



TTA

Common Tangent Method

This document is derived from a presentation by
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Tibial Tuberosity Advancement: A step-by-step approach to using the Common Tangent Method for determining advancement in cranial cruciate deficient stifles

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Pre-operative Planning and TTA Measurement:

Pre-operative planning for TTA requires craniocaudal and lateral radiographic X-rays (XRs) of the cranial cruciate deficient stifle. With the leg in extension at $\sim 135^\circ$, position the distal femur and proximal tibia such that the femoral condyles are superimposed on each other.

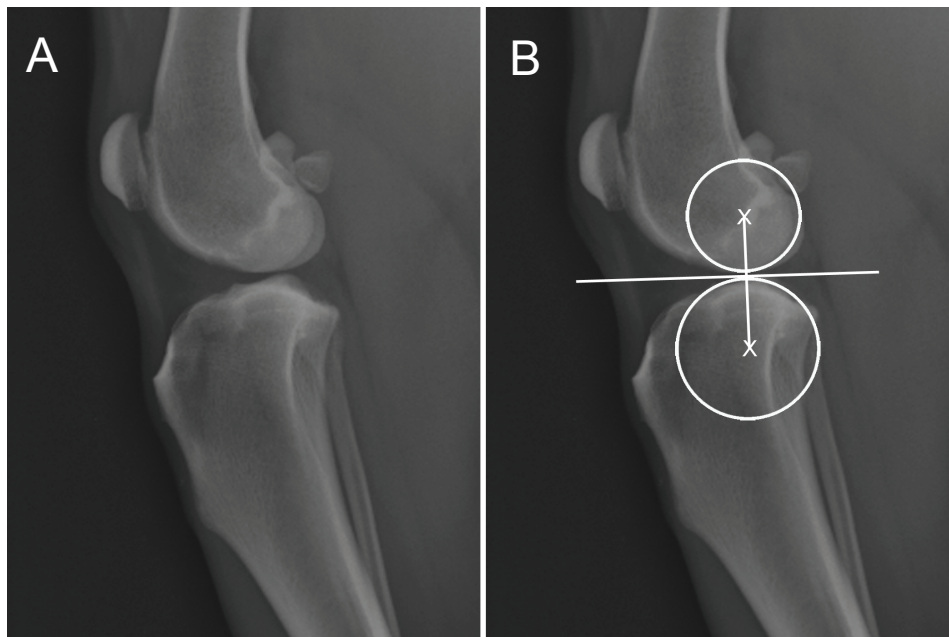


Figure 1: A) In this XR of a canine stifle in extension, the femoral condyles are almost perfectly superimposed on each other. B) This XR shows one way to calculate the common tangent between the condyles of the femur and the tibial plateau.

Early techniques for determining optimal tuberosity advancement used the tibial plateau (TP), as used by Barclay Slocum for the Tibial Plateau Leveling Osteotomy (TPLO) procedure. One definition of the tibial plateau draws “a line between a point on the medial plateau of the medial articular surface of the tibial plateau on the cranial intercondyloid area where the cranial ligament inserts and a point on the caudal margin of the lateral condyle of the tibia where the CrCL attaches.”¹ Another paper states: “The conventional method of defining the tibial plateau is to draw a line between its most cranial and most caudal margins.”² You will need to define the points where the CrCL and the CaCL ligament attach.

Variations in tibial plateau make it difficult to define and measure consistently and accurately. Small errors in measurement can lead to improper sizing of TTA implants. In addition, Leg Flexion changes the angle of the tibial plateau in relation to the patellar tendon, as seen in **Figure 2A**. These variations lead to incorrect measurements of TTA advancement. The common tangent method leads to more consistent repeatable results. Kyon recommends using the common tangent method for determining the required advancement.

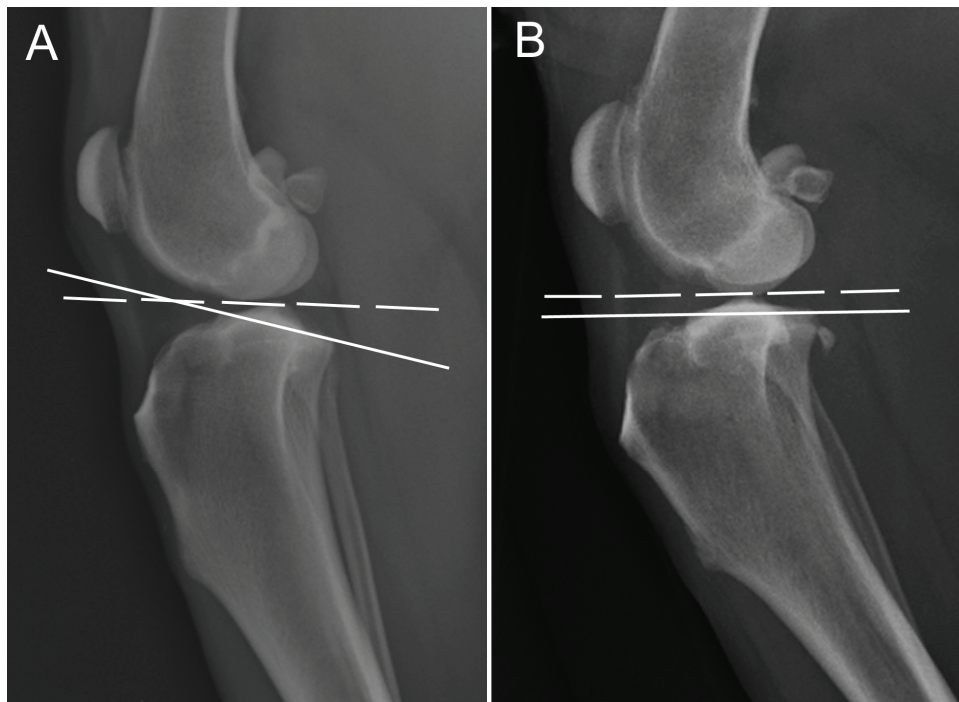


Figure 2: Degree of leg extension changes the TP angle in relation to the patellar ligament. 2A) In this case, the leg is extended more than 135°. This XR clearly displays the discrepancy between the common tangent line (dashed) and the tibial plateau line (solid). 2B) Notice, when the leg is flexed more than in Figure 2A to ~135°, the common tangent line and the tibial plateau line are parallel.

