ICUC Poster

Distal Radius Fractures

Comments by Prof. J. Jupiter

Jul 2020

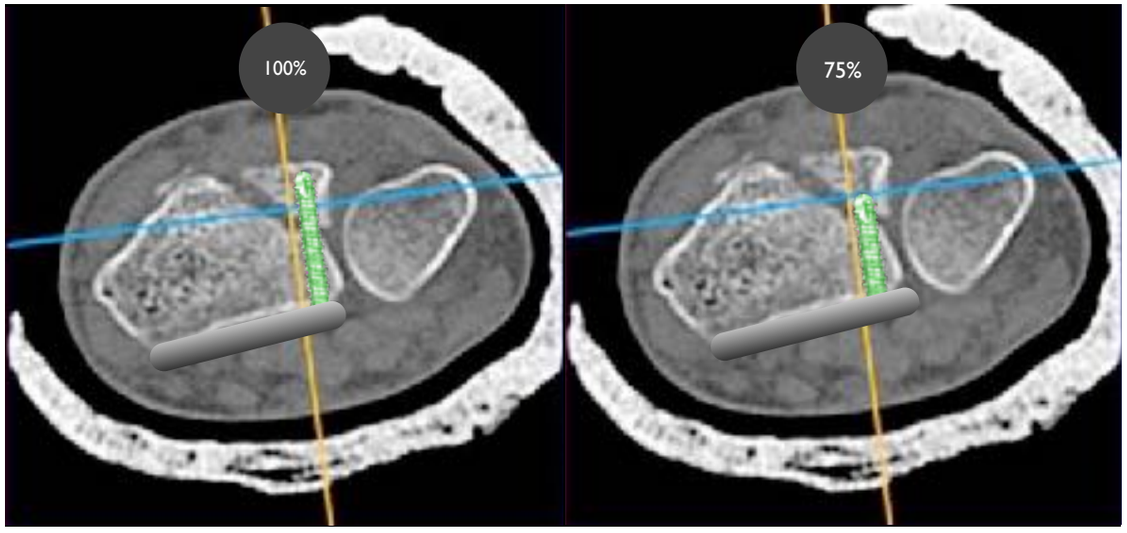
"I have many open questions and very few answers."

S.M. Perren, 2019

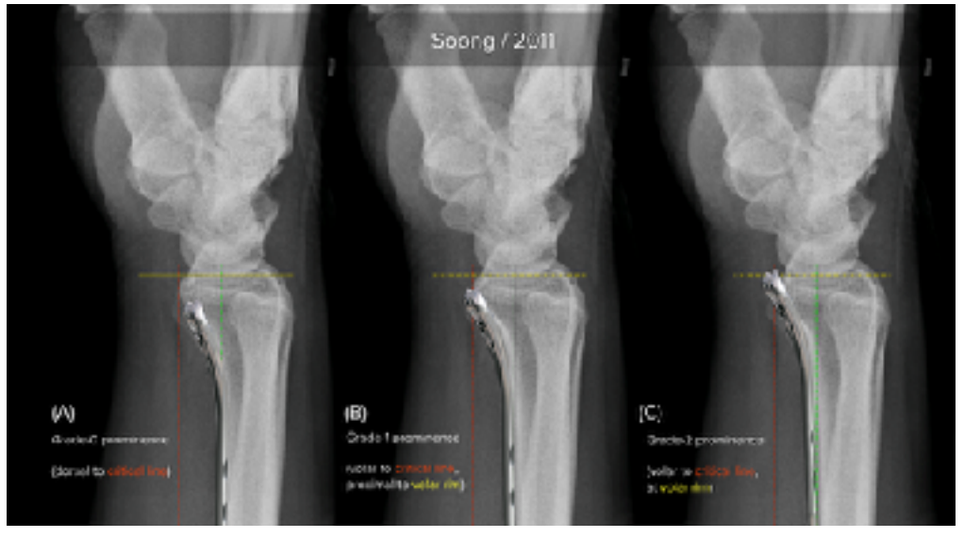
What is the ideal screw length?
What is the ideal plate position?

A. Fernández, J. Jupiter

Ideal Screw Length?



Ideal Plate Position?



Start-to-finish full HD data from each case is available at ICUC at icuc.net

ICUC **Posters**

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Complete from start to finish,
unselected series of surgical cases
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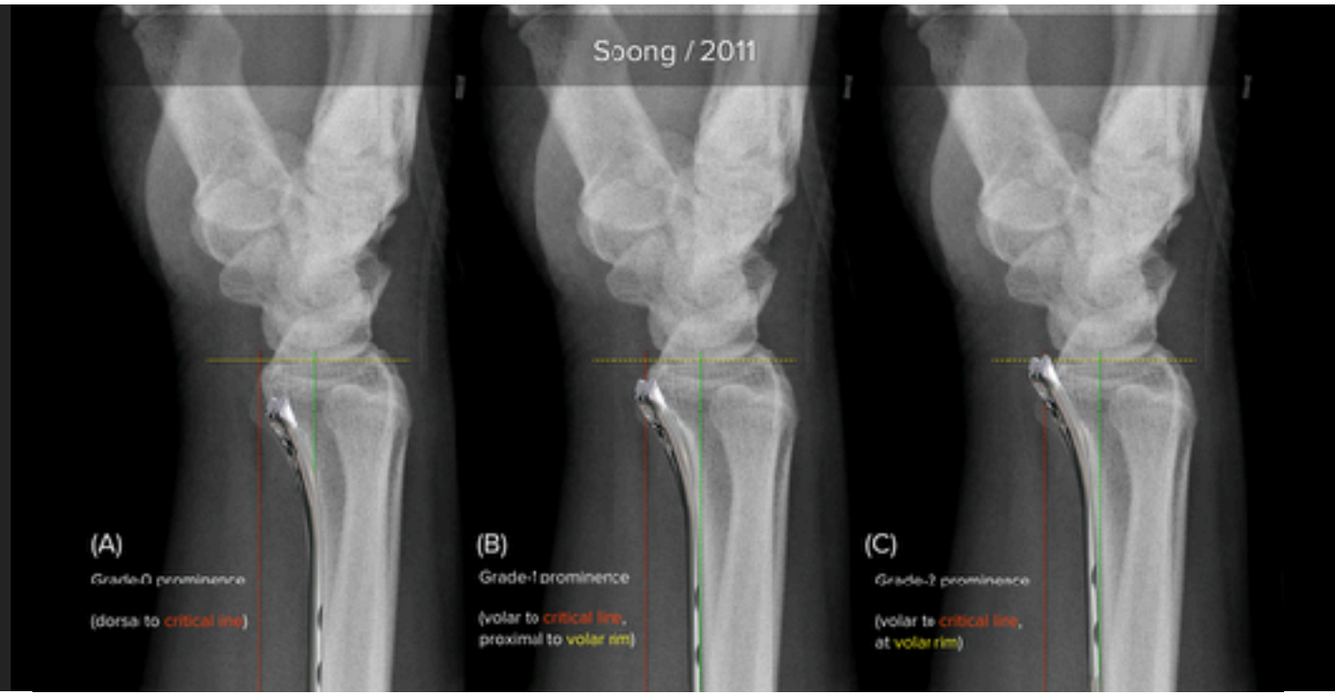
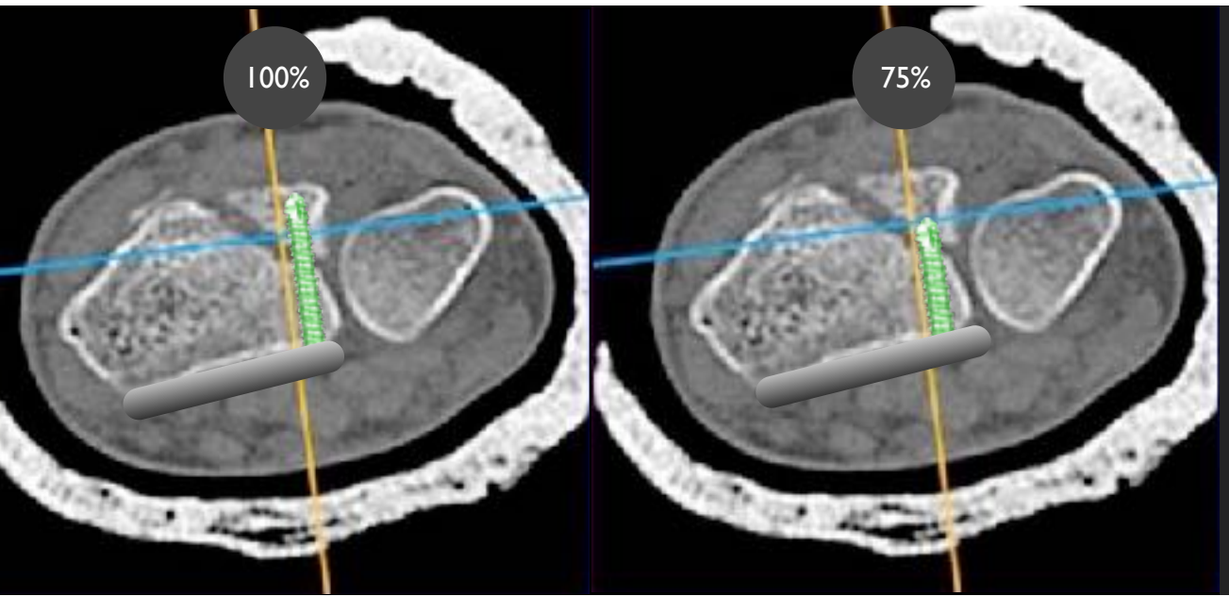
ICUC Posters are based on surgical cases taken from our library,
meaning the full set of data used by the authors is accessible through our platform.

We include a few case images to promote discussion on the subject.

ICUC

1) "Which is the ***ideal plate position*** of a volar plate, distal enough to get a good bone purchase, or not so distal as to avoid flexor tendon problems according to Soong/Kitay criteria?"





2) "Which is the **ideal screw length,** 100% including dorsal tendon impingement risk, or 75% and a lower bone purchase?"

We'd like to suggest that the placement of the plate may influence subsequent tendon problems and it's important to consider in the surgical technique.

BACKGROUND

"Locked unicortical distal screws of at least 75% length produce construct stiffness similar to bicortical fixation."
Using unicortical fixation during volar distal radius plating may protect extensor tendons without compromising fixation.

Wall 2013

The relationship between volar plate removal and a higher Soong grading stresses the importance of accurate plate positioning.

Selles 2018

"Regardless of plate selection, surgeons should avoid implant prominence at the watershed line of the distal part of the radius, which may increase the risk of tendon injury."

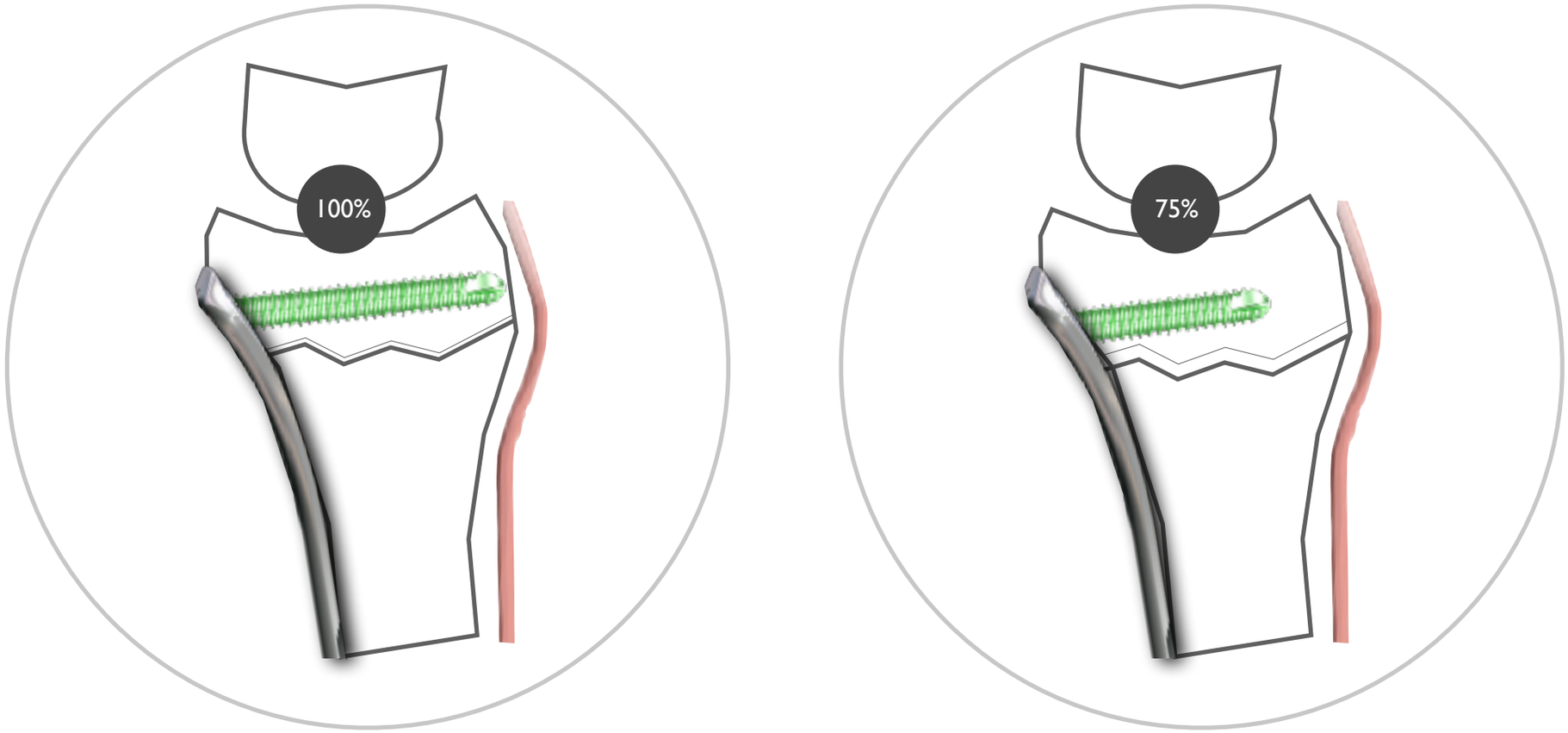
Soong 2011

"The analysis of 250 complex distal radius fractures...More than 60% of the fracture lines originated distal to this watershed line. Therefore to treat the majority of these fractures implants must be placed distal to this watershed line..."

