Mar 13, 2020

Radius of Curvature Measurements to Determine Best Location for Fresh Osteochondral Allograft of the Capitellum

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1 Works for me dx.doi.org/10.17504/protocols.io.9nmh5c6

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ABSTRACT

Osteocondritis dissecans (OCD) is a focal change in subchondral bone thought to be caused by factors that include genetic, vascular, microtrauma, or a combination of these. OCD lesions can be treated with nonoperative or operative management depending on severity. For larger, unstable lesions, fresh osteochondral allograft transplantation (FOCAT) has been described as an effective treatment. Fresh allografts are harvested from cadaver tissue and are applied operatively to the lesion. Despite generalized donor sites providing a good match to recreate the native joint anatomy, specific donor anatomy may result in poor graft fit. Restoring natural curvature is critical for successful treatment of OCD symptoms using FOCAT, and currently significant guess work is used to determine the graft tissue extraction site from the femoral condyle. In this study, goodness of fit of osteochondral allografts transplants is tested by measuring and analyzing radius of curvature (ROC) using a picture archiving and communication system (IMPAX, Agfa Healthcare, Mortsel, BE). The protocol for measuring ROC of the capitellum is adapted from data outlining the average size and location of OCD lesions on the capitellum. The protocol used for determining the ROC of potential graft extraction sites from the femoral condyle is based on early measurement data collected in this study. Upper extremity and lower extremity CT scans of OHSU patients with no evidence of prior surgery, intra-articular damage, variation of normal anatomy, or degenerative joint disease were used in this study.

1

Selecting a Patient & Formatting

a. Obtain all CT images from the Department of Radiology tagged "upper extremity" or "elbow" and "lower extremity" or "knee".
b. Review lists and exclude patients with indication of prior intra-articular fracture, surgery, degeneration, or variations of normal anatomy.
c. Randomize list, and select first patient for measurement.
d. Remove the demographics toggle from the screen, and select screen format (Series 1:2).
e. Display axial and sagittal views, set image contrast to "Bone".
f. Along the axial image, begin at the inferior-most point. Scroll superiorly to identify the axial slice that displays the longest distance between the anterior and posterior points (APL = Anterior Posterior Length) of the subchondral bone of both the medial and lateral condyles.

NOTE: All measurements in this study were evaluated using a picture archiving and communications system (IMPAX, Agfa Healthcare, Mortsel, BE). In this study, scans of patients for upper extremity measurements were limited between 11 and 21 years.

2 **Determining Radius of Curvature of the Medial Femoral Condyle**

2.1 **Location #1**

1. On the sagittal view, begin medially and scroll laterally until the sagittal slice aligns with the posterior endpoint of the APL of

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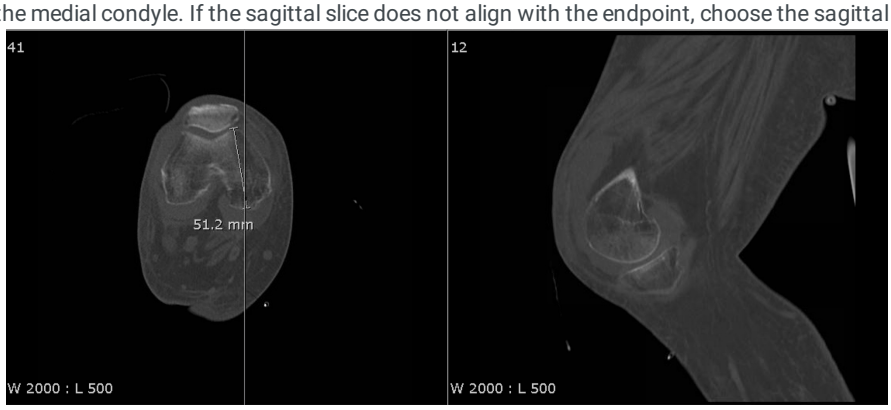
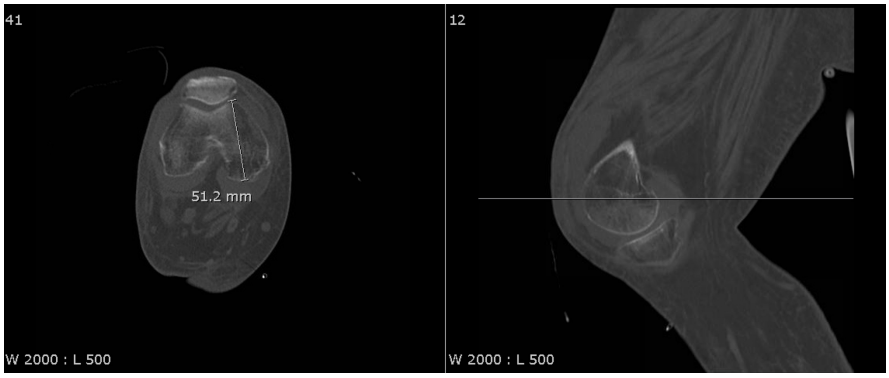
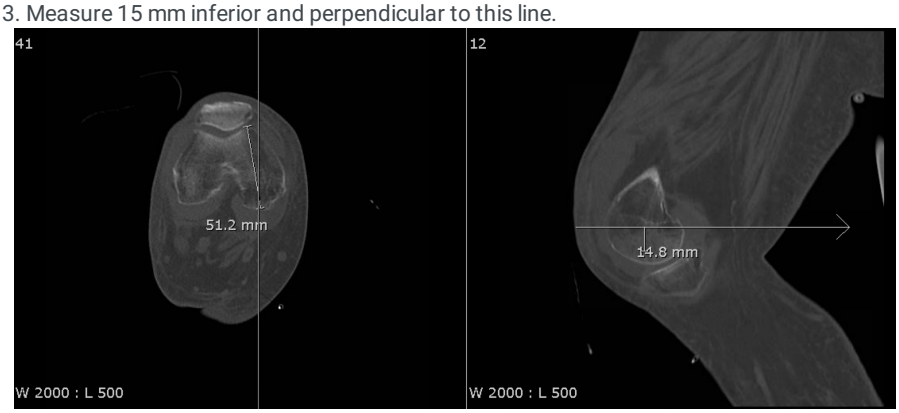
the medial condyle. If the sagittal slice does not align with the endpoint, choose the sagittal slice medial to the endpoint.