¹ Morris, Ethan et al. Comparison of tibial plateau angles in dogs with and without cranial cruciate ligament injuries, *JAVMA*, Vol218, No.3, February 1, 2001

² Reif, Ulrich et al. Influence of Limb Positioning and Measurement method on the Magnitude of the Tibial Plateau Angle, *Veterinary Surgery* 33:368-375, 2004

In this document, digital radiographs showing 100% magnification of the joint were used. This is determined by measuring the markers as shown in **Figure 3**. The template should also be at 100% magnification. The Kyon Template for TTA Common Tangent is at 100% magnification. If you will be using the template on radiographs that give a different magnification, the template can be enlarged or reduced on most copy machines.

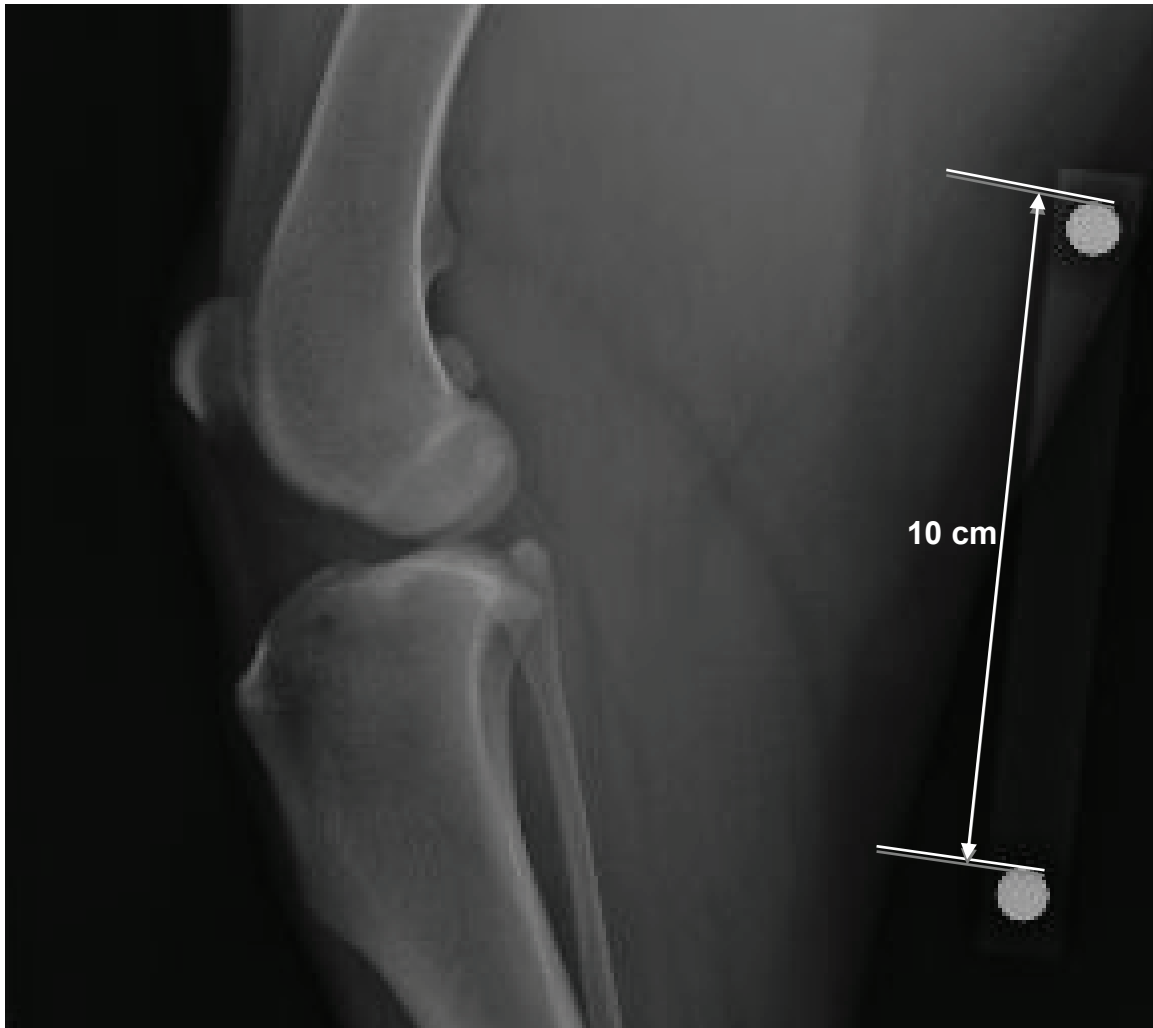


Figure 3: This is a digital medial lateral radiograph of the canine stifle.