K. Mader, D. Pennig 2006

ICUC

Extra-articular fracture

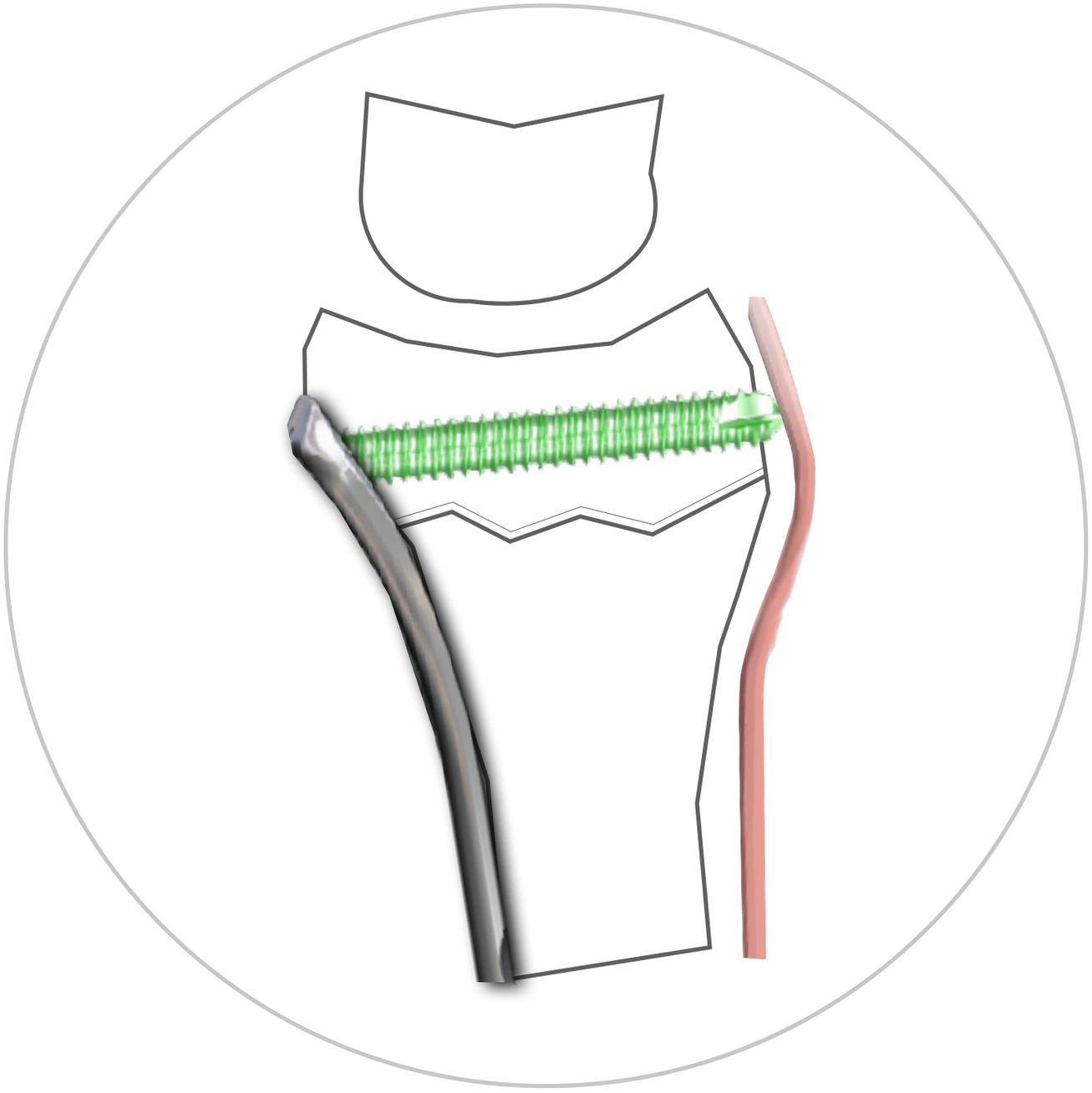


"Locked unicortical distal screws of at least 75% length produce construct stiffness similar to bicortical fixation"

Wall LB. 2012

The way a screw would normally function is to capture the opposite cortex and by tightening it it's bringing the plate into the near cortex, providing stability and compression.
A locked screw is different. What's the ideal screw length and what's the position of the screws related to the position of the plate? So, there have been several studies that have suggested that in simulated osteoporotic fractures with a locked volar plate that three-quarters of the length of from the volar to dorsal surface of the screws would be sufficient to provide satisfactory stability.

Extra-articular fracture



Because the difficulty, sometimes of understanding where the tip of the screw is related to the dorsal cortex, there have been very clear incidence of tendon ruptures on the dorsal side due to protuberance of the screws.

"In extra-articular distal radius fractures, distal locked screws should be 2 to 4 millimeters shorter than measured"

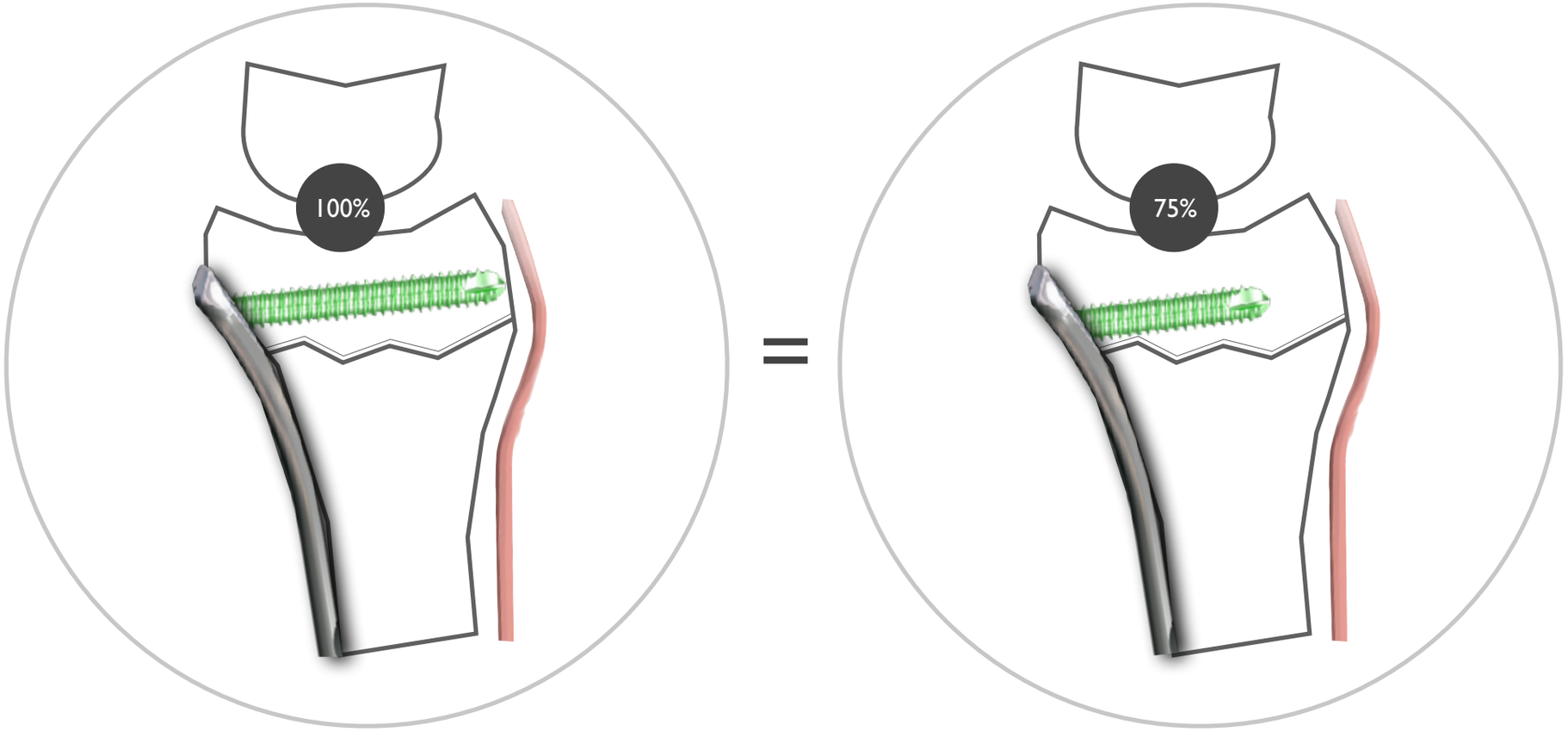
Jesse Jupiter.

"...to avoid dorsal tendon impingement and because the dorsal cortex bone purchase is not needed, as was well stated by LB Wall."

Wall LB1, Brodt MD, Silva MJ, Boyer MI, Calfee RP. 2012

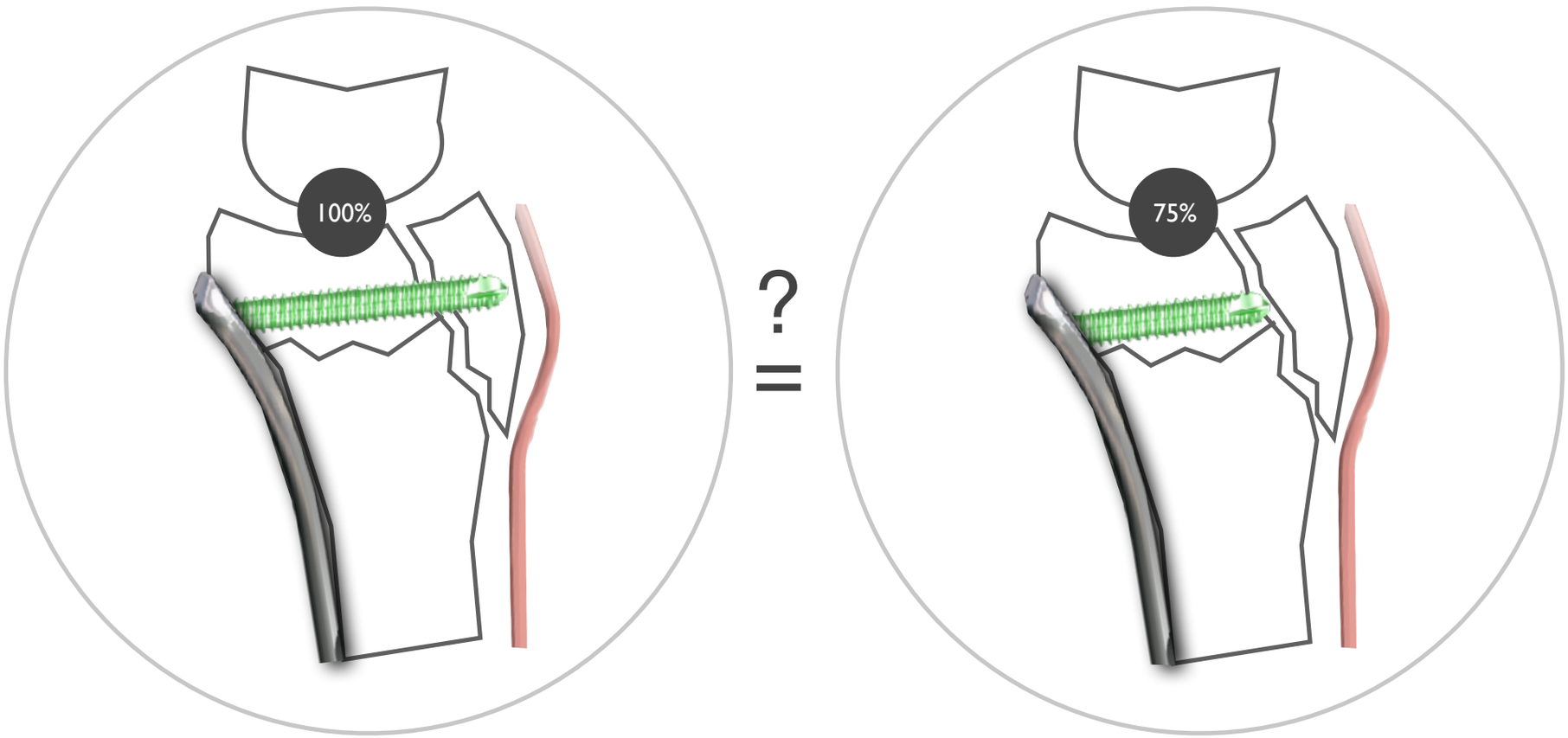
Therefore, by virtue of the understanding that enough stability can be provided without having screws go into the opposite cortex and the risk of future tendon problems. Most have suggested shortening the screw length to 2-4 millimeters below the cortex.

Extra-articular fracture



The question is: is this concept also valid for comminuted fractures or dorsally displaced dorsal ulnar fragments?

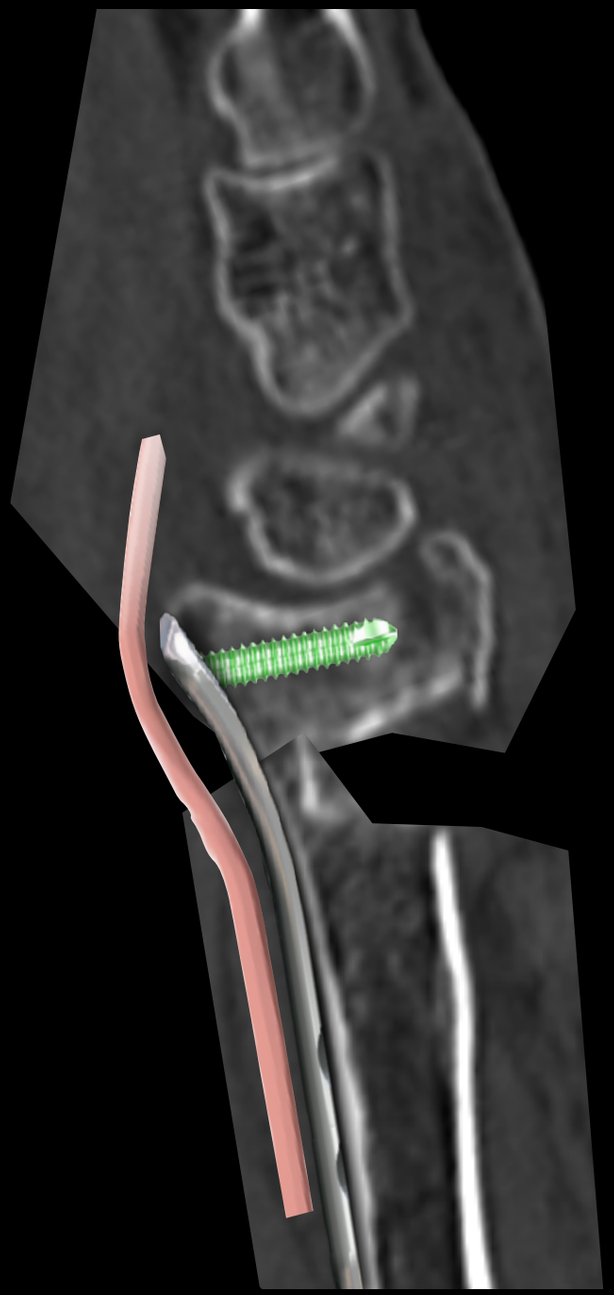
Dorsal ulnar corner fragment



ICUC

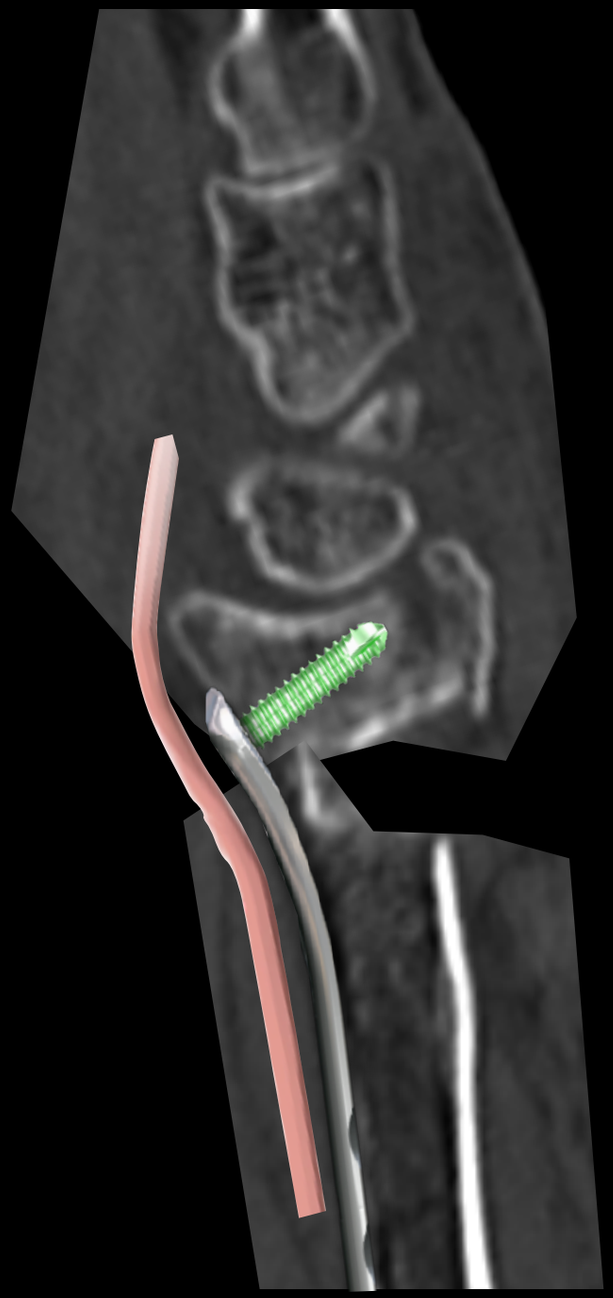
Is this concept also valid for comminuted fractures
or dorsally displaced dorsal ulnar fragments?

