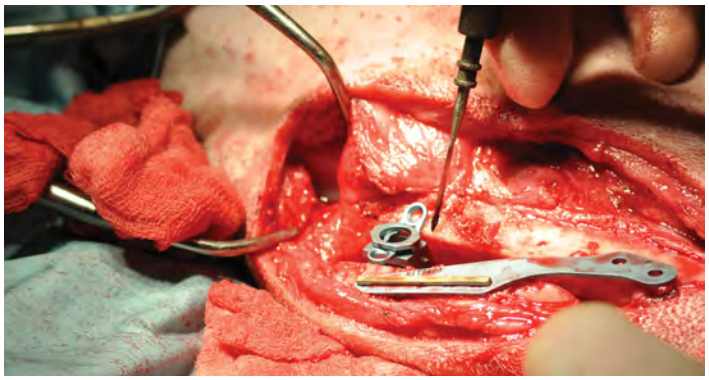
55 Use the spreader to distract the osteotomy then use a depth gauge to measure the depth of the caudal cut surface of the tibia near to its most proximal aspect – this equates to the length of cage you need to the closest 3mm. I recommend using a shorter rather than a longer cage as the cage can become particularly prominent on the lateral aspect.



56 Having selected the cage, insert it into the proximal aspect of the osteotomy for a trial fit



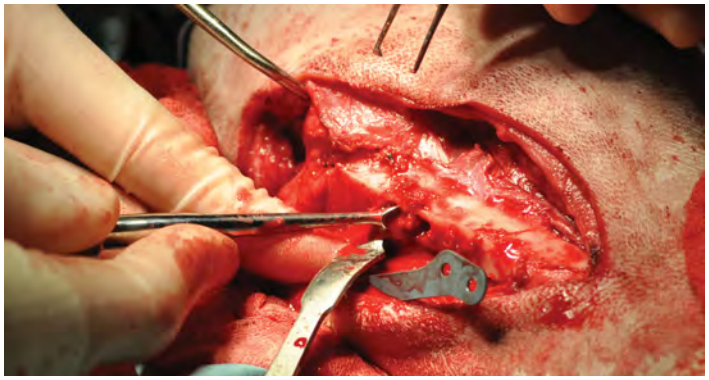
57 Remove the cage and using the oval plate bender, bend the caudal ear of the cage medially (outwards) and bend the cranial ear laterally (inwards).



58 Re-place the cage into the osteotomy, about 3mm distal to the most proximal aspect of caudal cut surface of the tibia.

59 If intending to harvest a bone graft, mark the level of the most distal aspect of the cage against the caudal cut surface of the tibia using diathermy or a bone scribe. Remove the cage

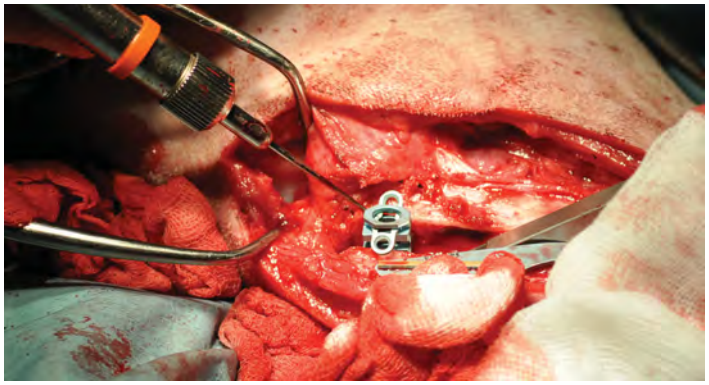
Harvesting bone graft (optional)



60 Using a Volkmann's curette and via the caudal cut surface of the tibia for access, harvest cancellous bone from the tibia. Only harvest from a location below the intended position of the cage – hence the need to mark the cage position above.

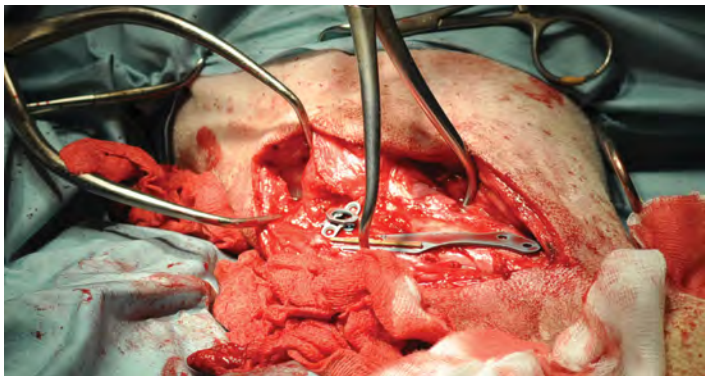
61 Collect the bone graft in a blood soaked swab or a 5ml syringe or similar.