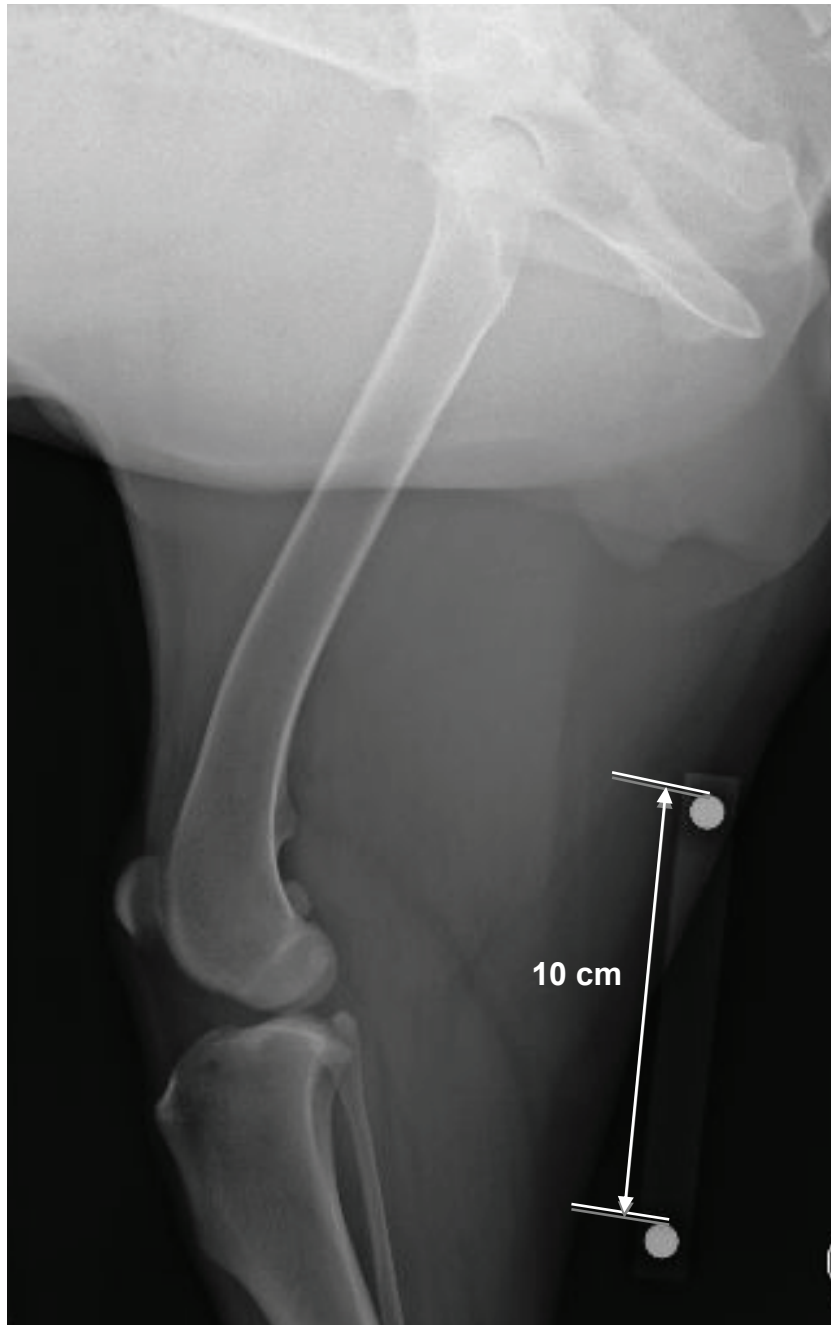


Figure 4: This digital XR shows the limb in extension at ~135°. Note that the marker spacing measures 10cm, confirming that the image is at 100% magnification.

STEP 1 – Determine Plate Size:

Before measuring the common tangent, determine what size plate best fits the tuberosity as seen in **Figure 5**. Note that the edge of the plate is aligned with the rostral border of the tibial crest. The most distal hole of the plate should fall on the cranial edge of the tibia, and in some instances off the edge on the cranial side. Following the tuberosity advancement, the distal plate holes will move caudally and allow for screw fixation along the long tibial axis.

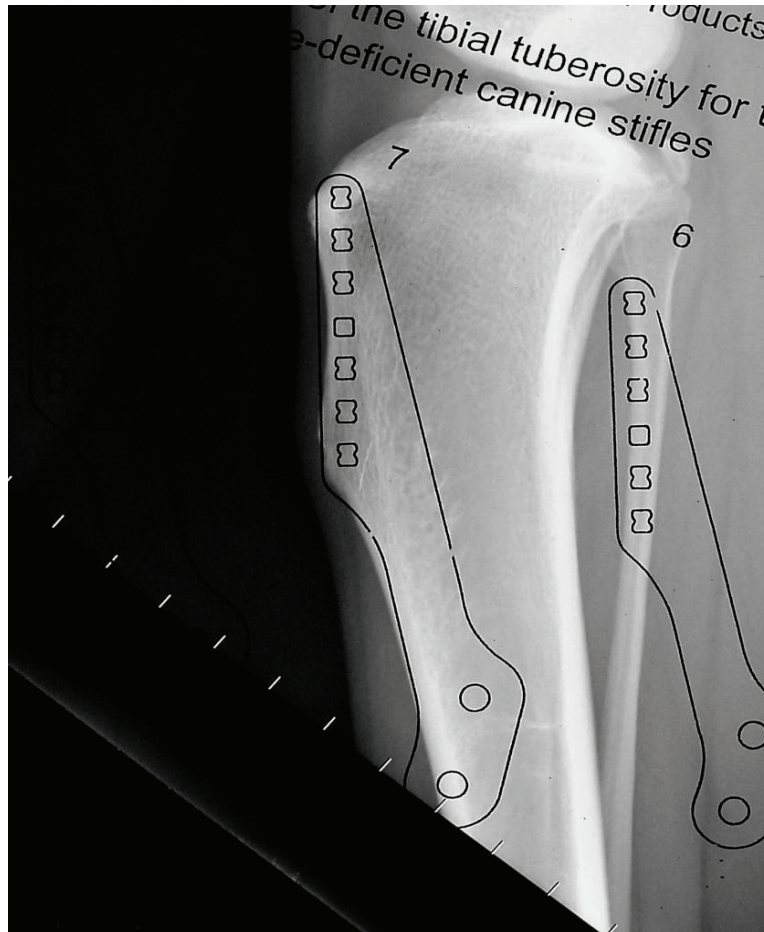


Figure 5: This XR, with the KYON template overlay, shows the correct sizing of a plate to match the tibial crest (Note: This image is from a different case than the other XRs in this document.)

The plate size provides an early indication of the required cage size. Plate and cage sizes are related. For example, you will not use a 7-hole plate with a 3mm cage, or a 12mm cage with a 3-hole plate. The table below shows typical pairings for plates and cages. If your measurements give you something different, recheck your measurements to be certain.