2. Switch to the axial view so that the tracked line is visible on the sagittal view. Draw a line on the sagittal view that traces this line.



3. Measure 15 mm inferior and perpendicular to this line.



4. Draw a line measuring 10mm superior from the inferior endpoint of the 15mm measurement.

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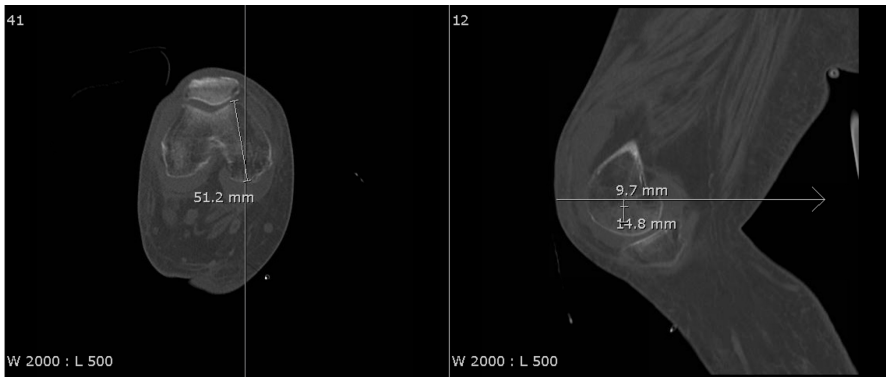
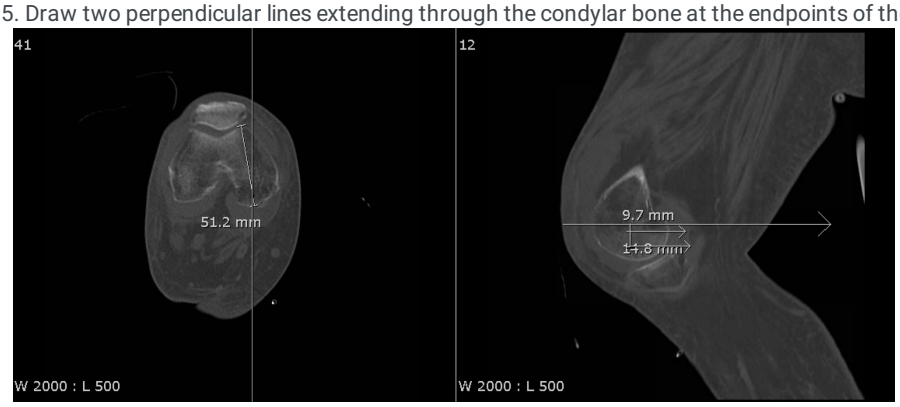
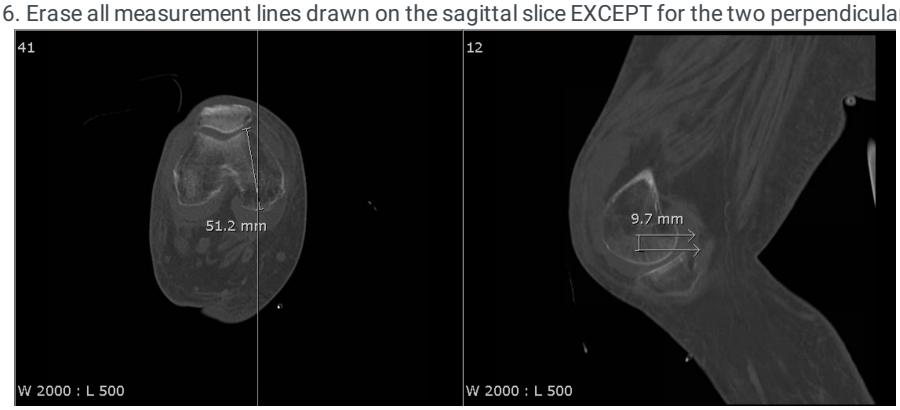


5. Draw two perpendicular lines extending through the condylar bone at the endpoints of the two lines.



6. Erase all measurement lines drawn on the sagittal slice EXCEPT for the two perpendicular lines drawn.



7. Use the "circle" function to trace a best-fit circle around the radius of the subchondral bone in between the two perpendicular lines.