Stabilising the osteotomy



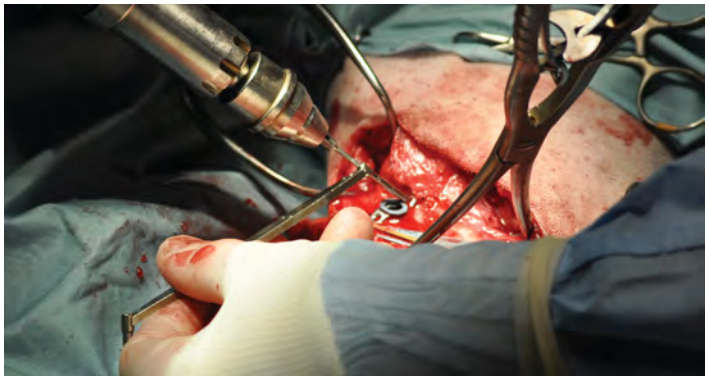
62 Place the cage in the correct position:

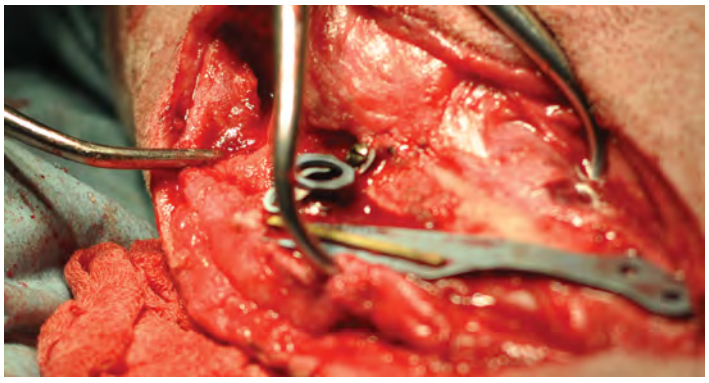
- (wide aspect proximal, narrow aspect distal
- perpendicular to the cut surface of the tibia
- most proximal aspect approx 3mm distal to the most proximal aspect of the cut surface of the caudal tibia.



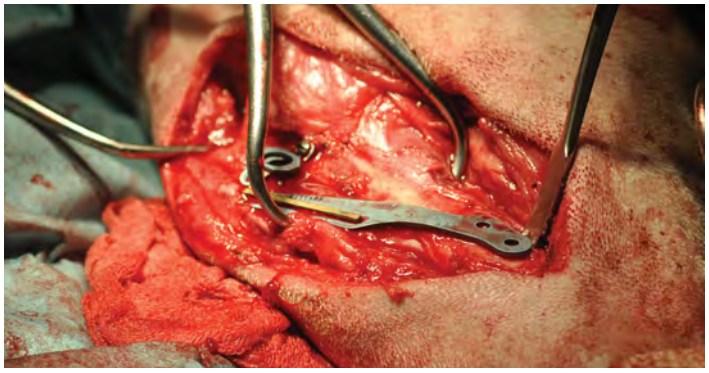
63 Using a large pair of single point reduction forceps between the cranial aspect of the mid tibial tuberosity and an adjacent point on the caudal tibial, reduce and compress the advanced tibial tuberosity. This can be a bit fiddly and takes a bit of practice. The tibial tuberosity has a tendency to migrate proximally but this can be controlled by applying a combination of digital pressure and application of the bone holding forceps. This end result should be:

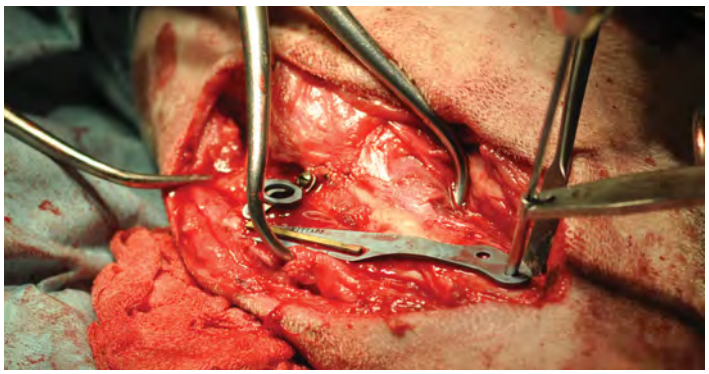
- The distal aspect of the osteotomy should be snugly compressed
- The distal screw holes should be over the mid to caudal tibial cortex
- The cage should be proximal to the most proximal fork hole
- The ears of the cage can be rotated to move its cranial screw hole as far as possible away from the proximal fork hole