The other situation is whether or not we have dorsally displaced fragments that may be better attempting to capture those fragments with the screws.
So we're going to look at a few images to promote discussion on this subject.



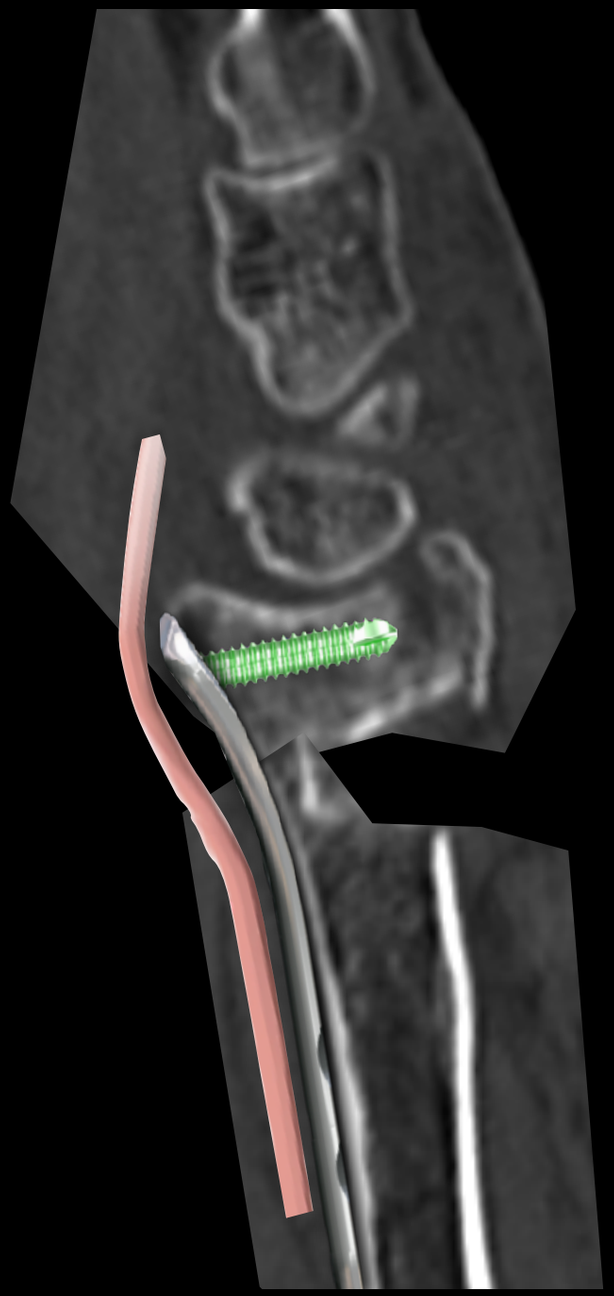
Protruding plate
good bone purchase

VS



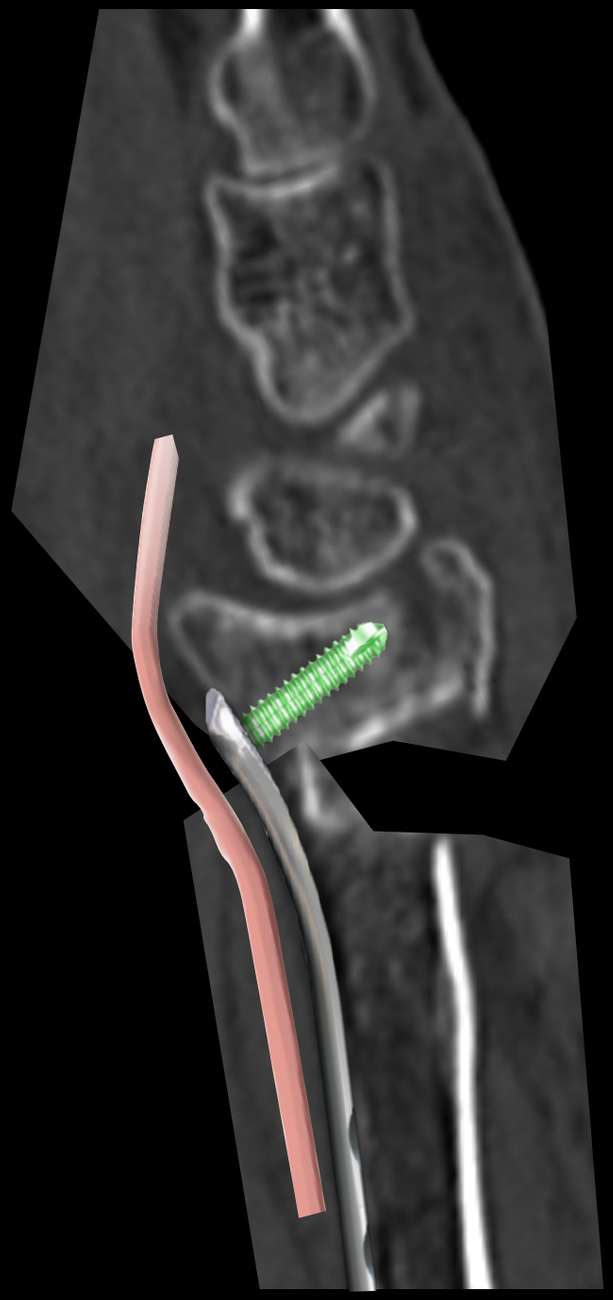
Not protruding plate
not so good bone purchase

In the first place, which is the ideal plate position? We've learned from several studies that if the implant extends distal to what might be considered a safe zone, its prominence can be a risk for tendon rupture.



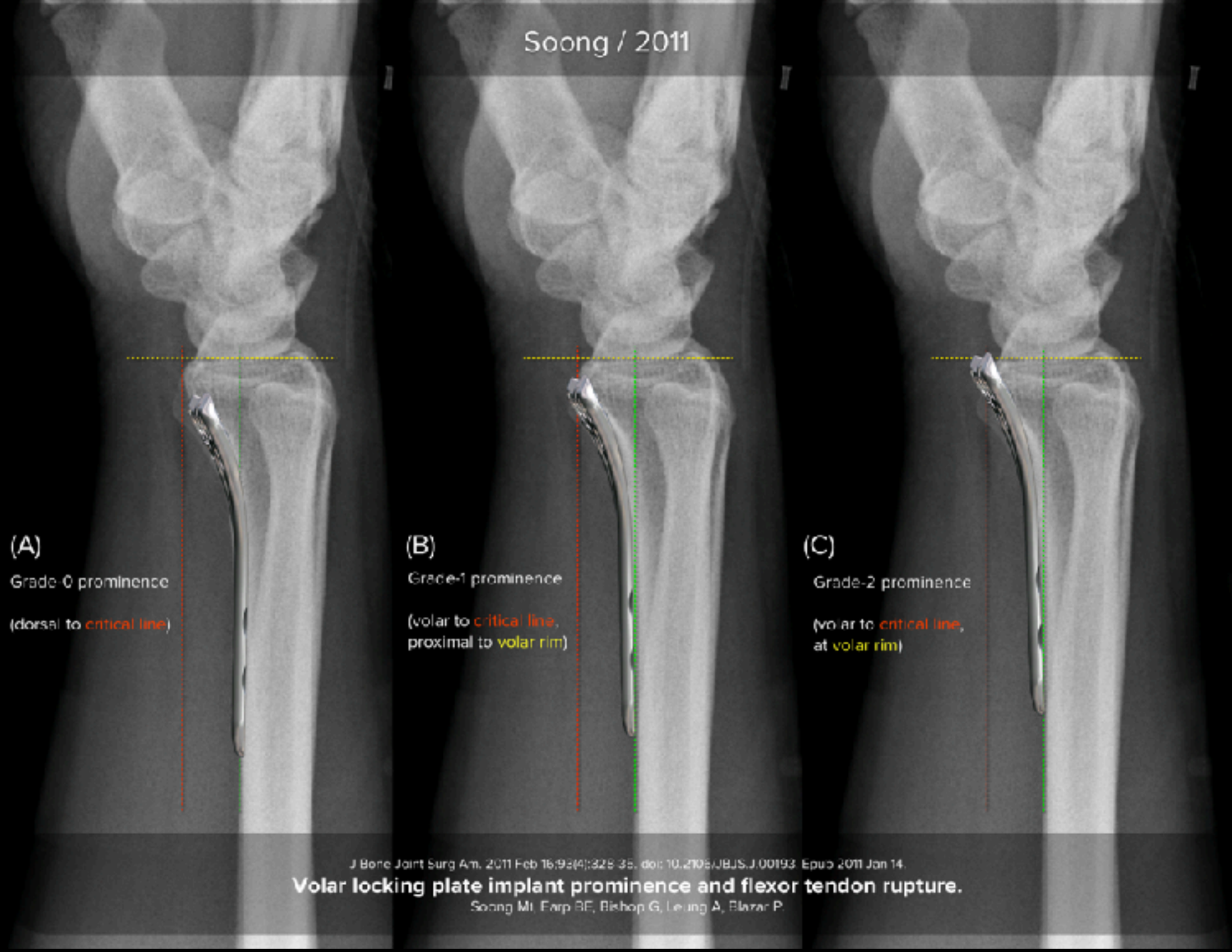
Protruding plate
good bone purchase

VS



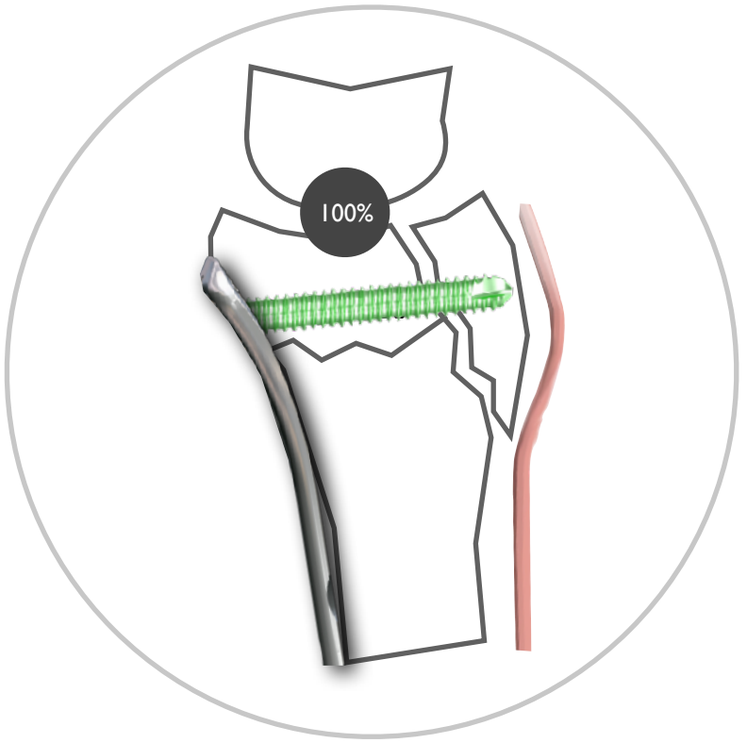
Not protruding plate
not so good bone purchase

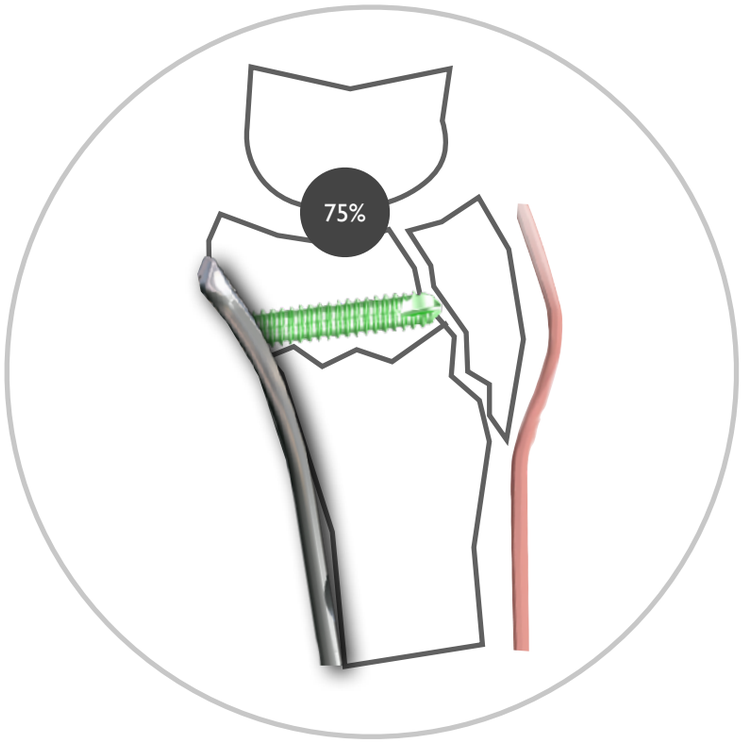
This position has been documented in several studies in North America and more recently a study by … in Hospitals for Special Surgery using ultrasound as demonstrated early tendon irritation way before clinical presentation in this situation of implants in a strategically risky position.

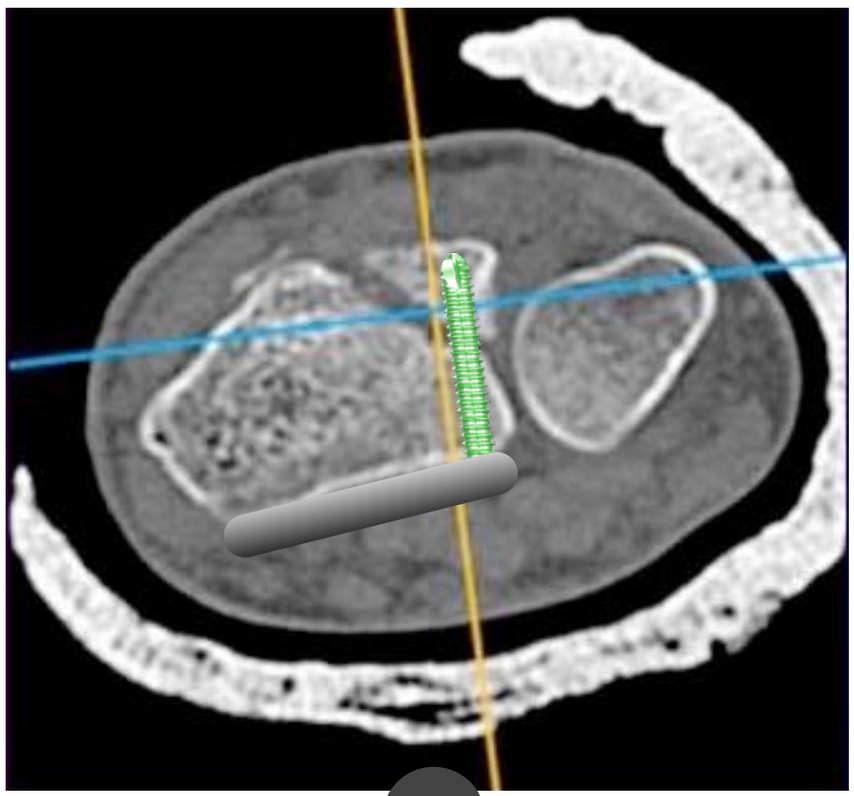


Well described by Soong, if you drop a line from the tip of the volar cortex, if the plate sits closer to the volar cortex, it's considered to be a safe zone; if we look at this then we realize if we drop this line the tip of this plate is sitting anterior to it and representing a risk factor.
We can look at a few images to promote discussion on this.