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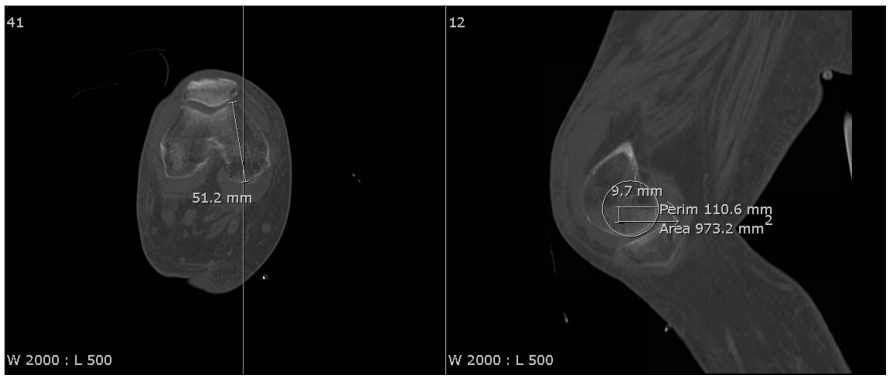
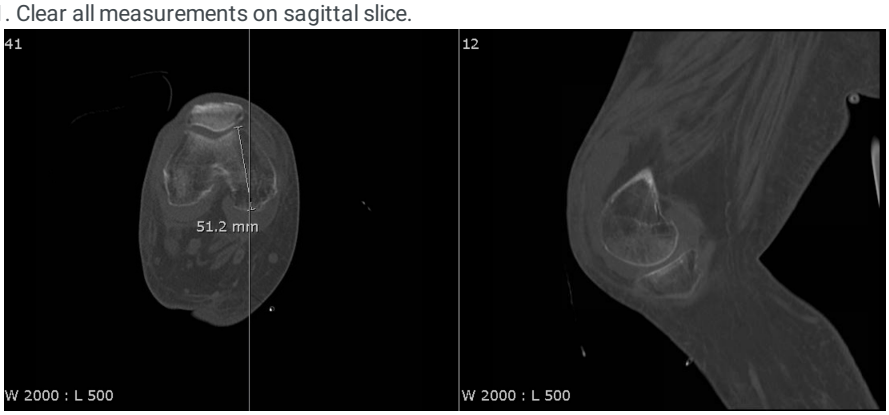
g 

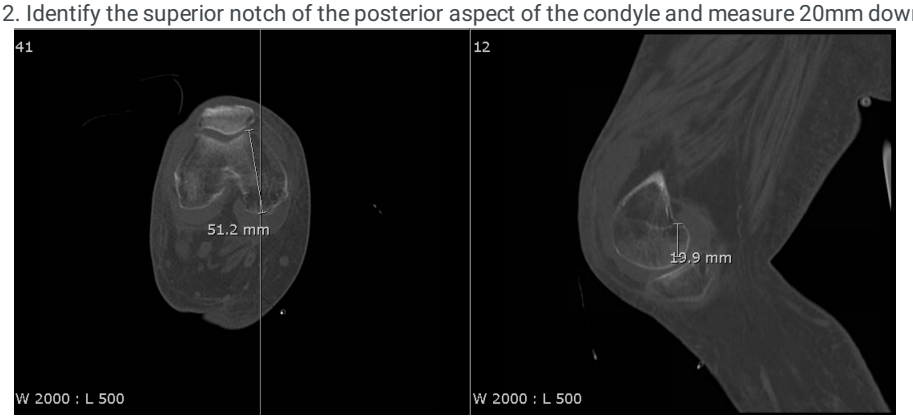
8. Record the area and perimeter.
9. Use area to derive radius of curvature.

2.2 Location #2

1. Clear all measurements on sagittal slice.



2. Identify the superior notch of the posterior aspect of the condyle and measure 20mm down from that point.



3. Draw a line that measures 10mm superior from the inferior endpoint of the 20mm line.

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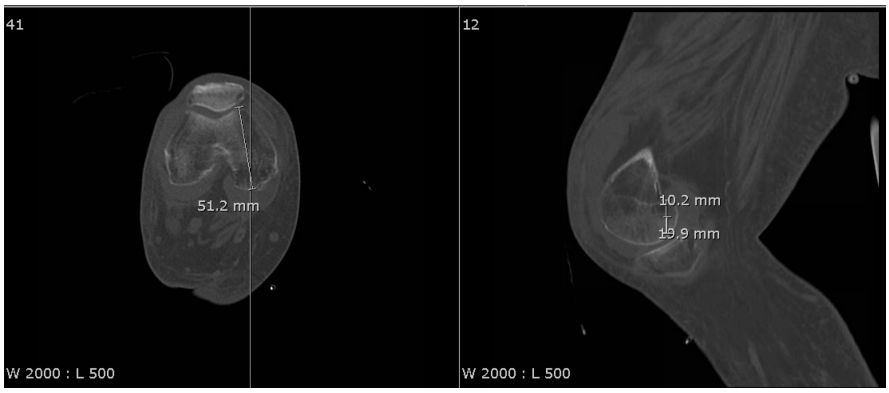
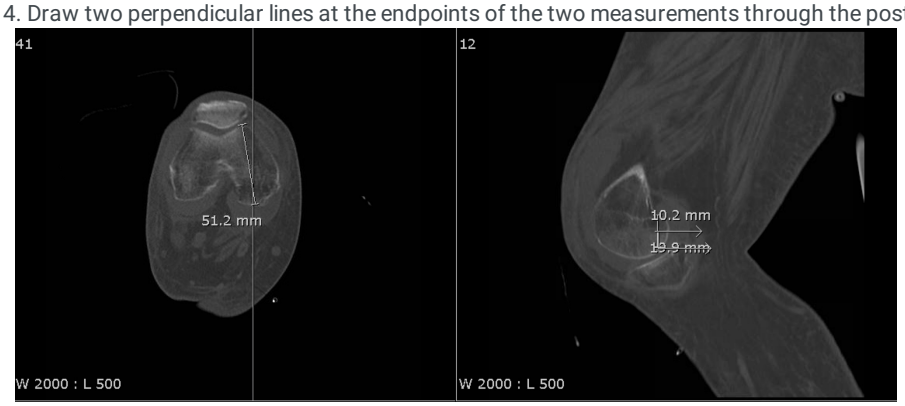
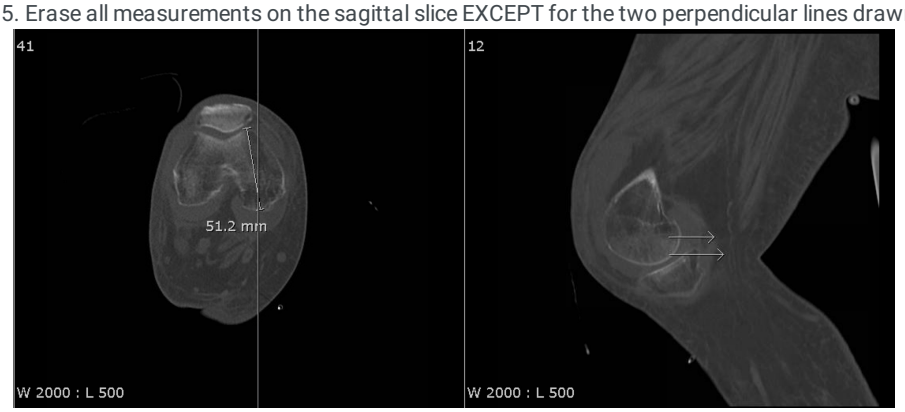