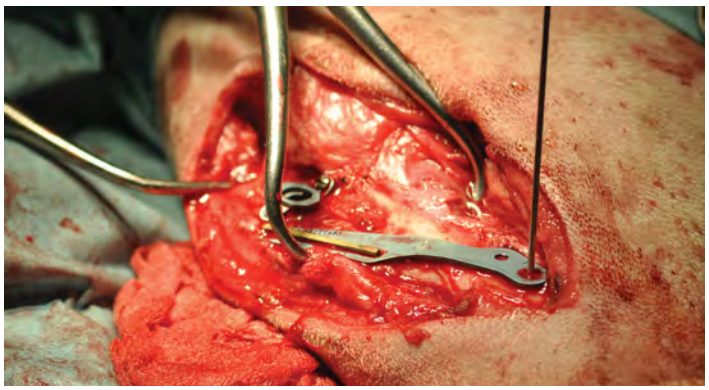




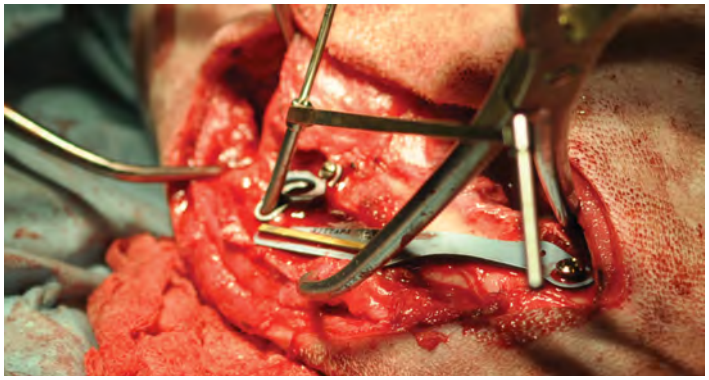
64 Using a 1.8mm drill bit, drill guide and depth gauge, drill and place the screw in the caudal cage hole. Aim at a reasonable angle caudo-distal to the fibular head. This will be a relatively long screw; approx 28mm in a Labrador. Place a self-tapping 2.4mm screw. Make sure you drive it sufficiently far that rides over the edge of cage and engages the ear correctly.



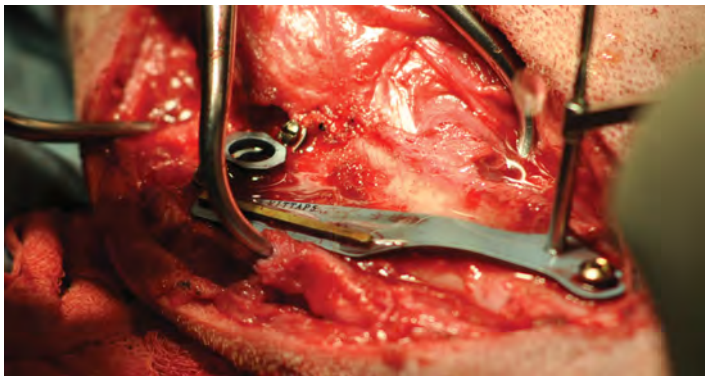


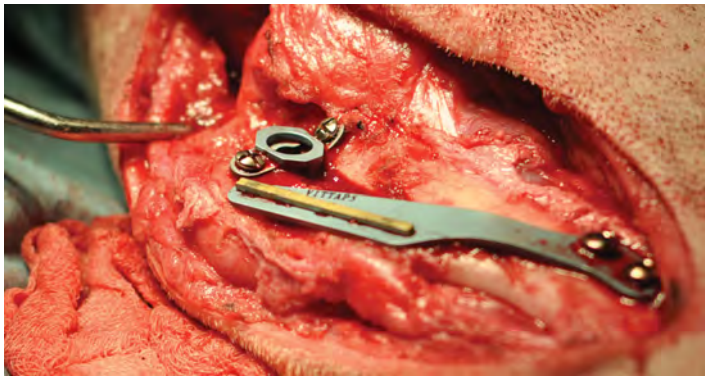


65 Drill the most proximal plate hole (2.0mm drill bit for 5 hole plates and smaller, 2.5mm for 6 hole plates and large. Measure and place 2.7mm or 3.5mm self tapping screw as appropriate. Do not angle much as will not engage in plate hole correctly.



66 Using a 1.8mm drill bit and drill guide, place the cranial cage screw – aim as proximally and cranially as bone stock will allow. As the depth gauge frequently does not sit on ear correctly, this screw frequently ends up being too long therefore don't add to measured length. Place 2.4mm self tapping screw

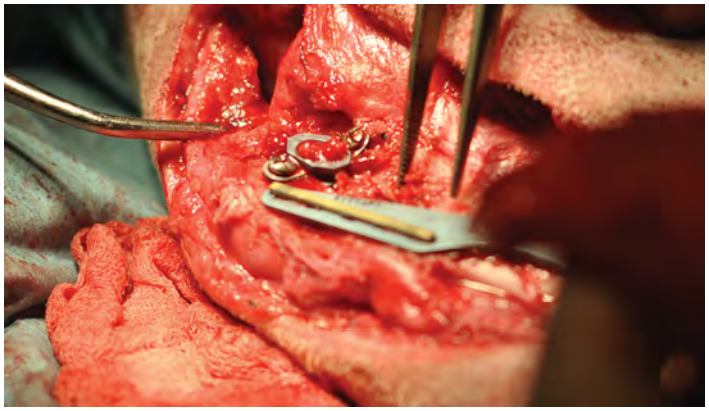




67 Place the most distal plate screw (2.5mm or 3.5mm as appropriate). Do not angle much as will not engage in plate hole correctly.