Standard Pairings for Plates and Cages

Plate Size	Cage Size
2 or 3 hole	3mm
3, 4, or 5 hole	6mm
5, 6 or 7 hole	9mm
6, 7 or 8 hole	12mm
7 or 8 hole	15mm

STEP 2 – Mark the Center Point of the Femoral Condyles:

Using the KYON Template for TTA Common Tangent, align the best fit circle around the articular margin of the femoral condyles. Use your best estimate to size the circle to match the margin. A good XR, that superimposes the condyles, is essential. In **Figure 6**, two condyles are visible. If this is the case, average the difference. If the difference is large, the XR should be done again as the goal is to have the condyles superimposed on each other. Here, we found the center of the outer condyle first.

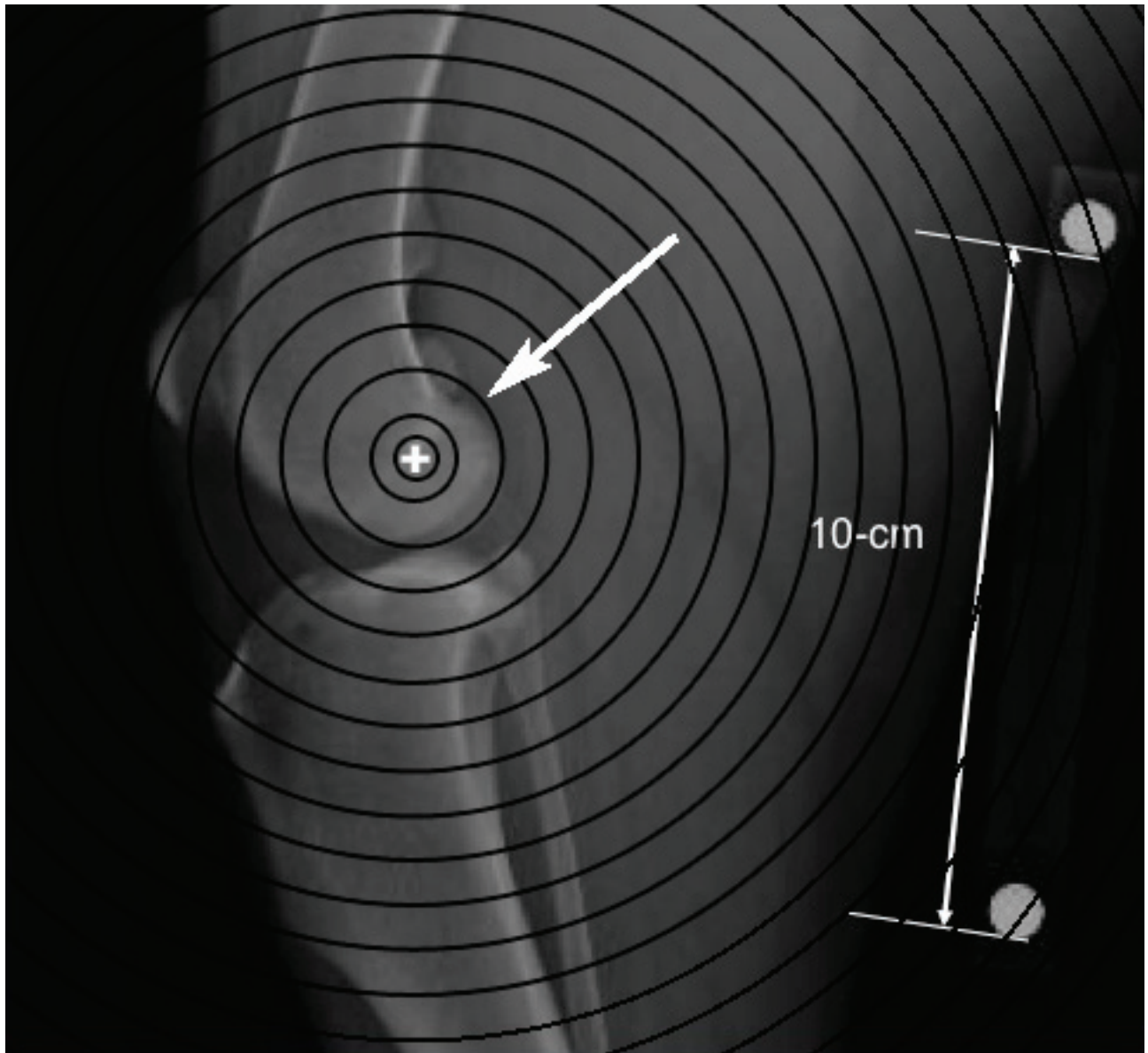


Figure 6: This XR, with template overlay, shows the best fit circle around the outer femoral condyle. The center of the circle is marked with a “+.”

In a manner similar to step two, use the best sized circle to define the margins of the inner condyle and mark the center of the circle, as seen in **Figure 7**. The point we are interested in is the midpoint between the two marks. This method averages the center point of the two condyles. Since this XR did not perfectly superimpose the two condyles, we found the center of each and will use the midpoint between these two marks.