4. Draw two perpendicular lines at the endpoints of the two measurements through the posterior subchondral bone.



5. Erase all measurements on the sagittal slice EXCEPT for the two perpendicular lines drawn.



6. Draw a circle that best fits the radius of curvature of the sub-chondral bone between the two perpendicular lines.

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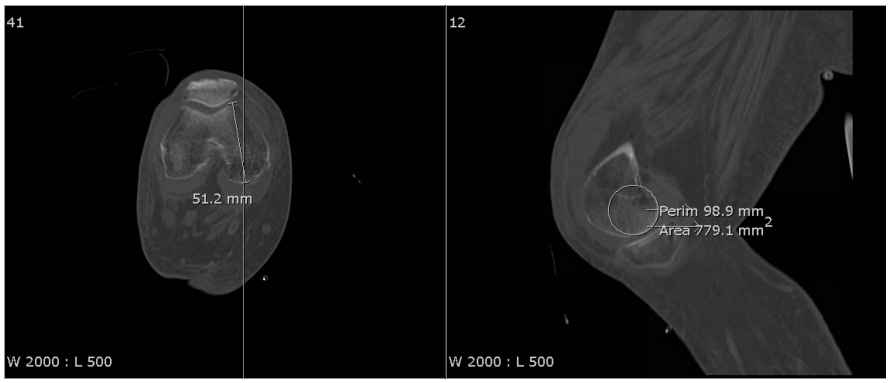
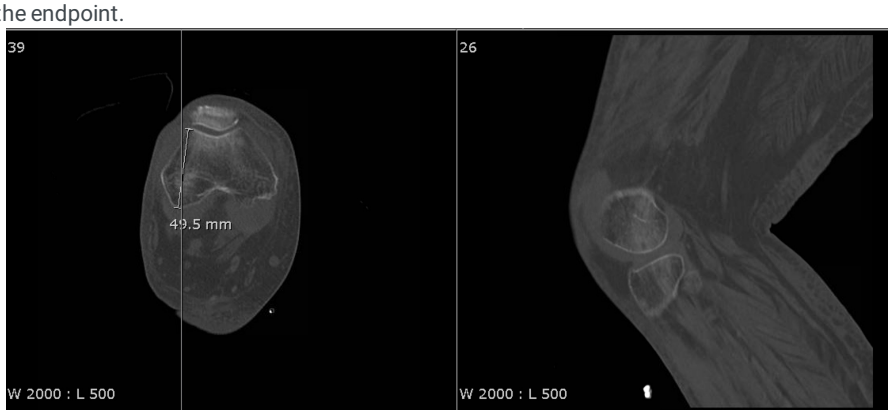


7. Record the area and perimeter.
8. Use area to derive radius of curvature.

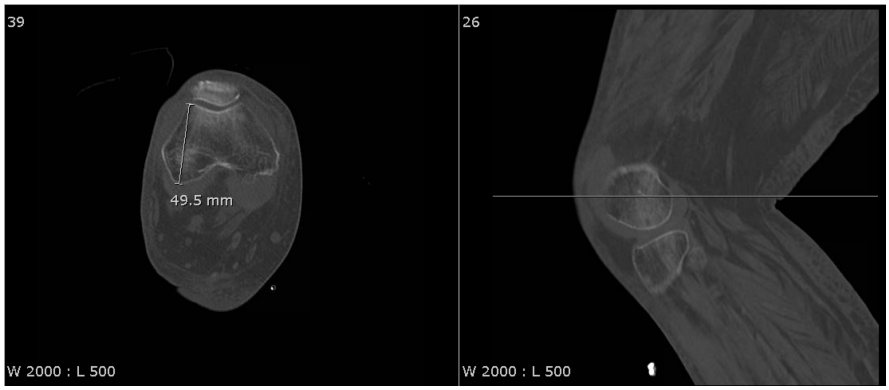
3 Determining Radius of Curvature of the Lateral Femoral Condyle

3.1 Location #1

1. On the sagittal view, begin medial and scroll lateral until the sagittal slice aligns with the posterior endpoint of the APL measurement line of the lateral condyle. If the sagittal slice does not align with the endpoint, choose the sagittal slice medial to the endpoint.