Finish and closure

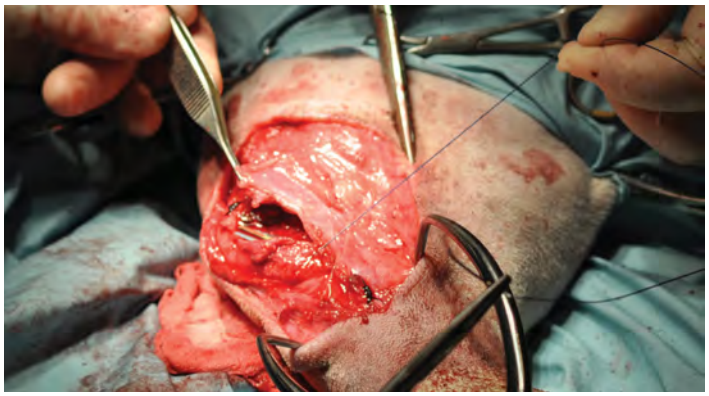
68 Flush the entire surgical site thoroughly

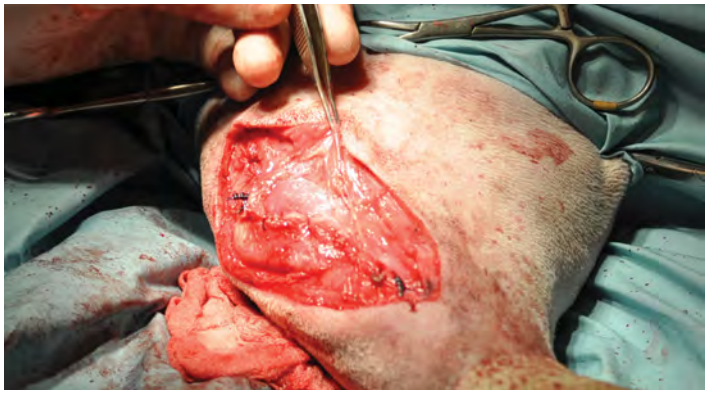


69 Place harvested cancellous autograft (or allograft) at the osteotomy site proximal and distal to the cage and in the cage itself

70 Close the joint capsule (3m PDS, simple continuous)

71 Close the medial retinaculum (3.5m PDS, simple continuous)





72 Starting distally, re-attach the pes anserinus to the elevated periosteum / soft tissue on the cranial aspect of the tibial tuberosity. This should be possible all the way proximally to include the caudal Sartorius muscle, and covering the implants most of the way (3.5m PDS, simple continuous). Occasionally it is not possible to close over the proximal plate and cage.

73 Close the subcutaneous fascia (3m PDS, simple continuous)

74 Close the subcutis (2m or 3m Monocryl, simple continuous

75 Close the skin (staples, skin sutures etc.)

76 Take well positioned radiographs and check post operative angles.

Post Operative Care

Post operative care of the TTA patient is critical. Until the osteotomy has filled and consolidated the repair is vulnerable. The patient is usually kept in the hospital overnight on appropriate analgesia. The patient is checked in 10 days. Until the first follow up radiograph strict lead exercise is essential for a maximum of 5-10 minutes. Hydrotherapy should be encouraged. If the 6 week follow up radiograph shows filling of the osteotomy then off lead exercise is permissible, initially 10 minutes at the end of a walk. Excercise is gradually increased back to normal.

Forkless Plates

TTA plates which are attached to the tibial crest by means of screws rather than forks have been available from us for some time. It has been hard to recommend them as there has been no evidence that they confer any benefit to the procedure. Indeed there have been concerns regarding stress risers. We have not heard of any issues using screws which outweigh the ease of use benefits. A study by Bisgard et al. Vet Surgery 40 (2011) 402-407 revealed no differences in outcomes or complication rates compared to forked plates. In addition they reported that it is possible to contour the forkless plate along its length. Contouring a forked plate could compromise the placement of the fork. Standard 2.4 Titanium TTA screws are used.