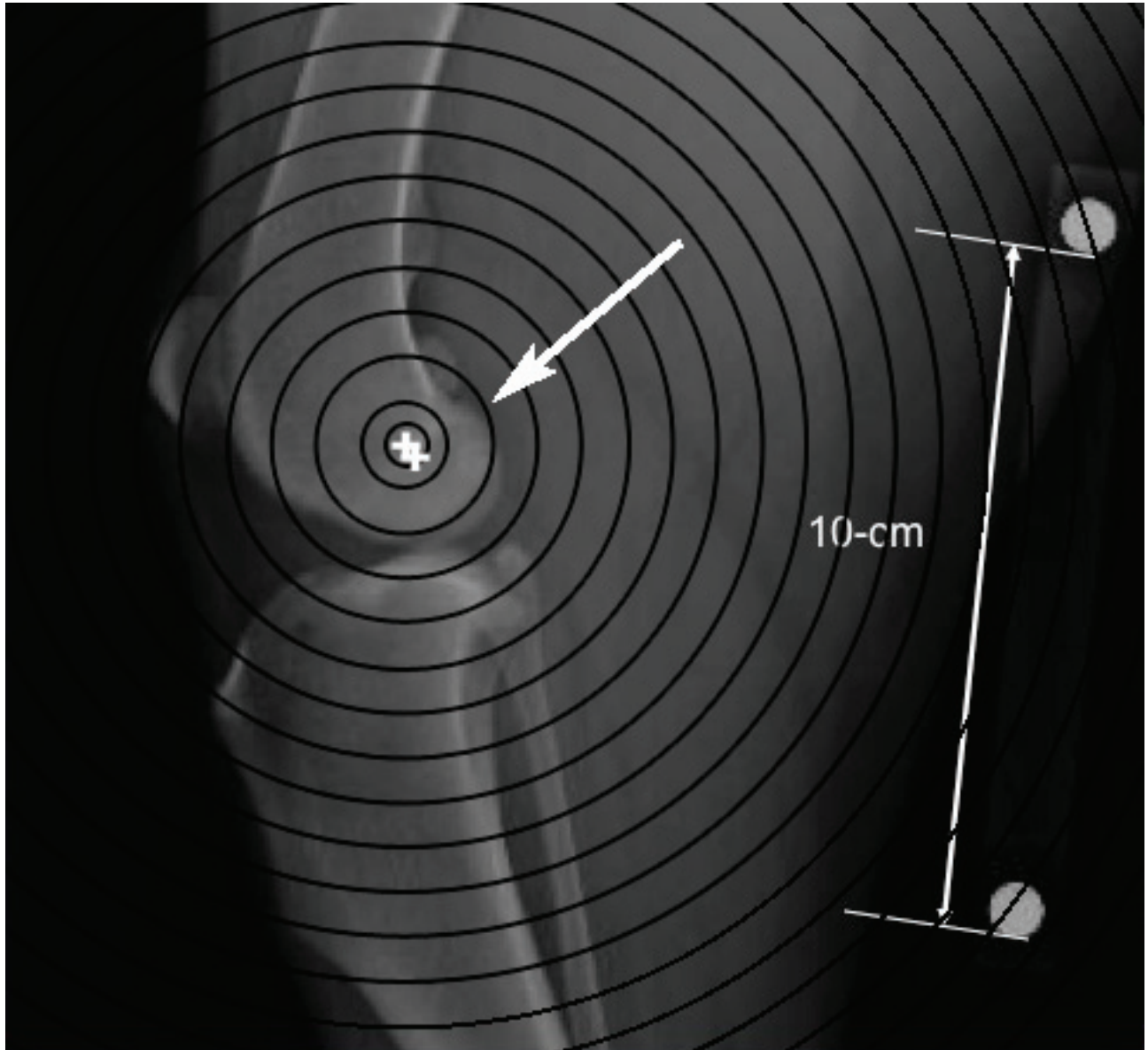


Figure 7: The circle template is defining the margins of the inner condyle and a “+” is drawn to define the center. Since this XR did not perfectly superimpose the two condyles, we found the center of each and will use the midpoint of these two marks.

STEP 3 – Mark the Center Point of the Tibial Condyles:

Use the circle template again to find the circle that best fits the margins of the tibial plateau, and mark the center of this circle.

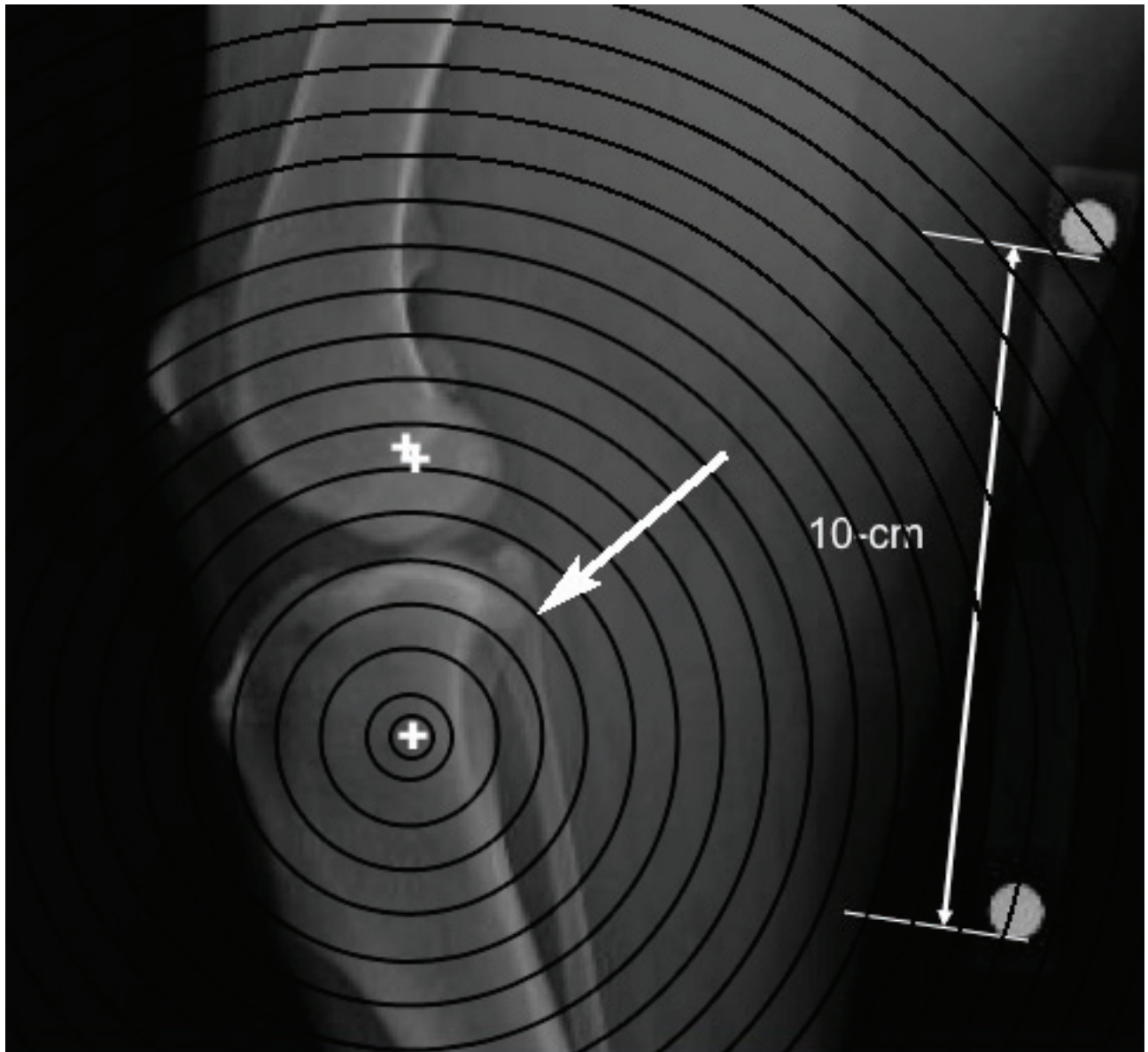


Figure 8: The circle template is defining the margin of the tibial condyle and a “+,” marks the center point.