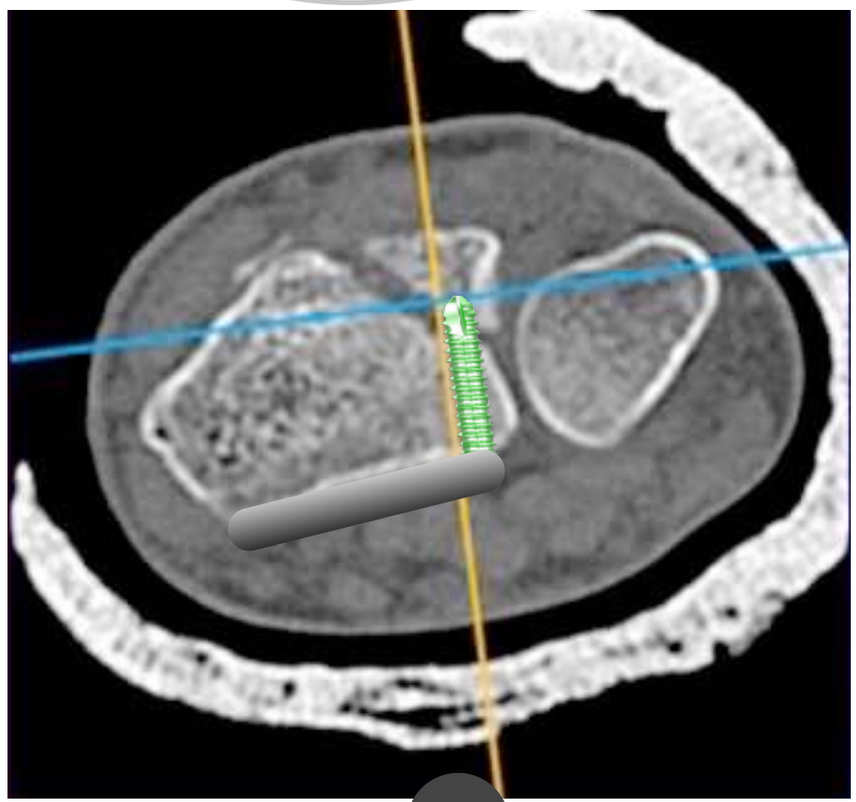
Dorsal ulnar corner fragment





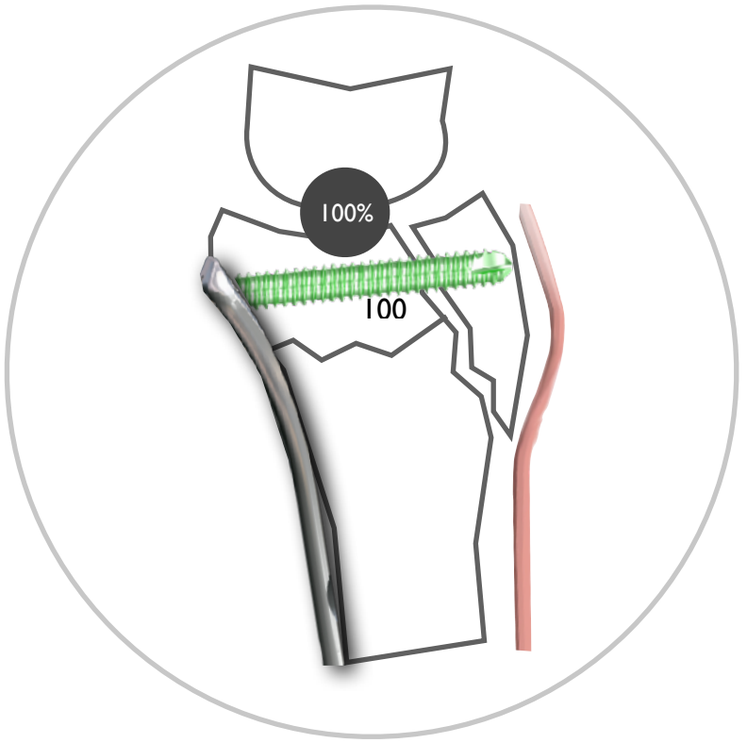


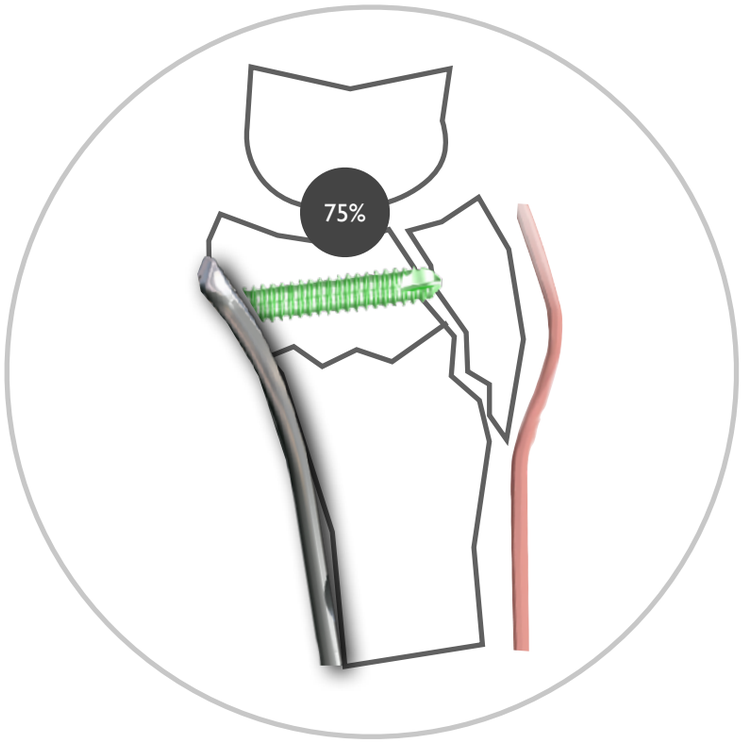
or

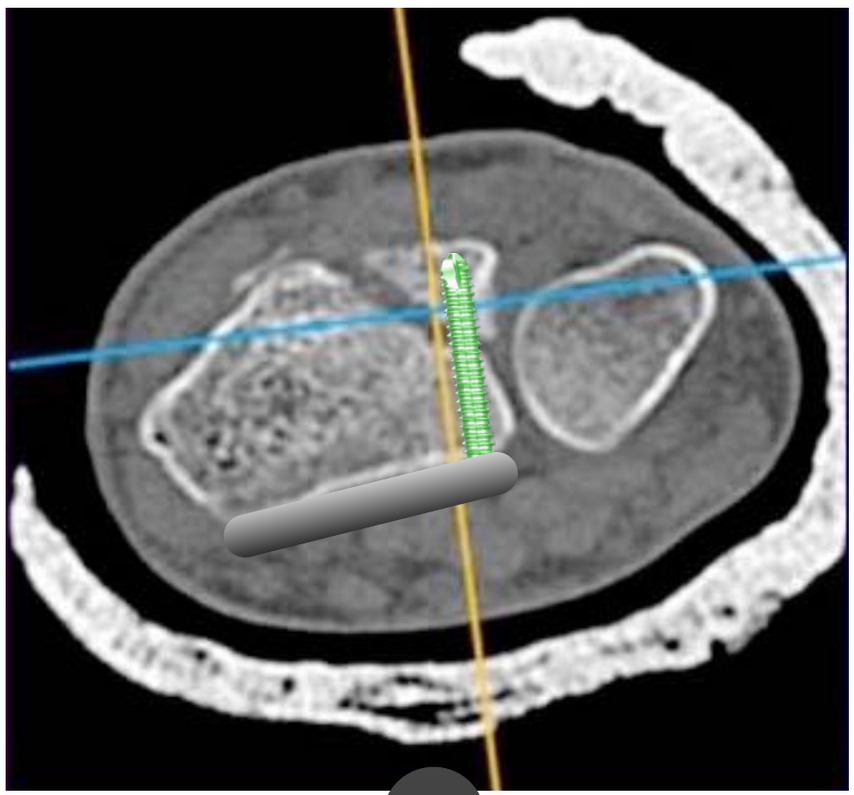


Cartoons or schematics throughout this presentation will show this difference, it will show screw position and length as well as plate position and length and look at how both may influence stability.

Dorsal ulnar corner fragment







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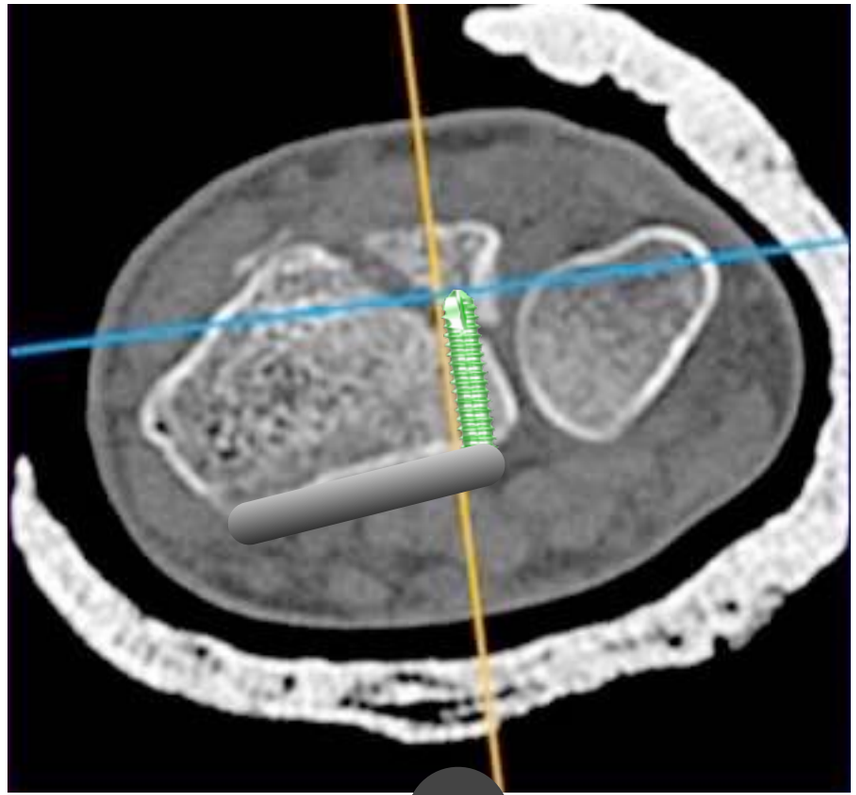


We're also seeing on this cross-sectional CT scan, we have a good bone-purchase screw coming from a plate that's in an incorrect position, in the sense of being too distal and being within the unsafe zone described by previous investigators.

We include a few case images to promote discussion on the subject.

ID: 23-DC-954

ID: 23-DC-256

ID: 23-DC-250

ID: 23-DU-968

ID: 23-DU-958

ID: 23-DU-212

We can look at a few images to promote discussion on this.

Back to Search 18:01 27%

< Distal Radius / Complex Case 65 of 68

ID: 23-DC-954 / 70y

Overall Assessment: To be discussed

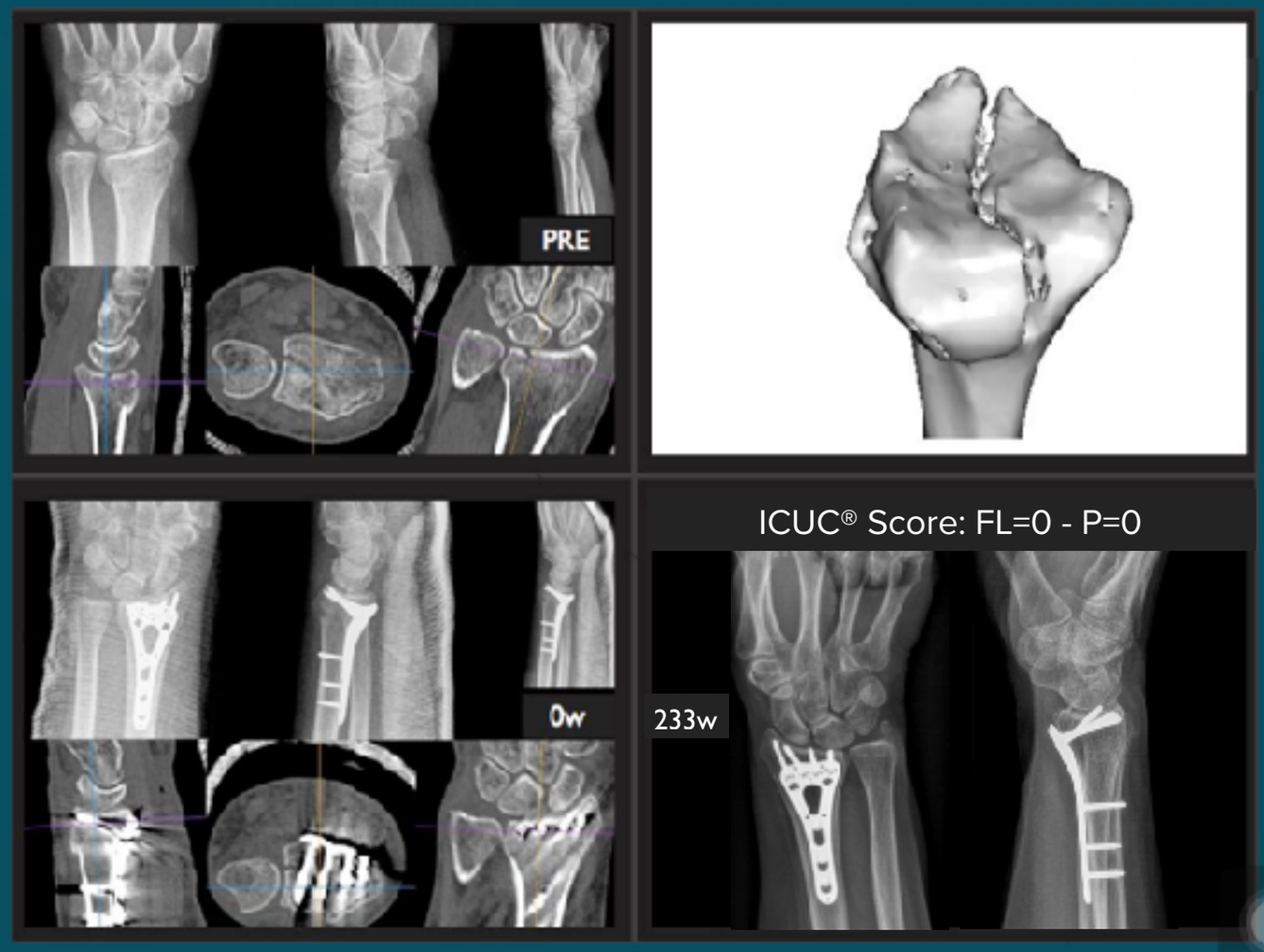
AO: 23-B

<1 Week

Broken Ulnar Styloid

SURGICAL APPROACH
Volar approach. Variable angle plate.

SUMMARY
S_ dissociation?