MODIFIED MAQUET TECHNIQUE (MMT)

Introduction

The Modified Maquet Technique(MMT) is a variation on the TTA and TTO techniques of cruciate management in that it aims to bring the tibial plateau to sit at right angles to the straight patella ligament. By creating an incomplete tibial crest osteotomy the placement of a TTA advancement cage alone creates sufficient post operative stability for rapid healing to occur. The technique preserves soft tissue, requires a minimum of implants and saves time and morbidity. The Maquet technique is described in man as a technique to reduce patellofemoral pressure. The MMT technique described here is that presented by Sebastien Etchepareborde to ECVS in 2010 and published in VCOT 2011.3.

Preoperative Evaluation

The advancement required is calculated as in the TTA technique using either the traditional or the common tangent method Transparent overlays for both are available free of charge on request.

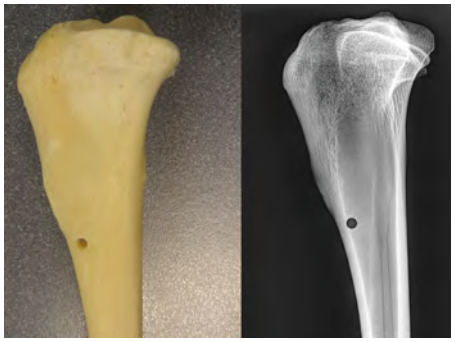
Surgical Technique

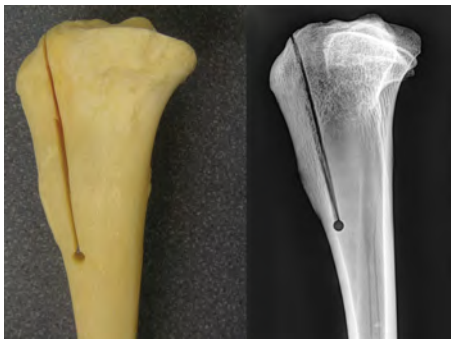
The entire procedure may be performed with the dog in lateral recumbency but surgeons may find that internal examination of the stifle may be more easily performed with the dog in dorsal recumbency. The dog is then flipped onto the lateral side for the MMT surgery .
The full limb is aseptically prepared. Sterile bandaging of the foot allows the surgeon to fully manipulate the limb throughout the procedure.

Exploration of the stifle joint is performed using the surgeon's preferred method. Meniscal injuries are dealt with and optionally a meniscal release may be performed.

The craniomedial aspect of the tibia is approached via a craniomedial skin incision. Without dissecting the subcutaneous tissues a straight longitudinal incision is made to bone approximately 10mm caudal to the tibial crest and extended to 20mm beyond the extent of the tibial crest. The soft tissues at the distal end of the incision are cleared using a periosteal elevator (001271 or similar). The site of the tibial crest osteotomy (TCO) is minimally cleared using a narrow elevator (7350/05, Freer or similar).

A 3.5mm hole is drilled immediately caudal to the cranial cortex approximately 5-15mm distal to distal extent of the tibial crest. This will act as a hinge once the tibial crest incision is complete. Sebastien Etchepareborde has demonstrated (VCOT 2010.6) that a relatively large hole such as 3.5mm spreads applied stress and is less likely to result in hinge fracture than a small 2.0mm hole. The tibial crest osteotomy is performed perpendicularly to the sagittal plane of the tibia. A saw guide is available to assist if required which will protect the patella ligament and direct the plane of the saw. Alternatively a pair of artery forceps may be pushed through the joint from medial to lateral just caudal to the straight patella ligament to act as a marker and protect the ligament. The osteotomy runs from a point cranial to the long digital extensor (LDE) to the previously drilled hinge hole. The position of the LDE may be gauged by palpating the tubercle of Gerdy laterally and passing a 'K' wire through from the medial side as a marker.

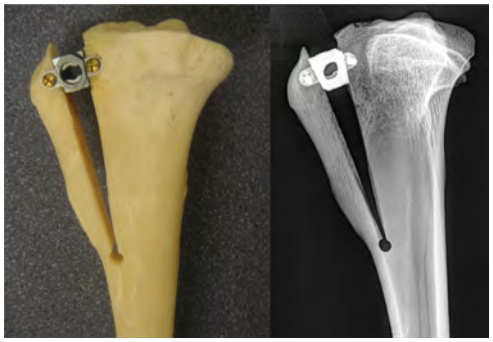




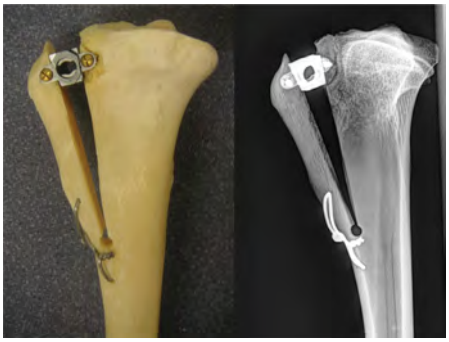
The osteotomy is best created using a power saw and blade approximately 10-15 mm wide and less than 1mm thick. All the modular air and electrical surgical saws are suitable. Where funds are limited the battery powered MultiSaw (001708) works very well.