STEP 4 – Align the Template with the Attachment Point of the Patella Ligament to the Patella:

Take the line template and set the top of the “0” line (shown in white for clarity) at the insertion point of the patellar ligament, as seen in **Figure 9**.

STEP 5 – Ensure the Template Guide Lines are Parallel with the Two Marked Center Points:

Rotate the template around the insertion point of the patellar ligament until the guide lines on the right align with the “+” on the tibial side and the midpoint of the two “+” signs on the femur side, as seen in **Figure 9**. The guide line, shown in white, marks the center of these two points.

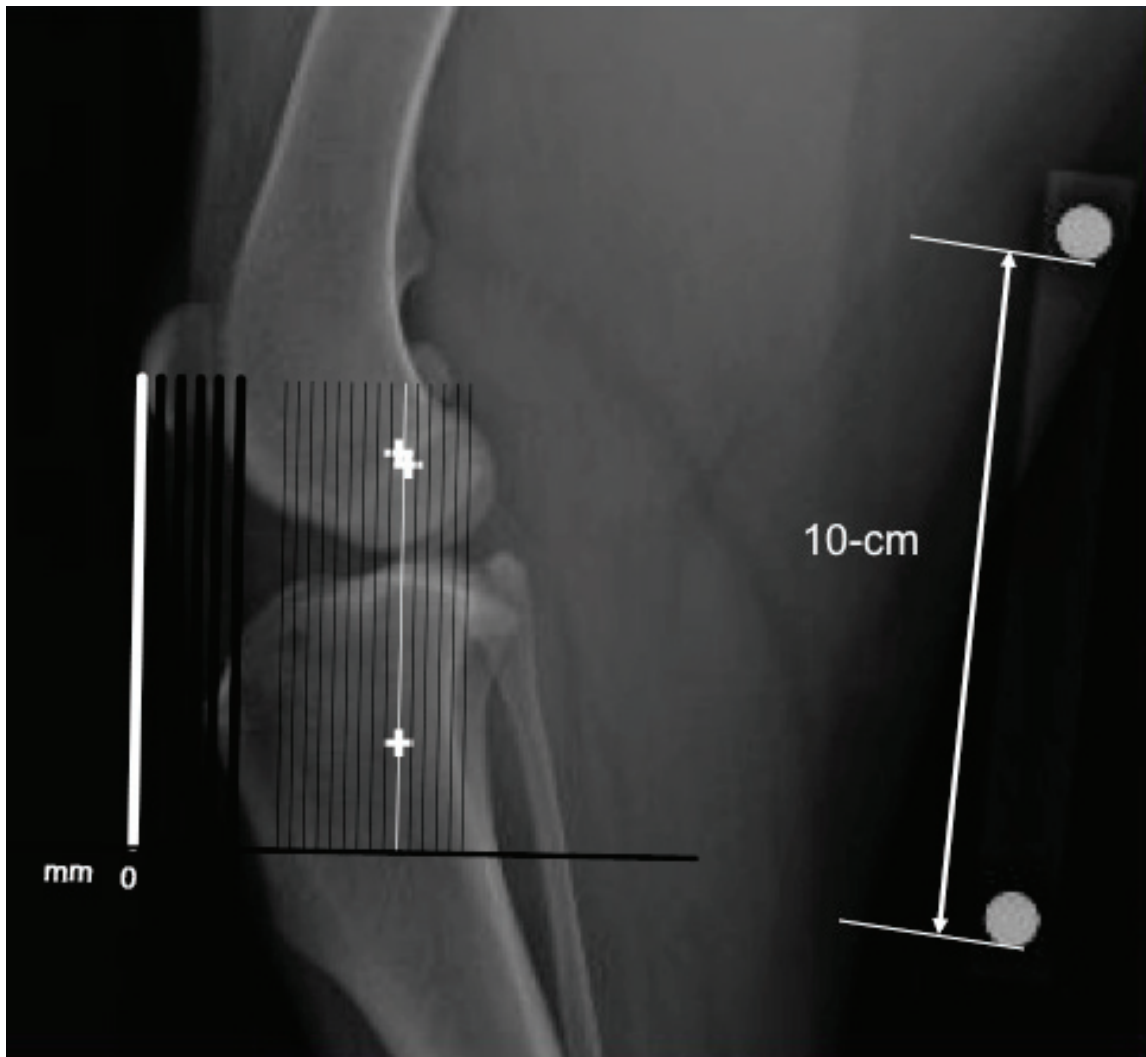


Figure 9: The line template is in correct position to determine the amount of advancement required. The top of the “0” line (shown in white) is touching the insertion point of the patellar ligament and the guide lines are parallel to a guide line from the center of the two marked points on the femur and the marked point on the tibia. The guide line running from the center of the two marked points on the femur and marked point on the tibia is colored white for clarity.

Step 6 – Determine the Required Advancement:

Using the line template, in the position defined in steps 4 and 5, note which line is closest to the tibial crest. This line gives you the size of the cage required for the tibial tuberosity advancement. In **Figure 10**, the line closest to the tibial crest is 9mm from line 0. This indicates that a 9mm cage is appropriate. If the crest falls between two lines, for example between 6mm and 9mm, in most cases the larger cage size will be appropriate.