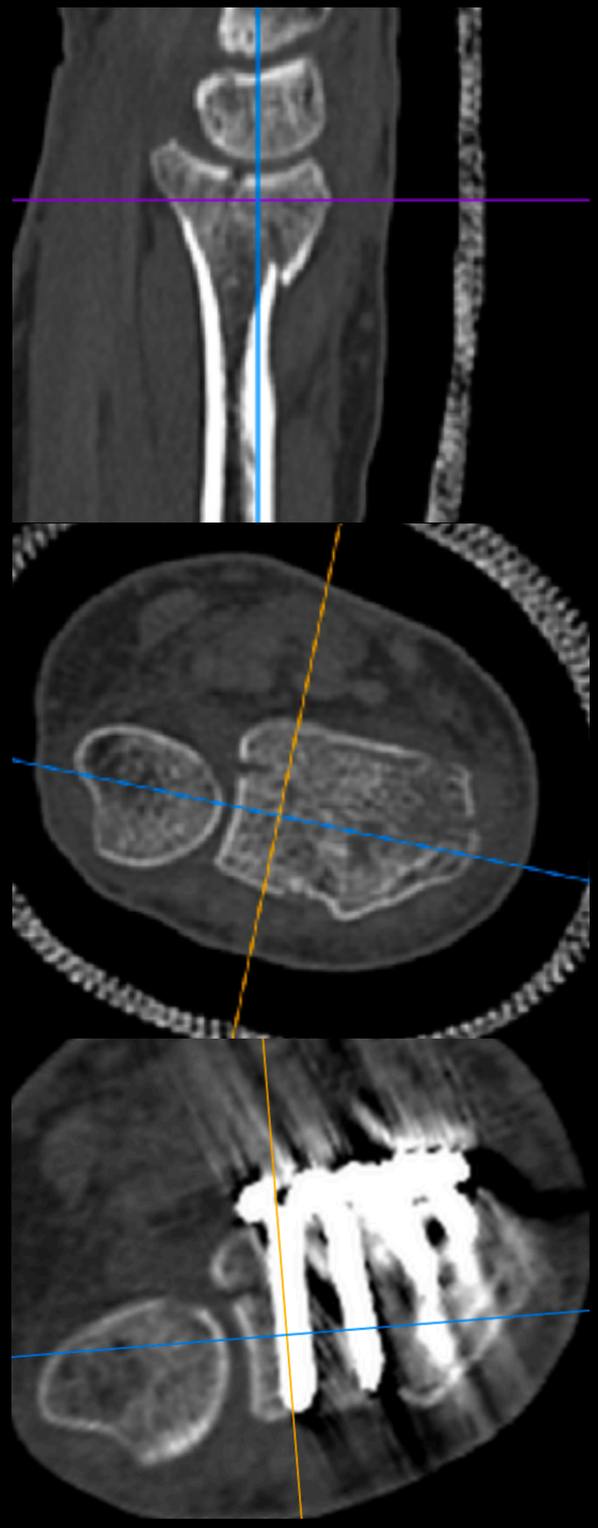


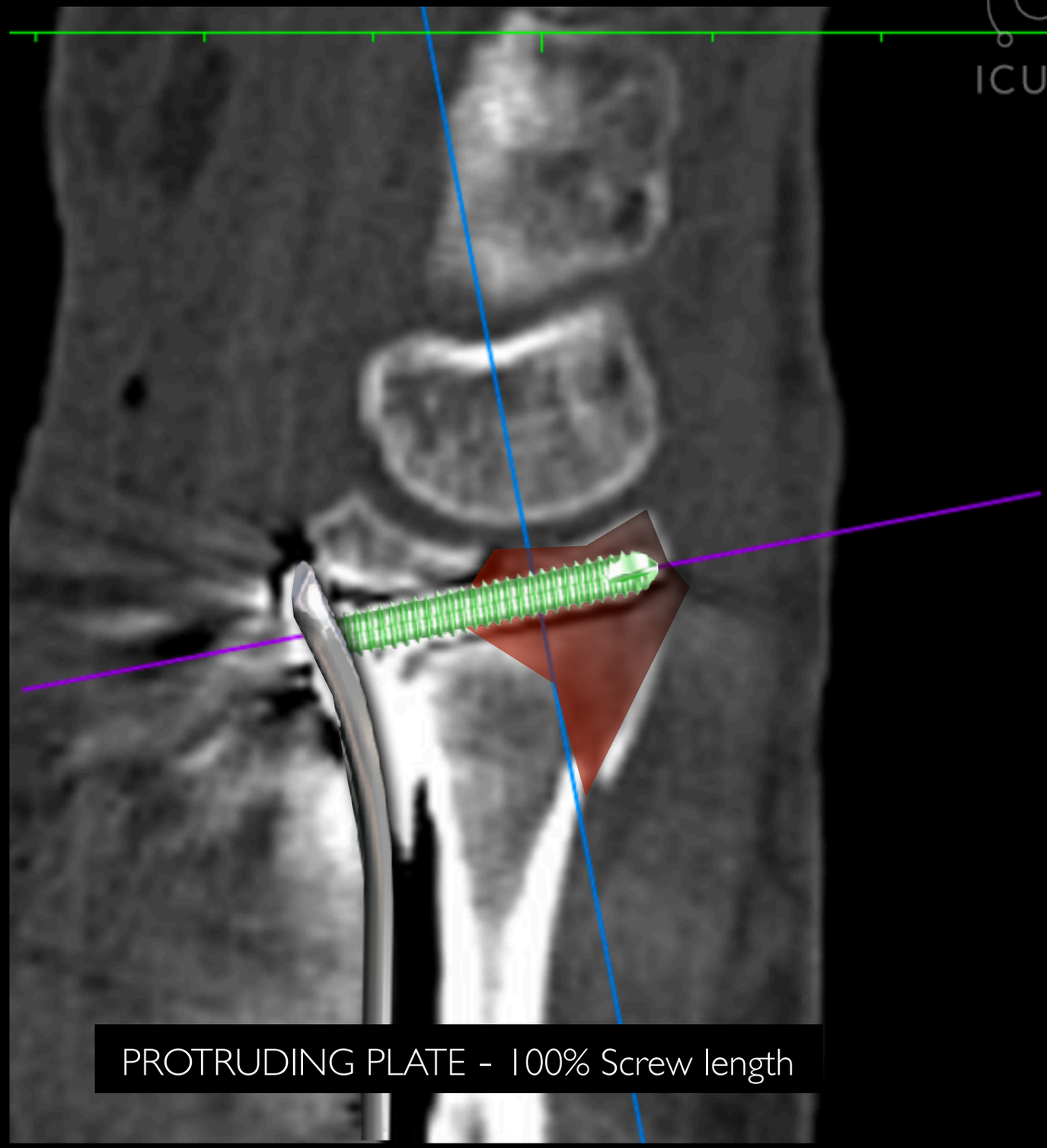
DISPLACEMENT ●○○ COMPLEXITY ●○○

REDUCTION ●●● IMPLANT POSITION ●●○

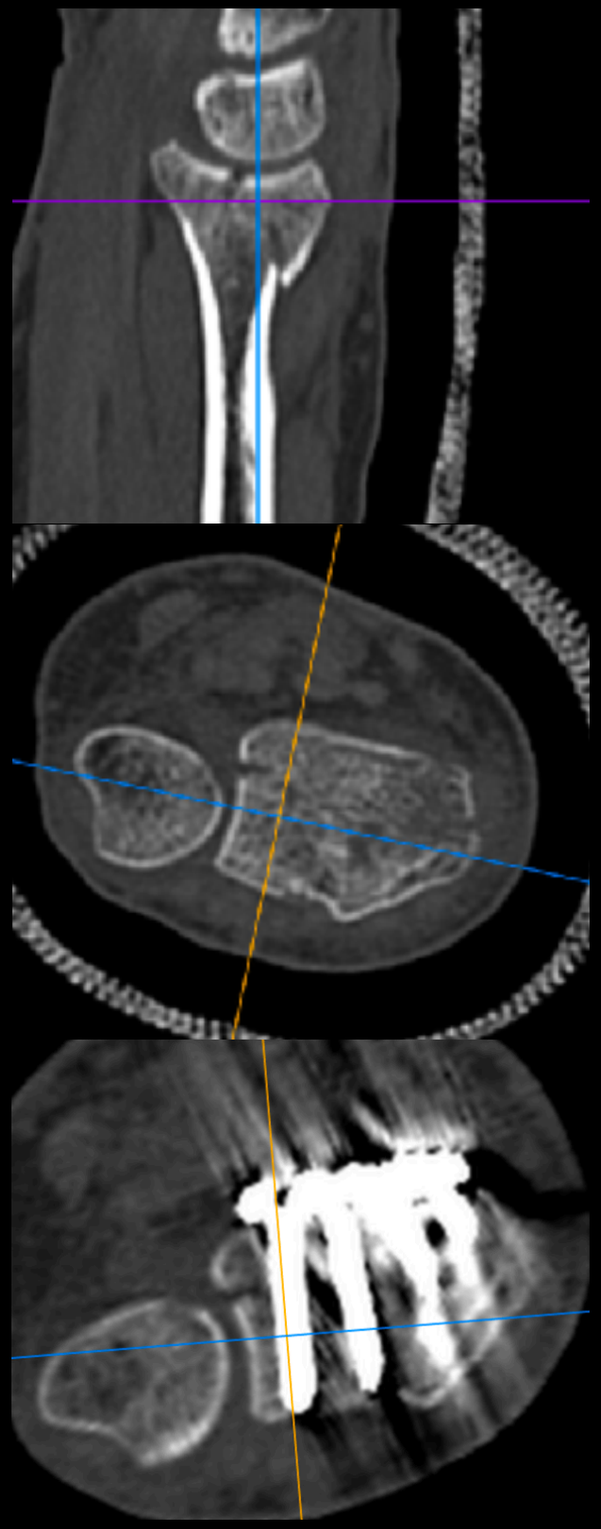
Ulnar Corner | Complex | Extra Articular | Simple

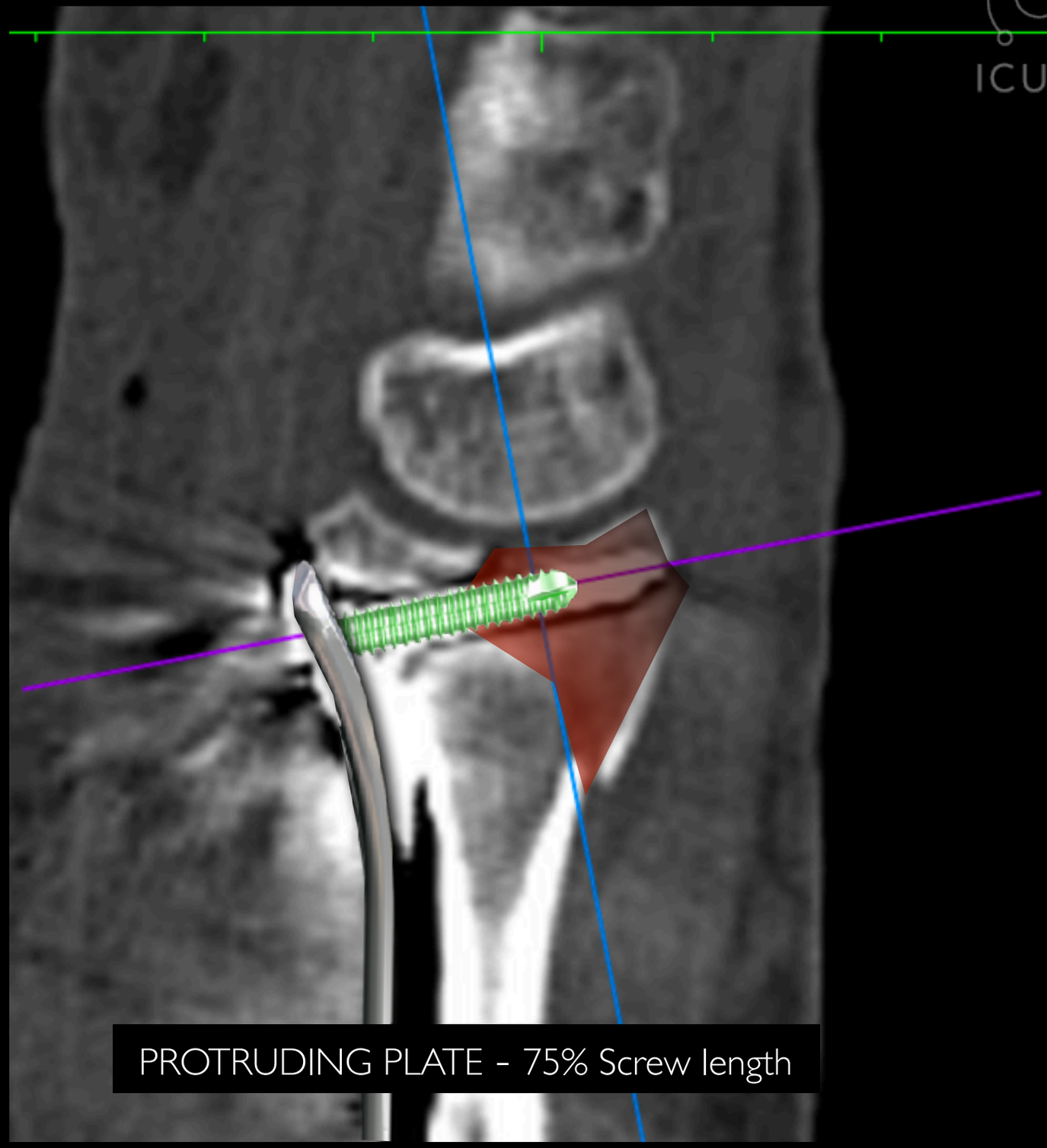
These images come from the ICUC database, that has data of the images, the care and the outcome from start to finish.