The osteotomy is carefully eased open to allow placement of the predetermined cage. Experience with the TTO procedure suggests that incremental opening of the osteotomy using the 'wedgie'(TTO002) minimises hinge fracture. The osteotomy may be finally opened to the correct width for the Titanium cage using the TTA spreader. (TTA444). This item has dedicated blades for each cage.

The cage is placed as shown in the image below, close to the proximal end of the TCO. The cage is secured using two 2.4mm titanium screws. The 'ears' of the cage should be contoured as follows: cranial ear down, caudal ear up.



If the hinge fails during surgery a tension band wire (TBW) may be placed bridging the distal end of the TCO as shown. If the hinge remains intact at the end of surgery there is no need for a TBW. It should be appreciated that even if the bone cracks the periosteum remains intact providing support.



Once again, the TTO experience shows that even when the hinge fails the tibial crest typically remains in place despite having no fixation. The TTA cage in the MMT procedure provides significant additional fixation so migration is unlikely.

A bone graft (autologous or allograft) may be added if desired.

In the Etchepareborde series a Robert Jones Dressing (RJD) was applied for one week post operatively. Analgesia as necessary, oral Cefazolin and Carprofene were administered for seven days postoperatively.

It is suggested that the dog should be restricted to leash exercise until the six week check radiograph by which time bone infill should be very visible. Physiotherapy will speed the recovery process and maximise mobility.

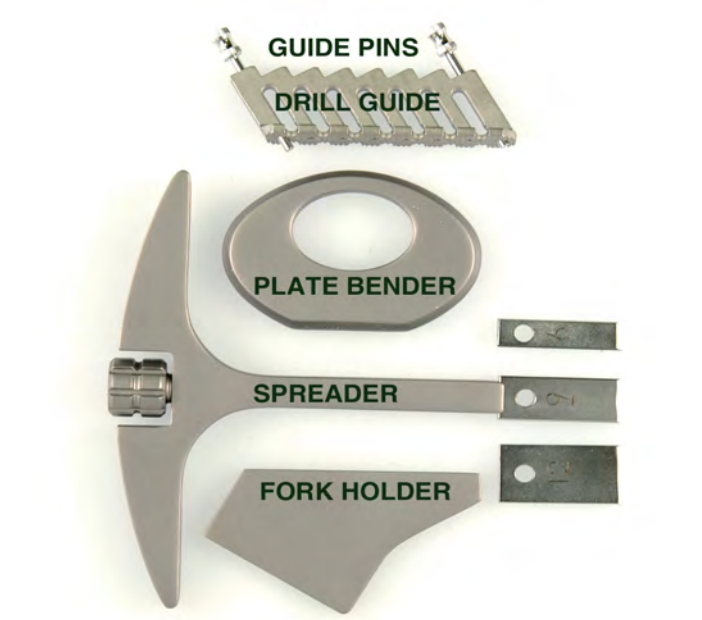
Special thanks to Sebastien Etchepareborde for his assistance and permission to use his images.

MMT Instruments and implants

TTA PLATES AND CAGES TITANIUM			
TTAC310	Cage 3 x 10mm titanium	2.4mm screw	**£55.00**
TTAC313	Cage 3 x 13mm titanium	2.4mm screw	**£55.00**
TTAC316	Cage 3 x 16mm titanium	2.4mm screw	**£55.00**
TTAC4512	Cage 4.5 x 12mm titanium	2.4mm screw	**£56.50**
TTAC4515	Cage 4.5 x 15mm titanium	2.4mm screw	**£56.50**
TTAC4518	Cage 4.5 x 18mm titanium	2.4mm screw	**£56.50**
TTAC616	Cage 6 x 16mm titanium	2.4mm screw	**£57.50**
TTAC619	Cage 6 x 19mm titanium	2.4mm screw	**£57.50**
TTAC622	Cage 6 x 22mm titanium	2.4mm screw	**£57.50**
TTAC7513	Cage 7.5 x 13mm titanium	2.4mm screw	**£60.00**
TTAC7516	Cage 7.5 x 16mm titanium	2.4mm screw	**£60.00**
TTAC7519	Cage 7.5 x 19mm titanium	2.4mm screw	**£60.00**
TTAC919	Cage 9 x 19mm titanium	2.4mm screw	**£62.50**
TTAC922	Cage 9 x 22mm titanium	2.4mm screw	**£62.50**
TTAC925	Cage 9 x 25mm titanium	2.4mm screw	**£62.50**
TTAC10519	Cage 10.5 x 19mm titanium	2.4mm screw	**£65.00**
TTAC10522	Cage 10.5 x 22mm titanium	2.4mm screw	**£65.00**
TTAC10525	Cage 10.5 x 25mm titanium	2.4mm screw	**£65.00**
TTAC1222	Cage 12 x 22mm titanium	2.4mm screw	**£67.50**
TTAC1225	Cage 12 x 25mm titanium	2.4mm screw	**£67.50**
TTAC1228	Cage 12 x 28mm titanium	2.4mm screw	**£67.50**
TTAC1525	Cage 15 x 25mm titanium	2.4mm screw	**£72.50**
TTAC1528	Cage 15 x 28mm titanium	2.4mm screw	**£72.50**
TTAC1531	Cage 15 x 31mm titanium	2.4mm screw	**£72.50**