2. Switch to the axial view so that the tracked line is visible on the sagittal view. Draw a line on the sagittal view that traces this line.



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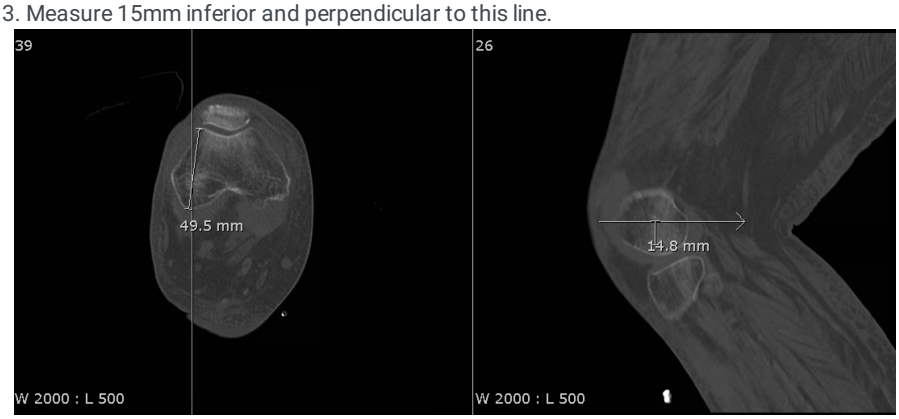
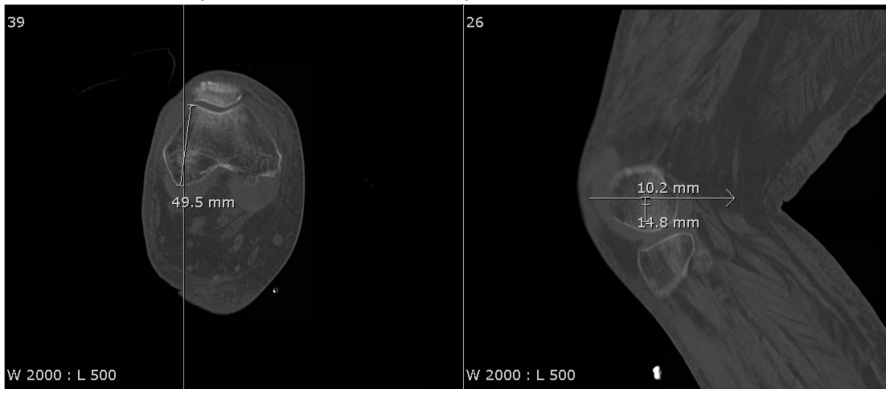
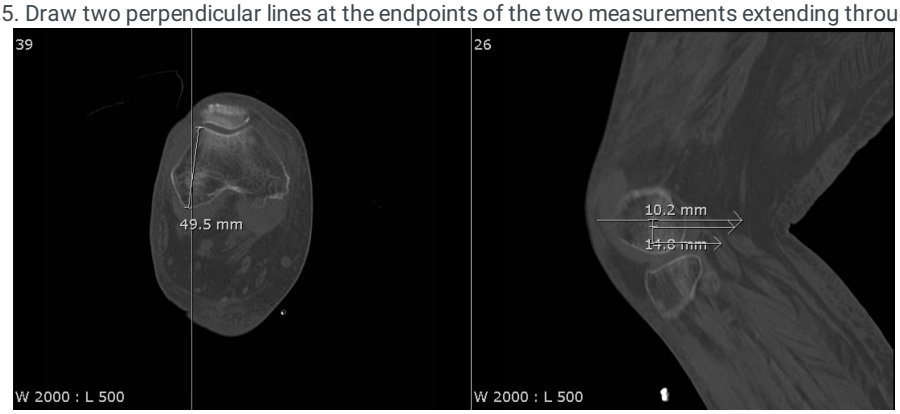
3. Measure 15mm inferior and perpendicular to this line.



4. Measure 10mm superior from the inferior endpoint of the 15mm measurement.



5. Draw two perpendicular lines at the endpoints of the two measurements extending through the posterior subchondral bone.



6. Erase all measurement lines drawn on the sagittal slice EXCEPT for the perpendicular lines drawn.

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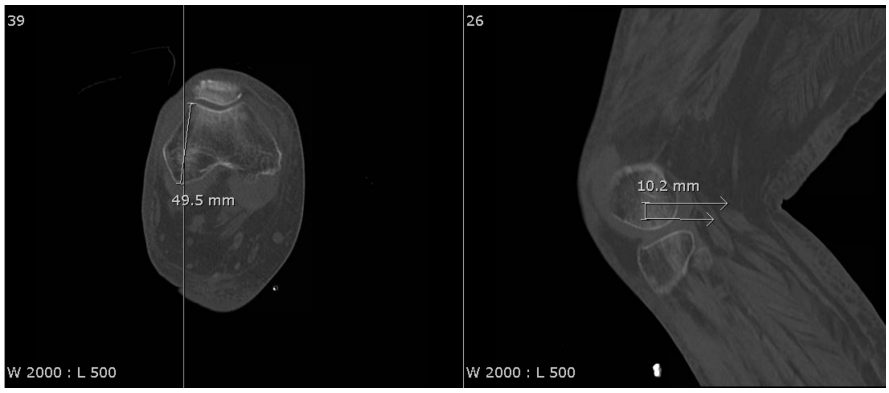
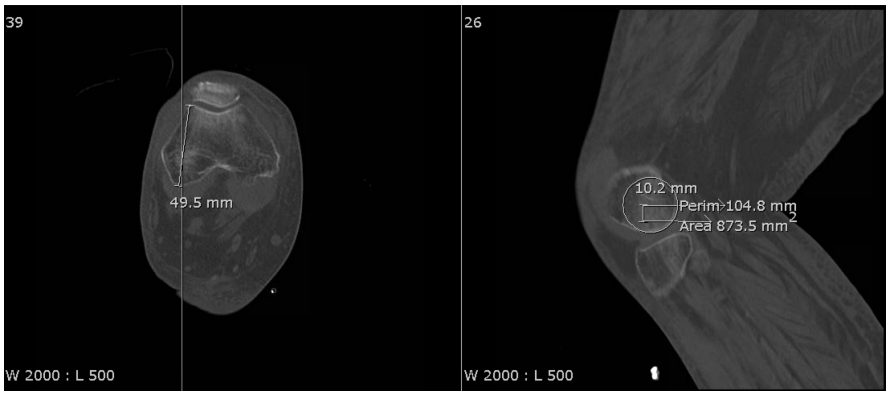