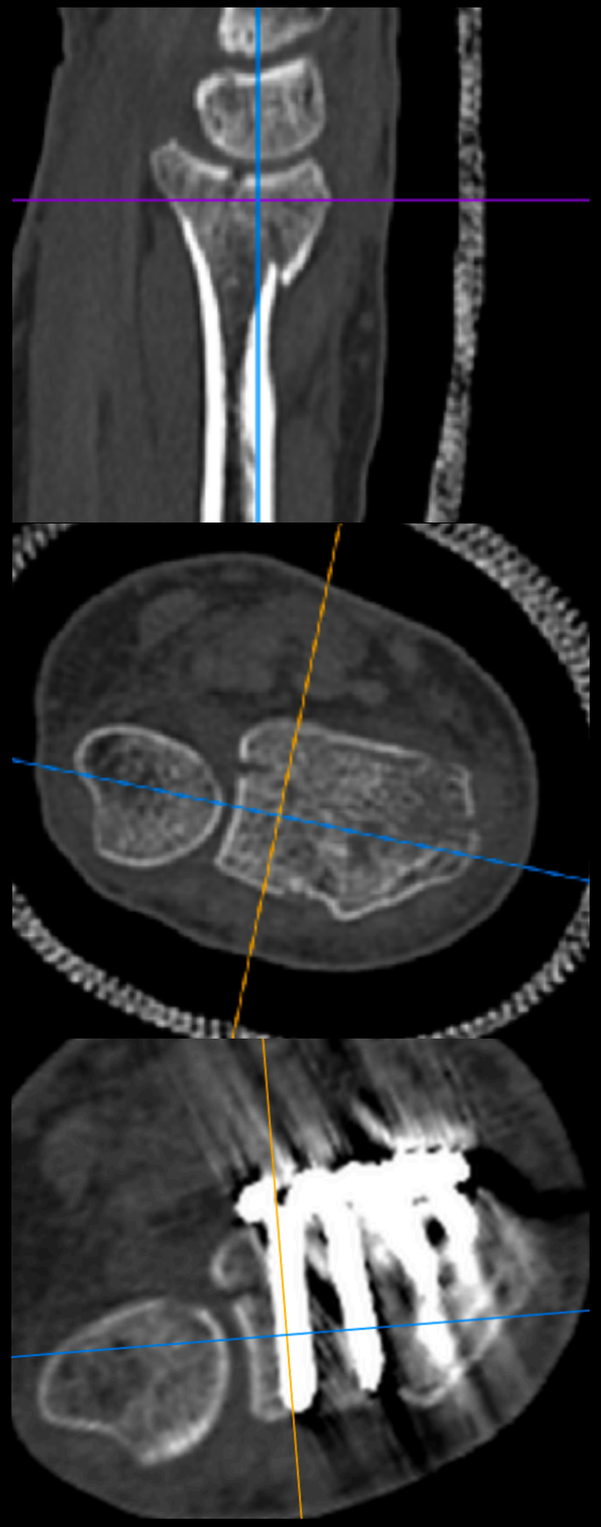


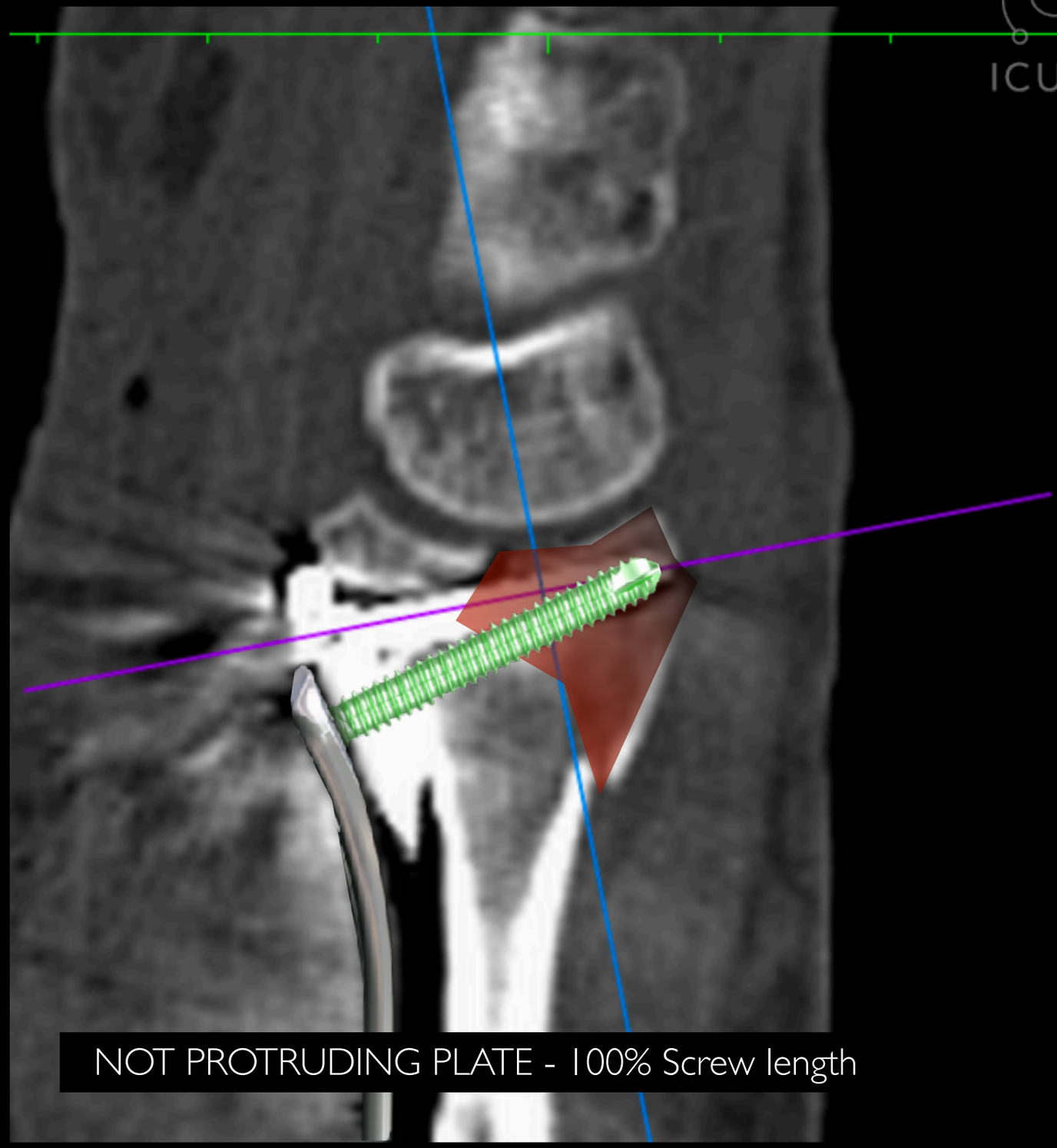
We've Illustrated to help understand this by schematic and coloring the fragments, but here's a case where the screw has captured into a large dorsal fragment; certainly this would seem very appropriate given the dimension of this dorsal fragment. This is an unsafe plate position.



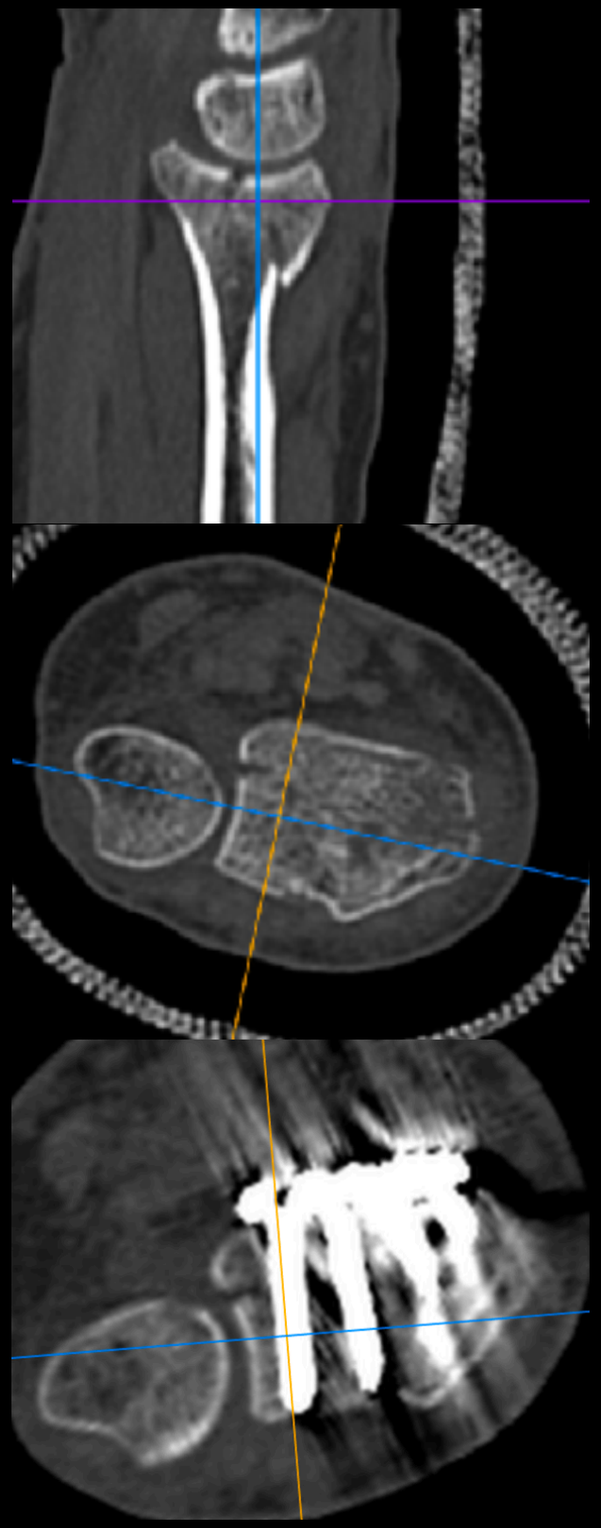


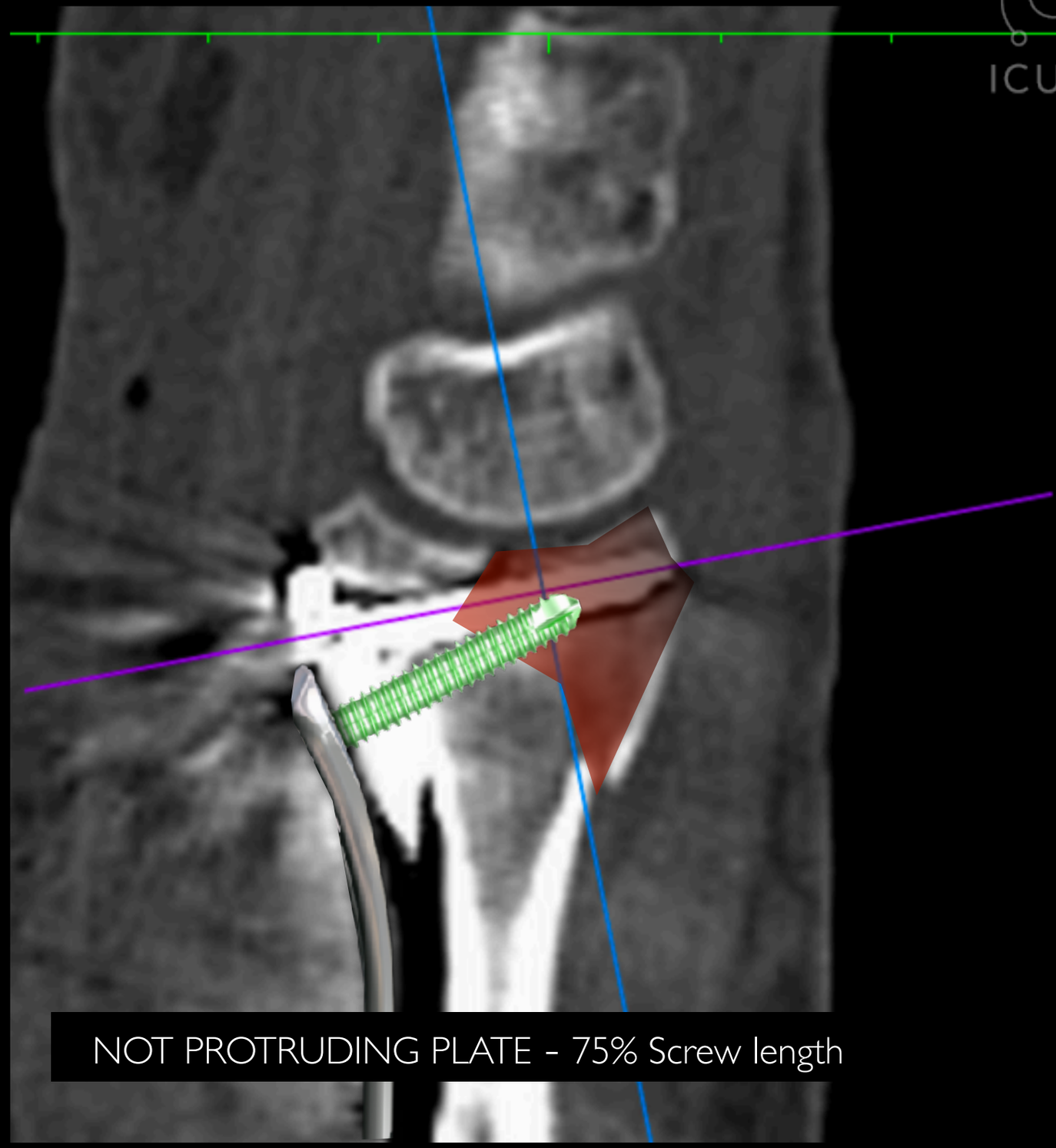
We have less amount of a screw into the bony fragment
Is this screw catalogued as stable as the first one?



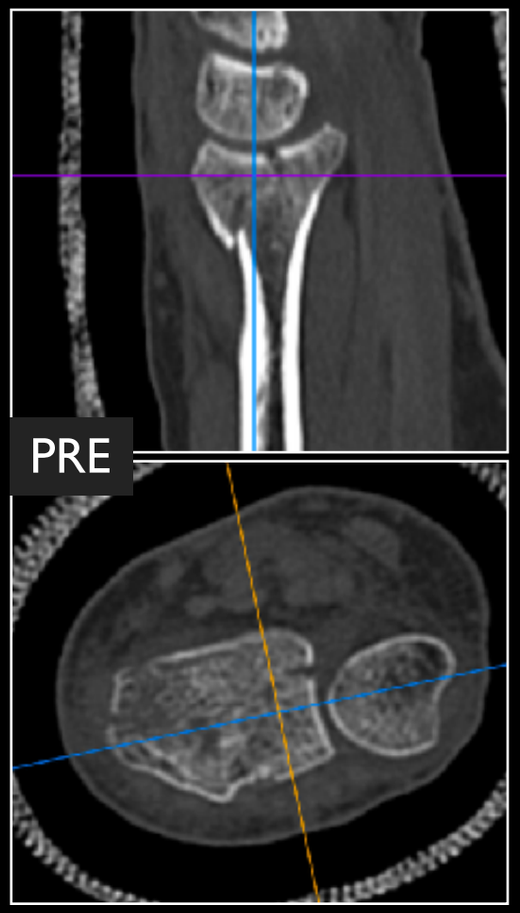


We have here a plate in a safer position. Is this screw catalogued as stable as the first one?
We don't know but many would believe it is.

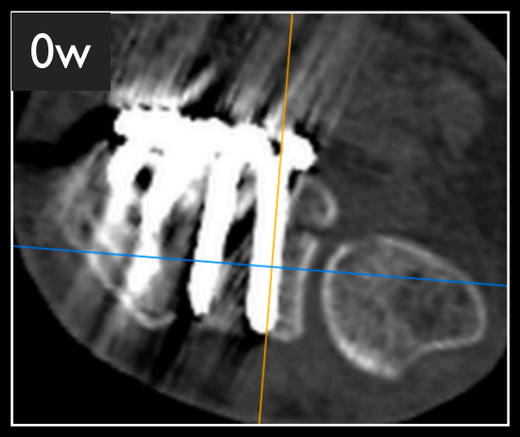




Is this screw catalogued as stable as the first one? We don't know but many would believe it is.