TITANIUM SCREWS 2.4MM CRUCIATE HEAD 1.8MM PILOT		
TICS2410	Titanium 2.4 Self Tapping Cortical Screw 10mm	**£9.75**
TICS2412	Titanium 2.4 Self Tapping Cortical Screw 12mm	**£9.75**
TICS2414	Titanium 2.4 Self Tapping Cortical Screw 14mm	**£10.00**
TICS2416	Titanium 2.4 Self Tapping Cortical Screw 16mm	**£10.00**
TICS2418	Titanium 2.4 Self Tapping Cortical Screw 18mm	**£10.25**
TICS2420	Titanium 2.4 Self Tapping Cortical Screw 20mm	**£10.25**
TICS2422	Titanium 2.4 Self Tapping Cortical Screw 22mm	**£10.50**
TICS2424	Titanium 2.4 Self Tapping Cortical Screw 24mm	**£10.50**
TICS2426	Titanium 2.4 Self Tapping Cortical Screw 26mm	**£10.75**
TICS2428	Titanium 2.4 Self Tapping Cortical Screw 28mm	**£10.75**
TICS2430	Titanium 2.4 Self Tapping Cortical Screw 30mm	**£11.00**
TICS2432	Titanium 2.4 Self Tapping Cortical Screw 32mm	**£11.50**
TICS2434	Titanium 2.4 Self Tapping Cortical Screw 34mm	**£12.00**
TICS2436	Titanium 2.4 Self Tapping Cortical Screw 36mm	**£12.50**
TICS2438	Titanium 2.4 Self Tapping Cortical Screw 38mm	**£13.00**
TICS2440	Titanium 2.4 Self Tapping Cortical Screw 40mm	**£13.50**

MMT INSTRUMENTATION		
TTA24	2.4 screwdriver (crosshead)	**£115.00**
H090208	1.8mm pilot drill for 2.4 screw	**£155.00**
H090106S	3.5mm Drill for hinge hole	**£20.50**
001271	Periosteal Elevator 6mm AO Type 180mm	**£42.50**
7350/05	Freer Periosteal Elevator	**£40.00**
TTA444	TTA Spreader and 3, 6, 9, 12 & 15mm Inserts	**£175.00**
001708	MultiSaw Surgical Kit	**£485.00**
TTA999	MMT Saw Guide	**£125.00**
TT0002	'Wedgie' osteotomy sSpreader	**£85.00**
TTAFCP	TTA Cage Forceps	**£60.00**
DG242735	Depth gauge for 2.4, 2.7 & 3.5 Ti Screws	**£75.00**
TTAFCP	Traditional TTA/MMT advancement overlay	**£FOC**
TTATAN	Common Tangent TTA/MMT advancement overlay	**£FOC**



TTA INSTRUMENTATION		
TTA555	TTA Drill Guide	**£120.00**
TTA666	TTA Fork Holder	**£95.00**
TTA444	TTA Spreader and 6, 9 &12mm Inserts	**£130.00**
TTA333	TTA Plate Bender	**£85.00**
TTA777	1.9mm pins (set of two)	**£15.00**
TTA24	TTA 2.4 Cross Head Screwdriver	**£100.00**
TTAPF0	TTA Plate and Fork Overlay	**£FOC**
TTAKIT	TTA Set (Includes all of the above)	**£500.00**
SHTTA242735	TTA Screwbox for 2.4, 2.7 & 3.5 Ti Screws	**£85.00**