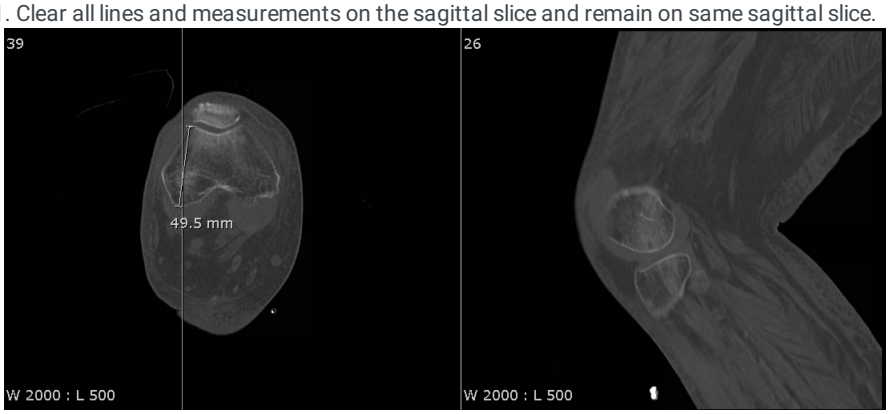
7. Draw a circle that best fits the radius of curvature of the subchondral bone in between the two lines.



8. Record the area and perimeter.
9. Use area to derive radius of curvature.

3.2 Location #2

1. Clear all lines and measurements on the sagittal slice and remain on same sagittal slice.



2. Identify the superior notch of the posterior condyle and Measure 20mm down.

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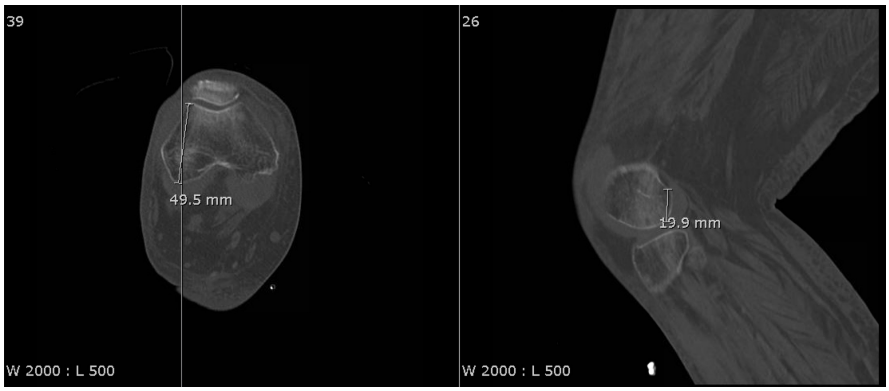
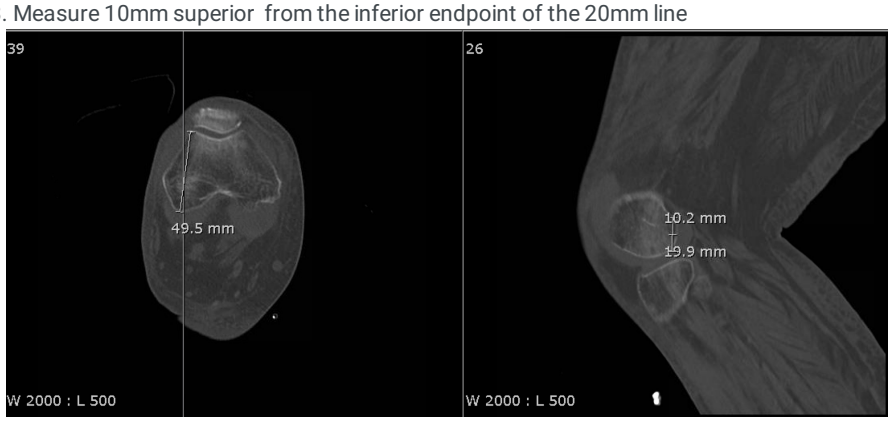
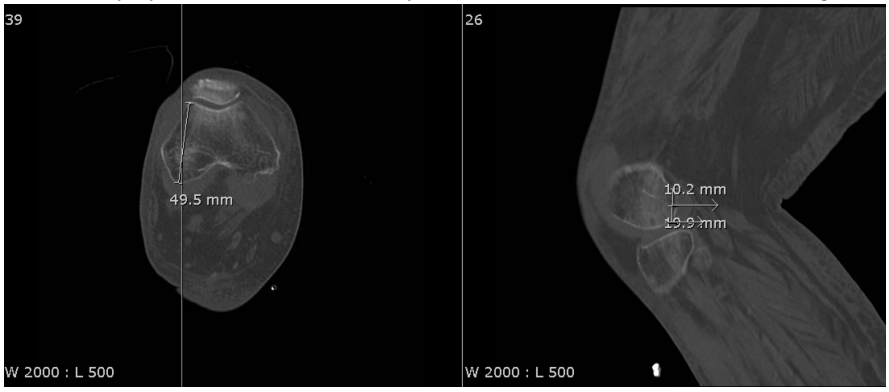