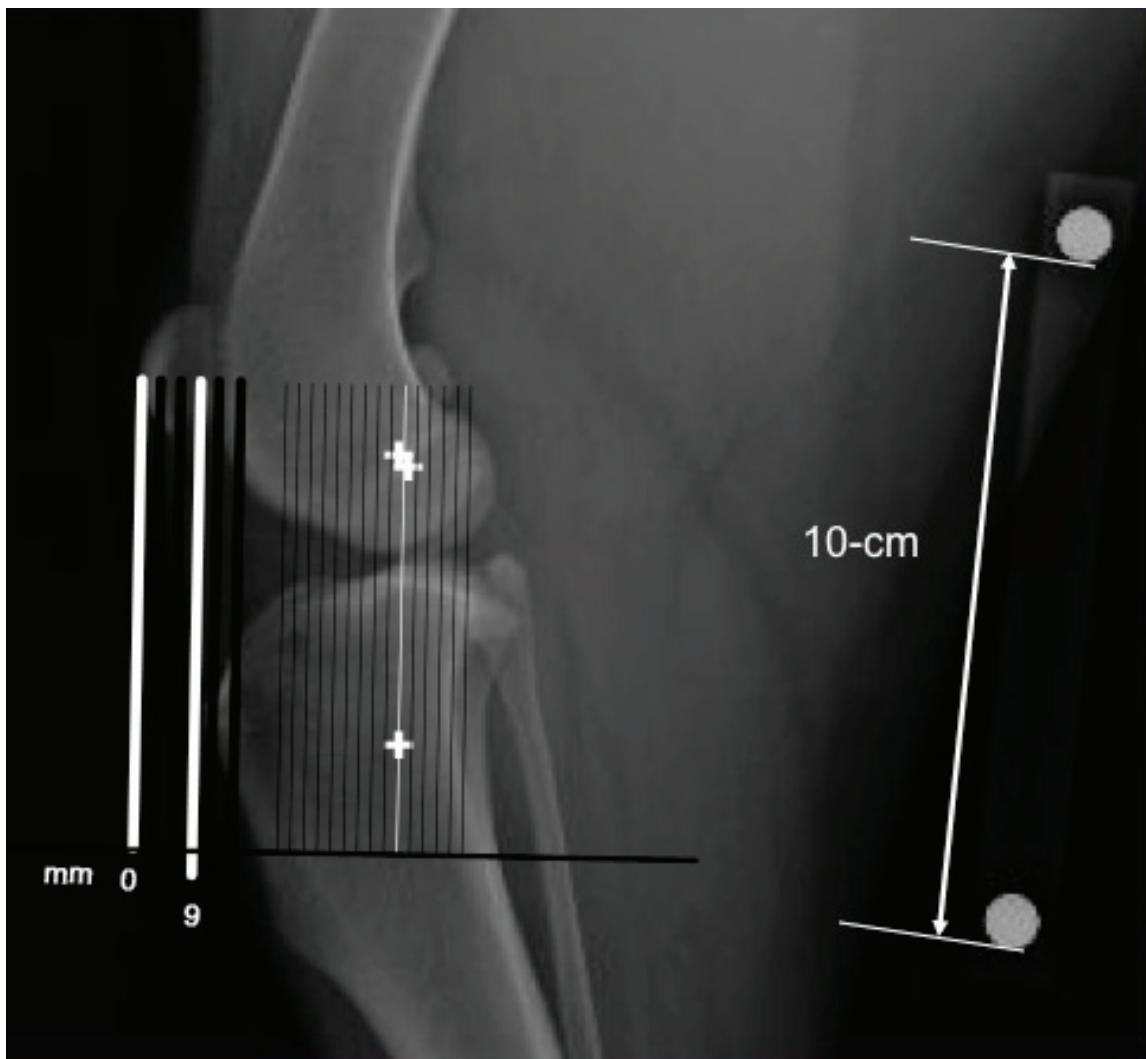


Figure 10: The line template is in position and the tibial crest is just touching the 9mm line. This indicates that a 9mm cage is appropriate for this dog.