TTA PLATES AND CAGES TITANIUM		
TTAC616	Cage 6 x 16mm titanium	**£50.00**
TTAC619	Cage 6 x 19mm titanium	**£50.00**
TTAC622	Cage 6 x 22mm titanium	**£50.00**
TTAC919	Cage 9 x 19mm titanium	**£55.00**
TTAC922	Cage 9 x 22mm titanium	**£55.00**
TTAC925	Cage 9 x 25mm titanium	**£55.00**
TTAC1222	Cage 12 x 22mm titanium	**£60.00**
TTAC1225	Cage 12 x 25mm titanium	**£60.00**
TTAC1228	Cage 12 x 28mm titanium	**£60.00**
TTAP3	Plate 3 hole titanium	**£20.00**
TTAP4	Plate 4 hole titanium	**£20.00**
TTAP5	Plate 5 hole titanium	**£20.00**
TTAP6	Plate 6 hole titanium	**£25.00**
TTAP7	Plate 7 hole titanium	**£25.00**
TTAP8	Plate 8 hole titanium	**£25.00**
TTAF3	Fork 3 prong titanium	**£25.00**
TTAF4	Fork 4 prong titanium	**£25.00**
TTAF5	Fork 5 prong titanium	**£25.00**
TTAF6	Fork 6 prong titanium	**£30.00**
TTAF7	Fork 7 prong titanium	**£30.00**
TTAF8	Fork 8 prong titanium	**£30.00**

TITANIUM SCREWS 2.4MM CRUCIATE HEAD 1.8MM PILOT		
TICS2416	Titanium 2.4 Self Tapping Cortical Screw 16mm	**£9.25**
TICS2418	Titanium 2.4 Self Tapping Cortical Screw 18mm	**£9.45**
TICS2420	Titanium 2.4 Self Tapping Cortical Screw 20mm	**£9.60**
TICS2422	Titanium 2.4 Self Tapping Cortical Screw 22mm	**£9.80**
TICS2424	Titanium 2.4 Self Tapping Cortical Screw 24mm	**£10.00**
TICS2426	Titanium 2.4 Self Tapping Cortical Screw 26mm	**£10.20**
TICS2428	Titanium 2.4 Self Tapping Cortical Screw 28mm	**£10.40**
TICS2430	Titanium 2.4 Self Tapping Cortical Screw 30mm	**£10.60**
TICS2432	Titanium 2.4 Self Tapping Cortical Screw 32mm	**£10.90**
TICS2434	Titanium 2.4 Self Tapping Cortical Screw 34mm	**£11.15**
TICS2436	Titanium 2.4 Self Tapping Cortical Screw 36mm	**£11.60**
TICS2438	Titanium 2.4 Self Tapping Cortical Screw 38mm	**£11.90**
TICS2440	Titanium 2.4 Self Tapping Cortical Screw 40mm	**£12.00**

TITANIUM SCREWS 2.7MM HEX HEAD 2.0MM PILOT		
TICS2706	Titanium 2.7 Self Tapping Cortical Screw 6mm	**£8.65**
TICS2708	Titanium 2.7 Self Tapping Cortical Screw 8mm	**£8.85**
TICS2710	Titanium 2.7 Self Tapping Cortical Screw 10mm	**£9.05**
TICS2712	Titanium 2.7 Self Tapping Cortical Screw 12mm	**£9.25**
TICS2714	Titanium 2.7 Self Tapping Cortical Screw 14mm	**£9.45**
TICS2716	Titanium 2.7 Self Tapping Cortical Screw 16mm	**£9.70**
TICS2718	Titanium 2.7 Self Tapping Cortical Screw 18mm	**£9.90**
TICS2720	Titanium 2.7 Self Tapping Cortical Screw 20mm	**£10.15**
TICS2722	Titanium 2.7 Self Tapping Cortical Screw 22mm	**£10.35**
TICS2724	Titanium 2.7 Self Tapping Cortical Screw 24mm	**£10.60**
TICS2726	Titanium 2.7 Self Tapping Cortical Screw 26mm	**£10.80**
TICS2728	Titanium 2.7 Self Tapping Cortical Screw 28mm	**£11.00**

TITANIUM SCREWS 3.5MM HEX HEAD 2.5MM PILOT		
TICS3518	Titanium 3.5 Self Tapping Cortical Screw 18mm	**£9.15**
TICS3520	Titanium 3.5 Self Tapping Cortical Screw 20mm	**£9.50**
TICS3522	Titanium 3.5 Self Tapping Cortical Screw 22mm	**£9.95**
TICS3524	Titanium 3.5 Self Tapping Cortical Screw 24mm	**£10.25**
TICS3526	Titanium 3.5 Self Tapping Cortical Screw 26mm	**£10.65**
TICS3528	Titanium 3.5 Self Tapping Cortical Screw 28mm	**£11.00**
TICS3530	Titanium 3.5 Self Tapping Cortical Screw 30mm	**£11.40**
TICS3532	Titanium 3.5 Self Tapping Cortical Screw 32mm	**£11.80**
TICS3534	Titanium 3.5 Self Tapping Cortical Screw 34mm	**£12.20**

BOXES FOR TTA SCREWS & EQUIPMENT		
SHTTA242735	TTA Screwbox for 2.4, 2.7 & 3.5 Ti Screws	**£85.00**
BXTTA2215	Box and silicone insert for TTA equipment	**£85.00**

VETERINARY INSTRUMENTATION

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