PRE



0w

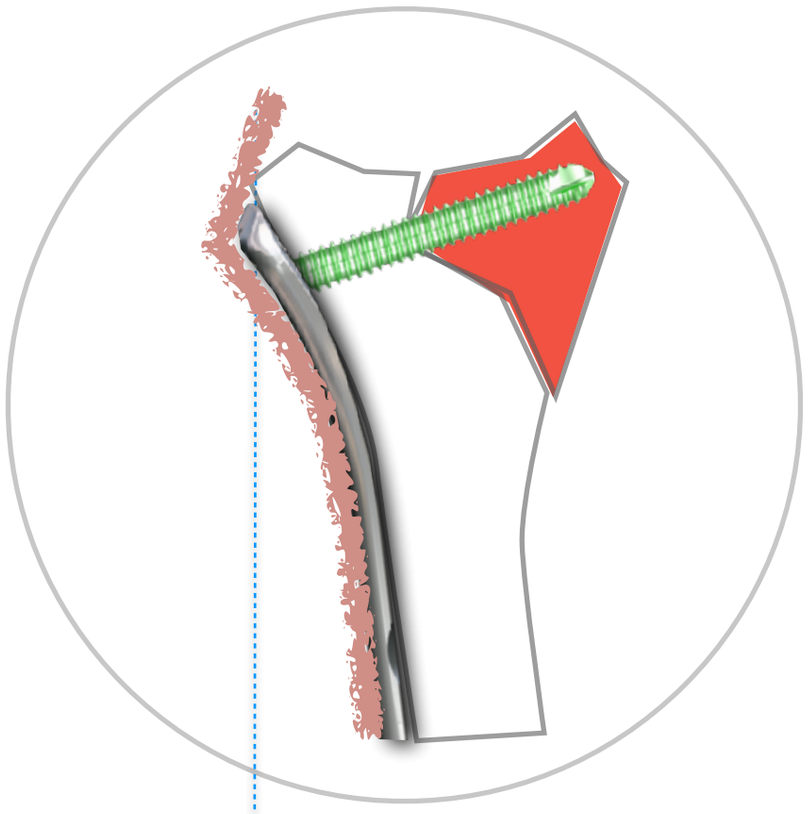
223w

ICUC® Score: FL=0 | P=0

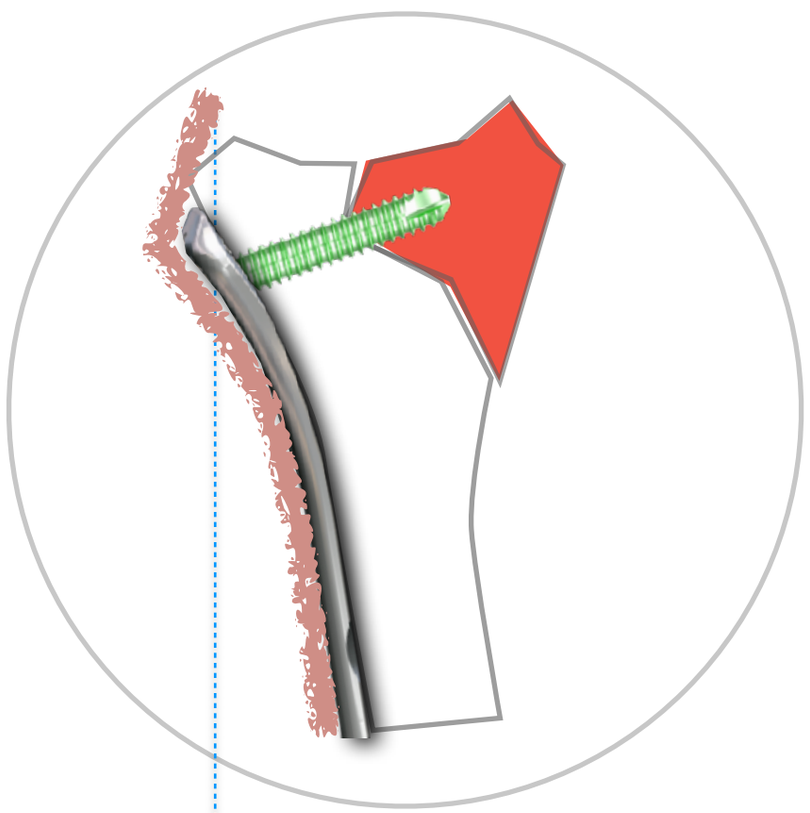
And here strength of the ICUC database is a long-term follow up with both functional patient rated and radiographic evaluation.

PROTRUDING PLATE

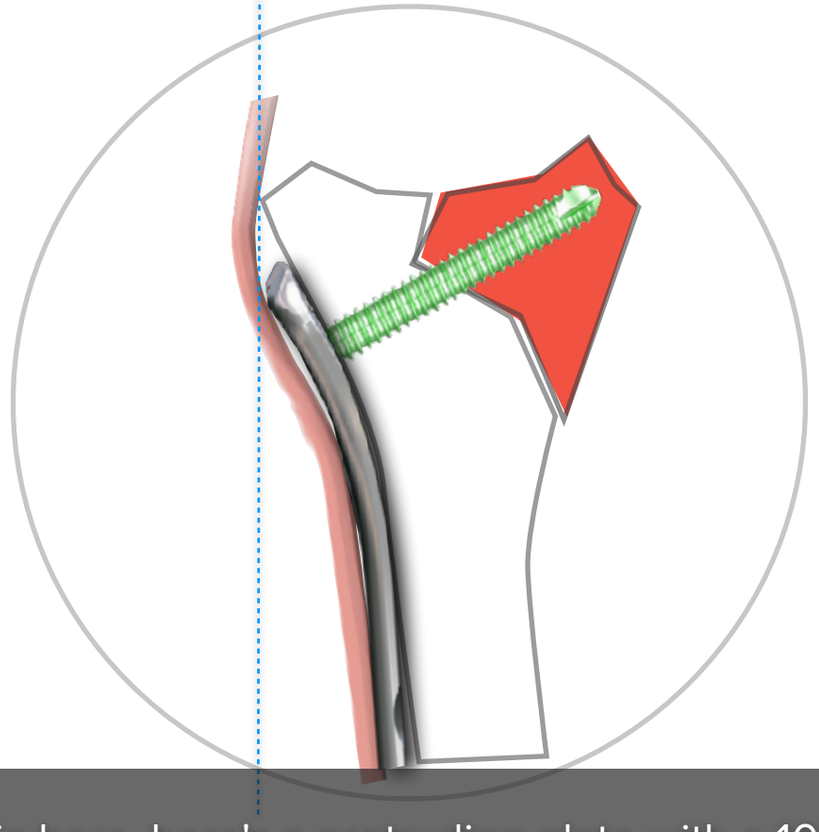
100%

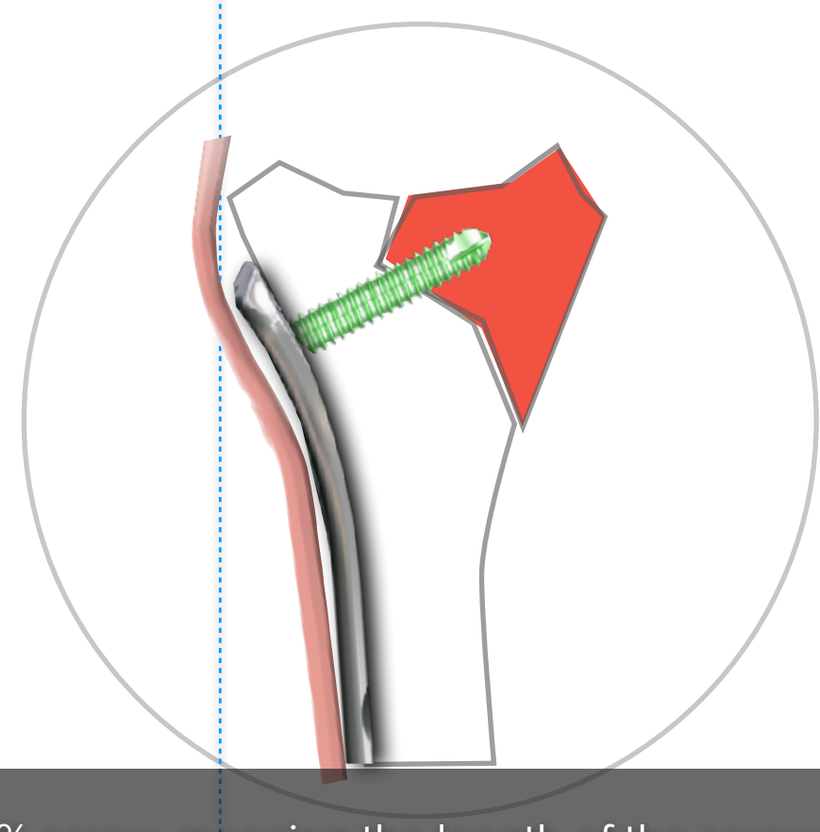


75%



NOT PROTRUDING PLATE

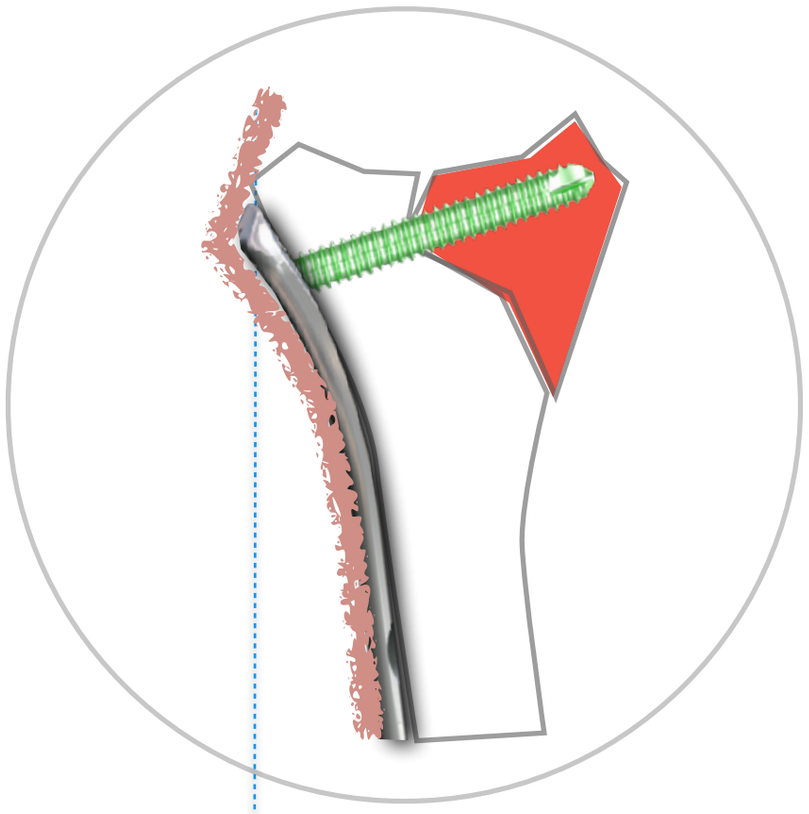




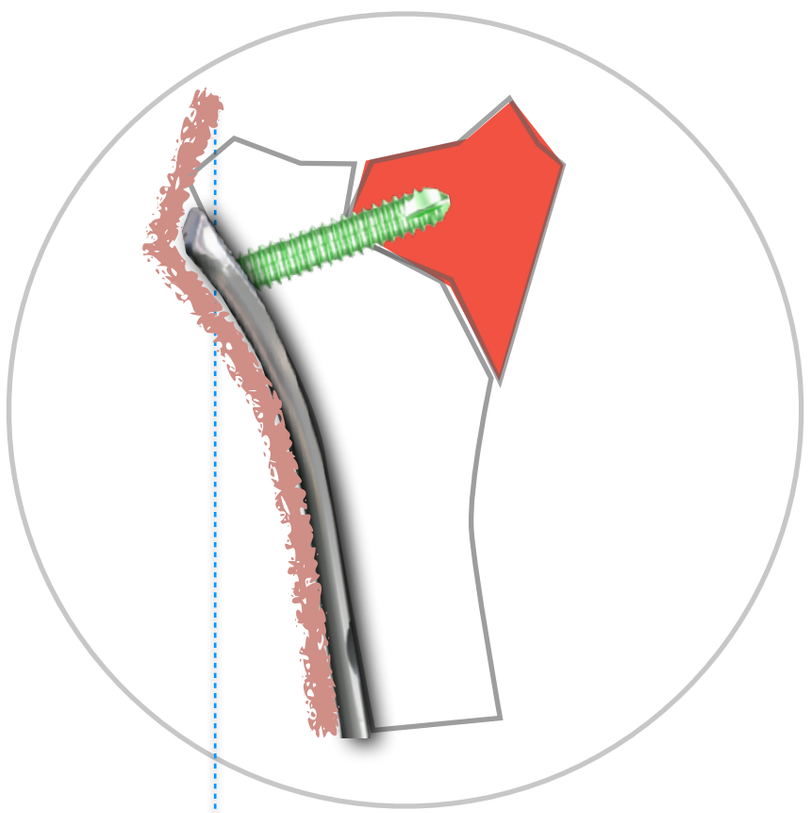
And if you look at this schematic here, here's a protruding plate with a 100% screw, meaning the length of the screw, going all the way through the dorsal fracture fragment versus a protruding plate with less option and capturing this.

PROTRUDING PLATE

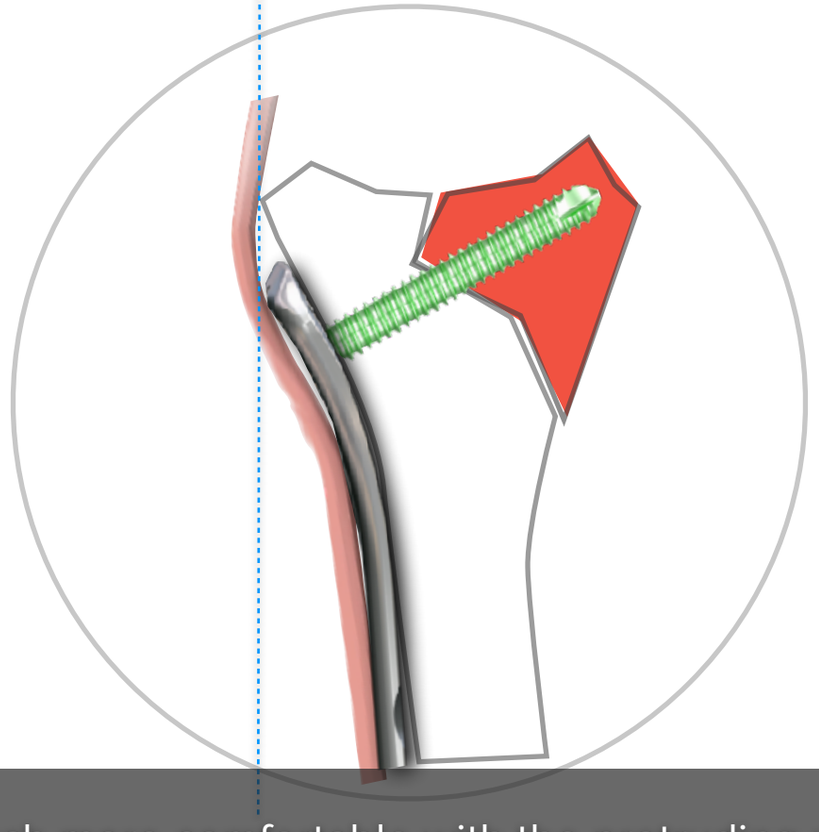
100%

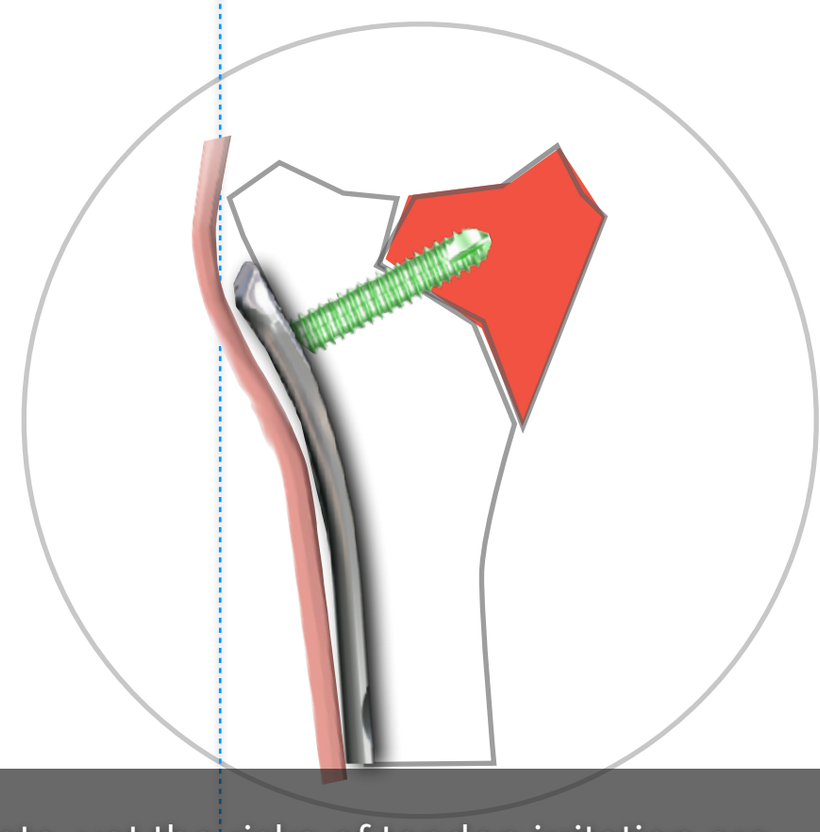


75%



NOT PROTRUDING PLATE





Certainly, one would feel much more comfortable with the protruding plate, yet the risks of tendon irritation are substantially greater. And we believe that the capture can be done equally as well with the plate in a safe position.