3. Measure 10mm superior from the inferior endpoint of the 20mm line



4. Draw two perpendicular lines at the endpoints of the two measurements extending through the subchondral bone.



5. Erase all measurement lines drawn on the sagittal slice EXCEPT for the perpendicular lines drawn.

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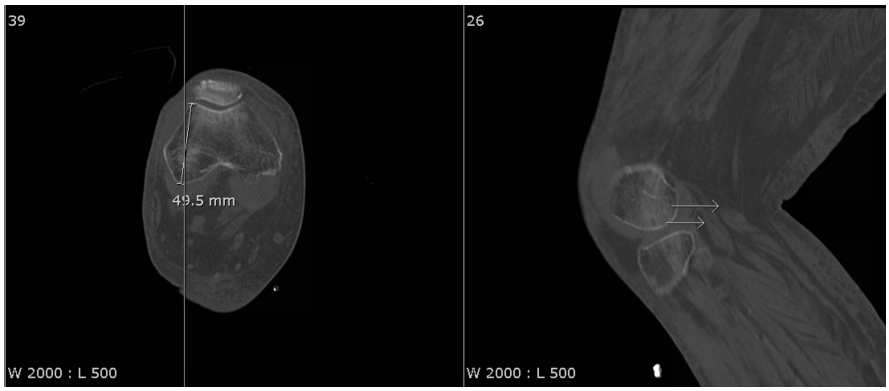
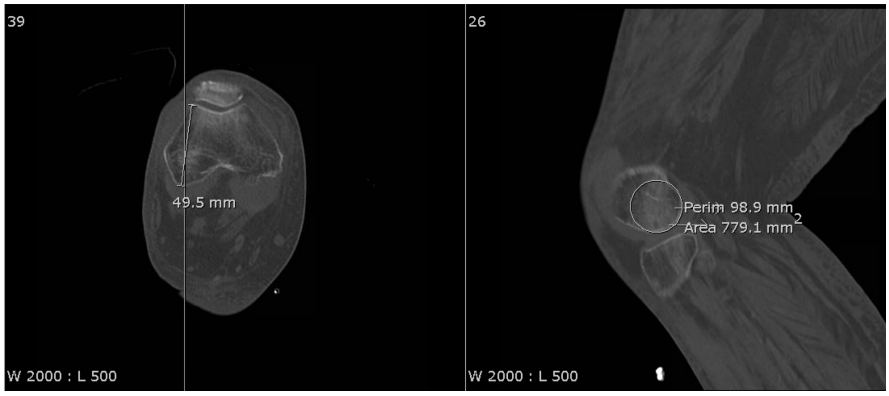


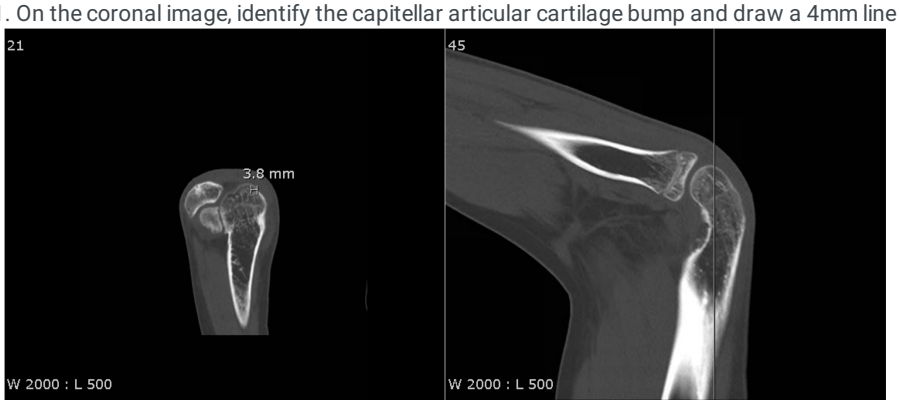
6. Draw a circle that best fits the radius of curvature of the subchondral bone in between the two lines.



7. Record the area and perimeter.
8. Use area to derive radius of curvature.

4 Determining Radius of Curvature of the Capitellum

4.1 1. On the coronal image, identify the capitellar articular cartilage bump and draw a 4mm line medially from that point.



2. Scroll along the sagittal image until the slice matches up with medial edge of the 4mm line. If the line does not match perfectly select the slice medial to the point.