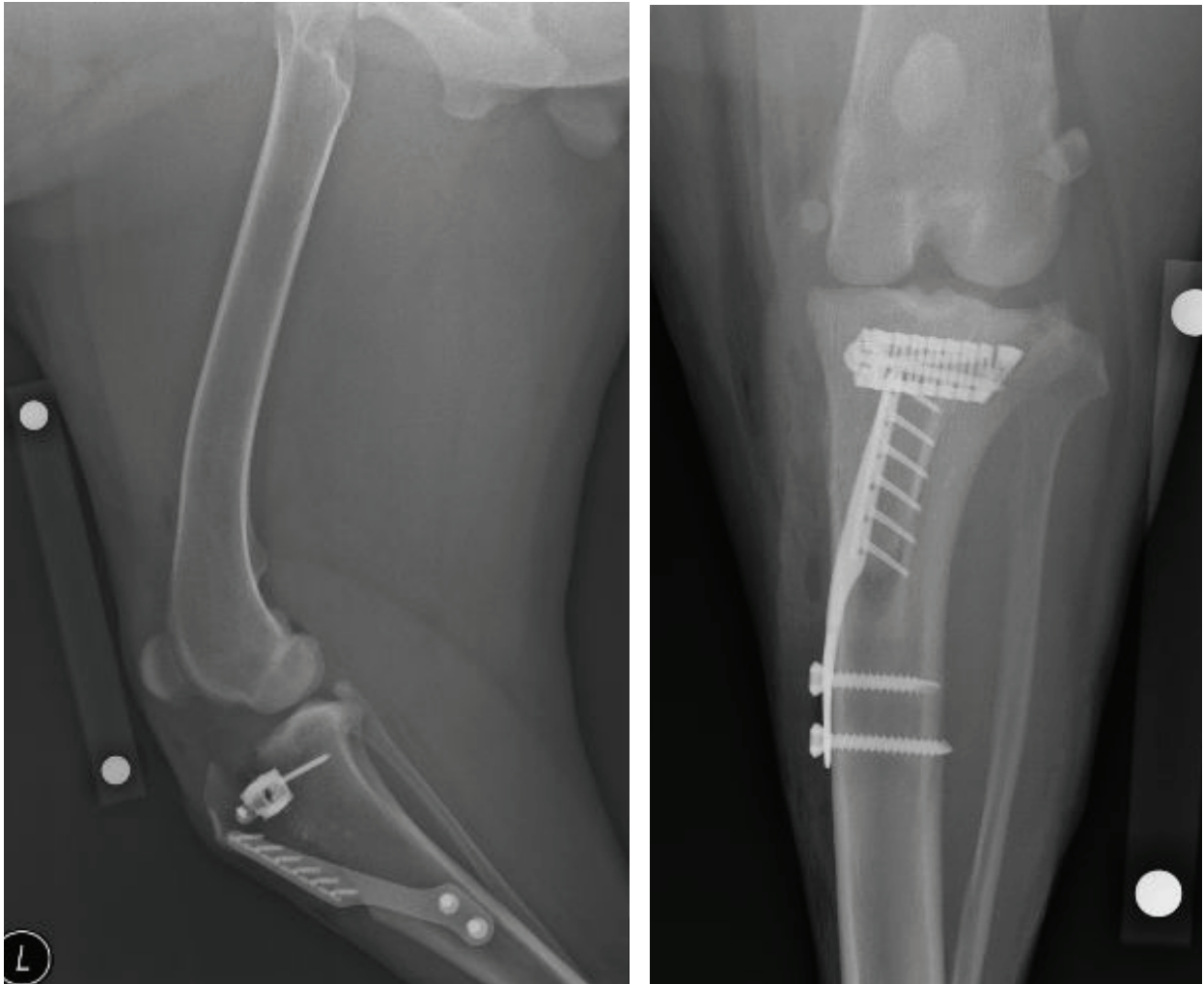


Figure 11: These immediate post-operative XRs show a 6-hole plate implanted with a 9x25-mm cage.

Additional Comment:

In **Figure 12**, notice what the measurement would look like if the tibial plateau insertion points were used to generate the tangent. This variance can be due to the extension of the leg not being 135° or the angle of the tibial plateau. When leg extension is ~135°, the TP and the Common Tangent lines are parallel. If the TP line and the Common Tangent line are parallel, the cage size measurement will be the same.

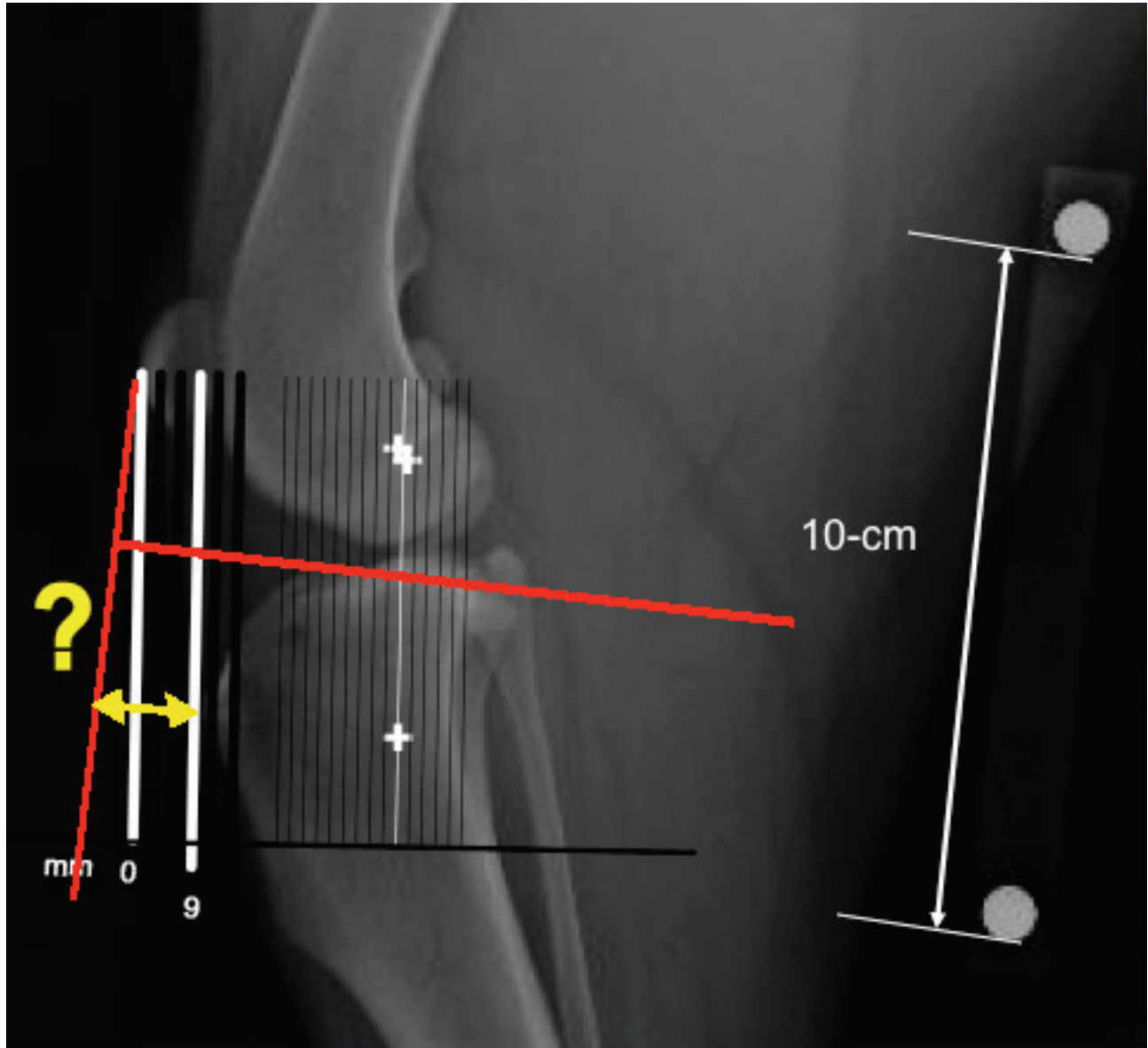


Figure 12: Using the insertion points of the ligaments on the tibial plateau (red line) can give a much larger cage size than the common tangent method.

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