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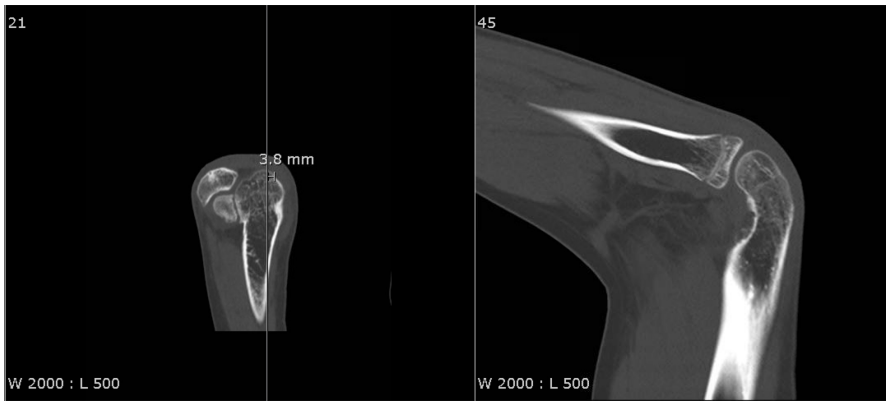
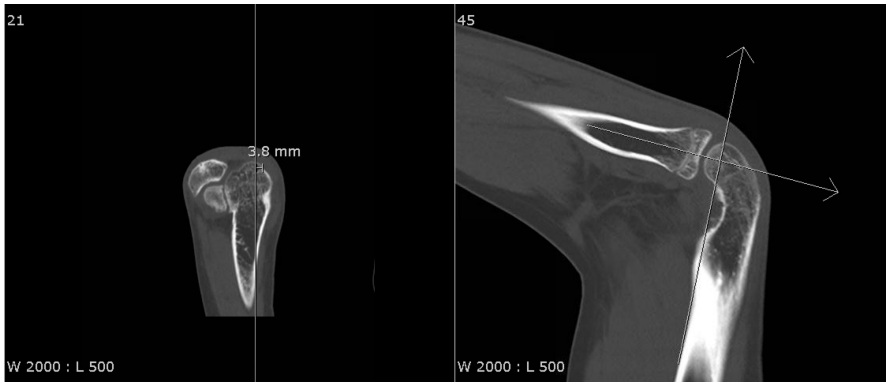
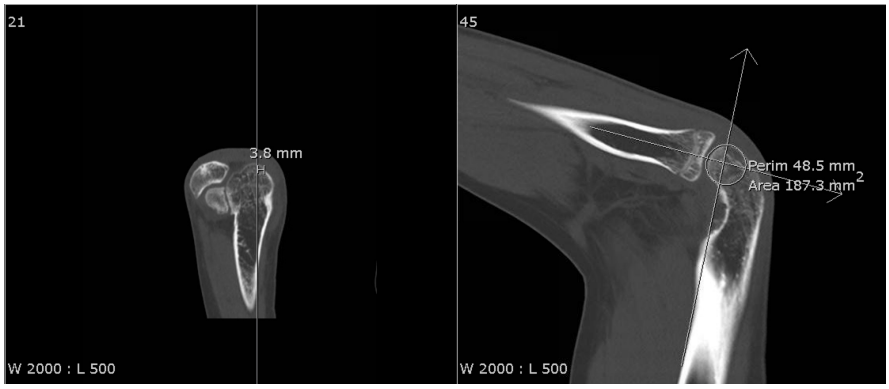


3. Draw a line through the capitellum bisecting the radial head at the midline. Draw a line through the capitellum from the superior side that approximates the shaft of the humerus. If the arm is angled at 90 degrees use the anterior aspect of the humerus.



4. Draw a circle that best fits the radius of curvature of the subchondral bone with the bisection of the lines as the center.



5. Record the area and perimeter.
6. Use area to derive radius of curvature.
7.The same protocol was used at 180 degree elbow extension:

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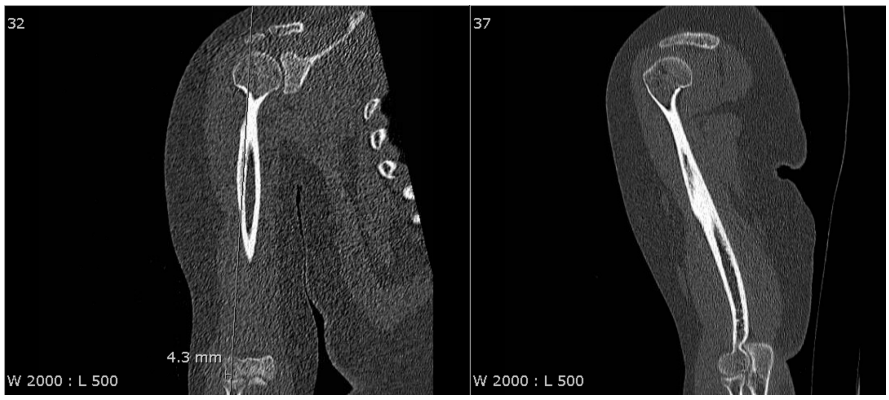

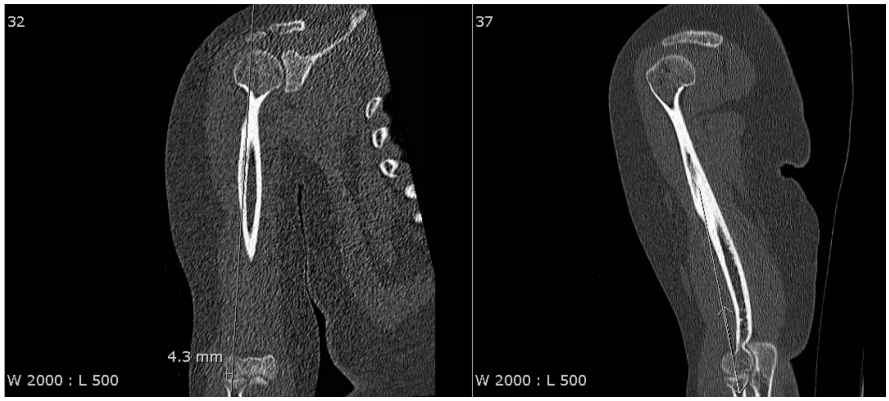

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