"...rupture of these flexor tendons can occur almost at any time, unpredictably after volar plating. Enough so to begin to think that perhaps, especially in patients under the age of 45, all plates should be removed."

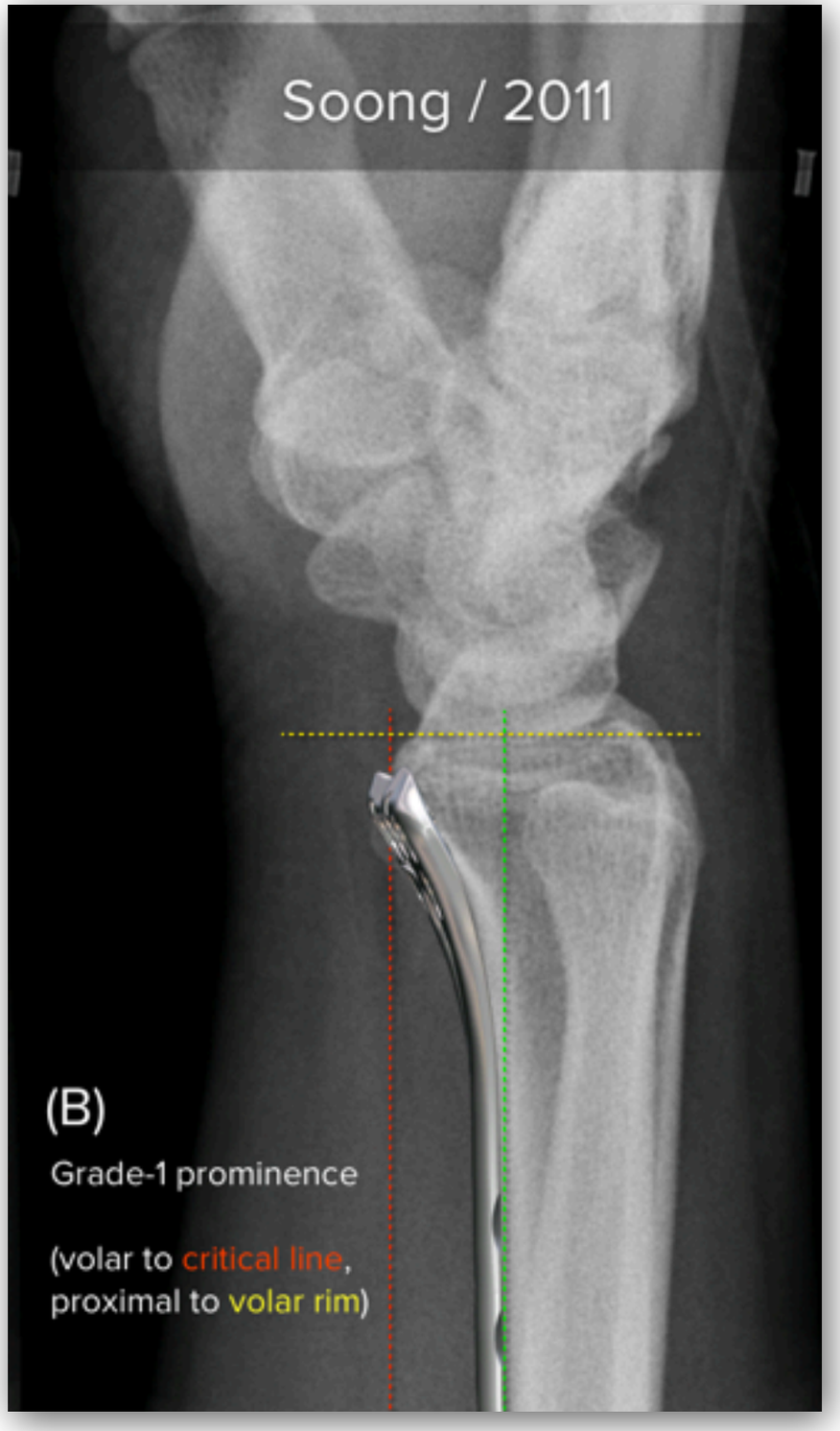
So we wonder about both plate position and screw length and whether or not one is important enough to warrant, that is capturing the dorsal lunate facet, important enough to place the plate in a less optimal position.

We would agree that striving to put the plate in a better position, using the screws to grab the large facet, but perhaps using angular stable fixation, would be preferential to having the plate more distally and having a more vertical placed screws, which may support the subchondral bone a little bit more appropriate theoretically.

The messages here are two:

One is the fact that we have identified that the placement of the plate on the volar cortex is very important as people's experience extends longer and longer.
We've come to realize that there is a risk of a volar plate causing tendon problems.

Remember that the concept for volar plate, for dorsally displaced fractures, was so appealing because it might minimize the extensor tendons problems we used to see with dorsal implants. But as we become critical in our analysis of outcome, we've come to realize that the volar plate can cause flexor tendon problems particularly with flexor pollicis longus.



Can this happen on a time related basis?

It does not appear to be.

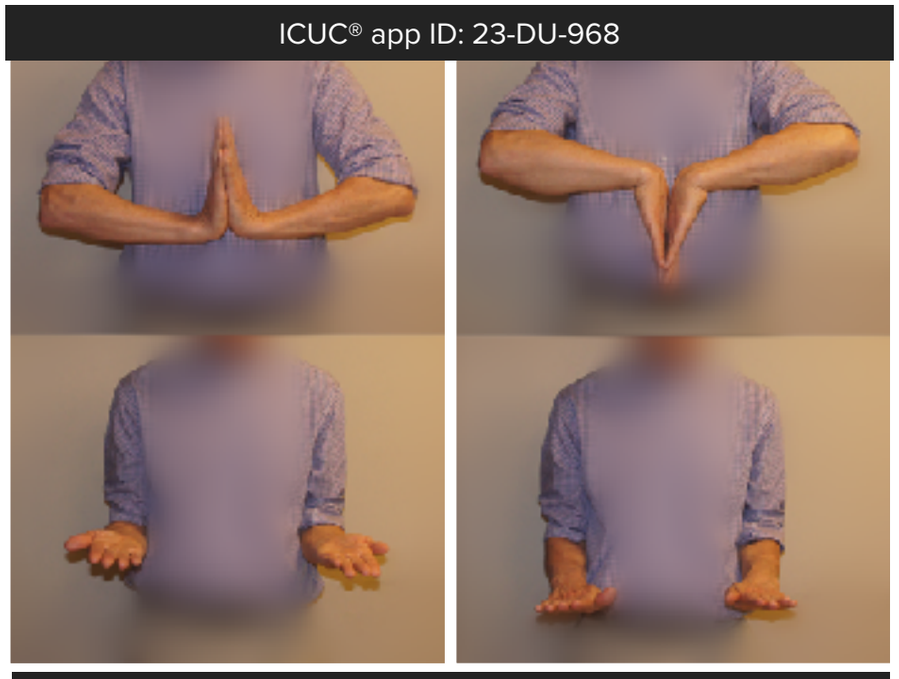
Can this occur in patients who’re not having symptoms?

It certainly can.

Can it be more complicated if an implant is placed outside the safe zone?

Absolutely.

And so, if it requires the placement of a plate more distally , in order to get an adequate reduction and stabilization, perhaps that's ok, but we are now believing more and more that one should recommend a plate removal at a certain period of time, particularly in younger individuals.

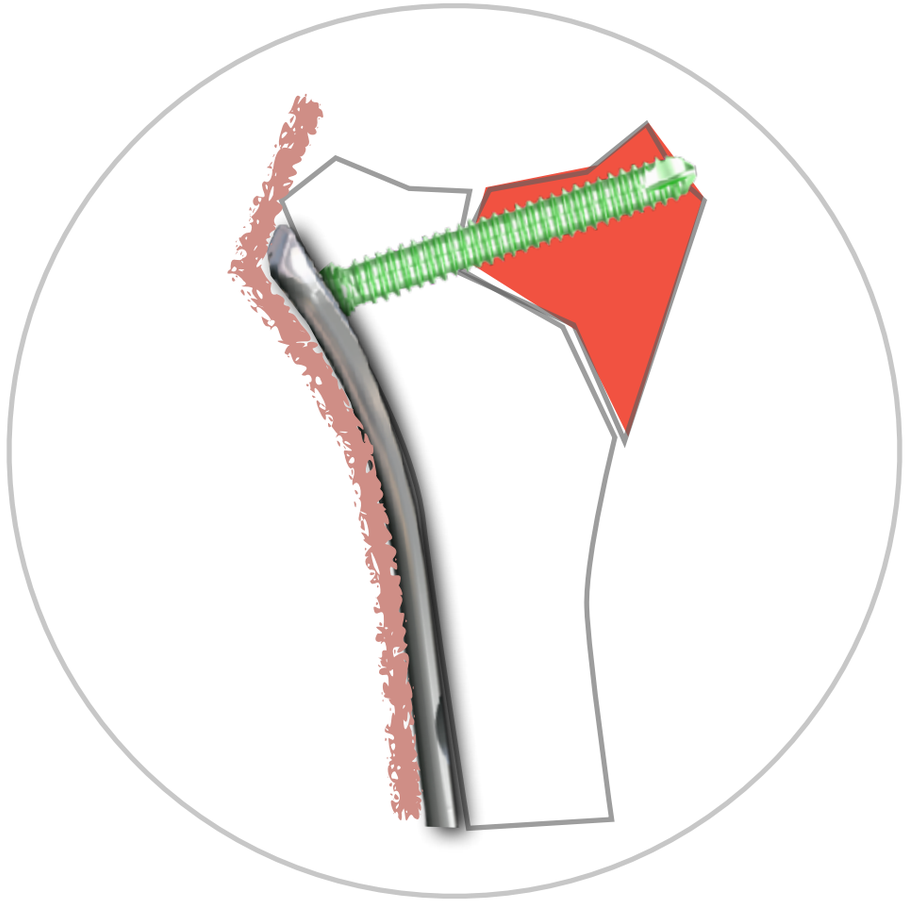


21w after implant removal
ICUC® Score: FL=1 - P=0

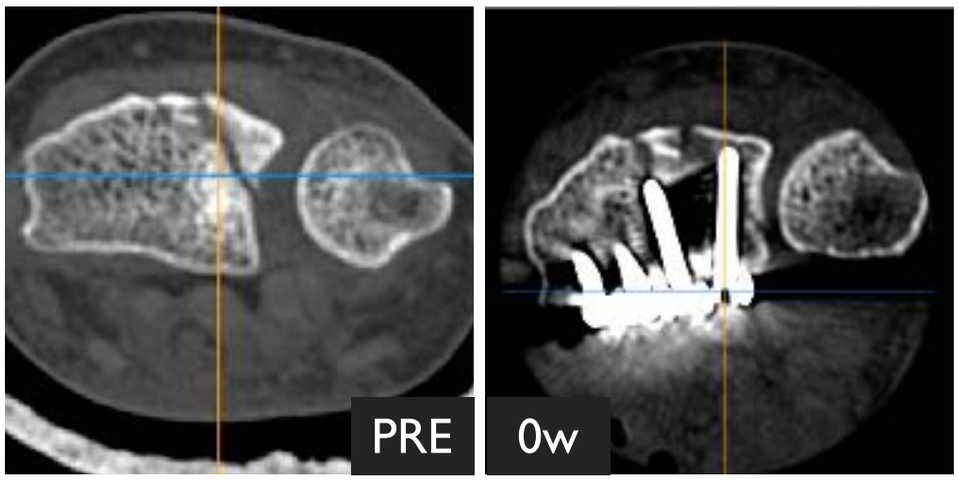
0w after Implant removal

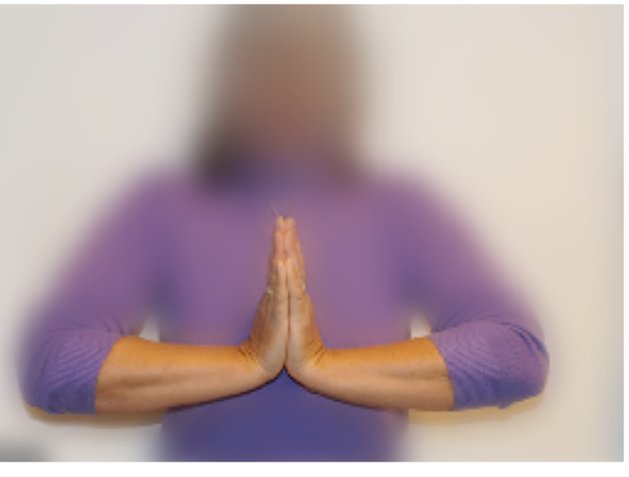
The second critical aspect is, can a screw be used, although it’s not functioning truly like a screw, to help stabilize control dorsally displaced fragments, particularly the lunate facet, and we think it can in a large fracture fragment it requires extension of the screw into the bulk of the fracture fragment.

But we still believe that one has to be very cautious extending it beyond the cortex due to the risk of tendon problems.



The data in this ICUC data collection, support the clinical observation of prior publications regarding the risk of tendon problems with the plate positioned and the outcome of use of the volar plate, if this is looked out carefully and grabbing the dorsal lunate facet with the screws has shown on long term follow up to be very effective.





ICUC® Score: FL=0 - P=0

We include a few case images to promote discussion on the subject.

ID: 23-DC-954

ID: 23-DC-256

ID: 23-DC-250

ID: 23-DU-968

ID: 23-DU-958

ID: 23-DU-212

Let's look at this patient:

ID: 23-DC-256 / 70y

Overall Assessment: To be discussed

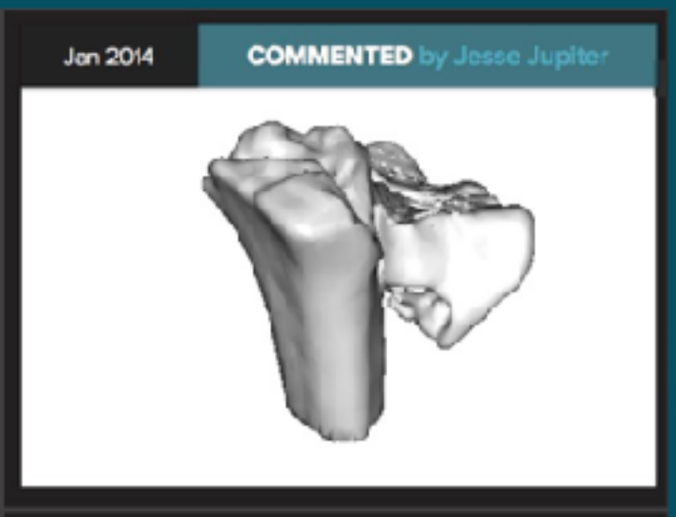
AO: 23-C

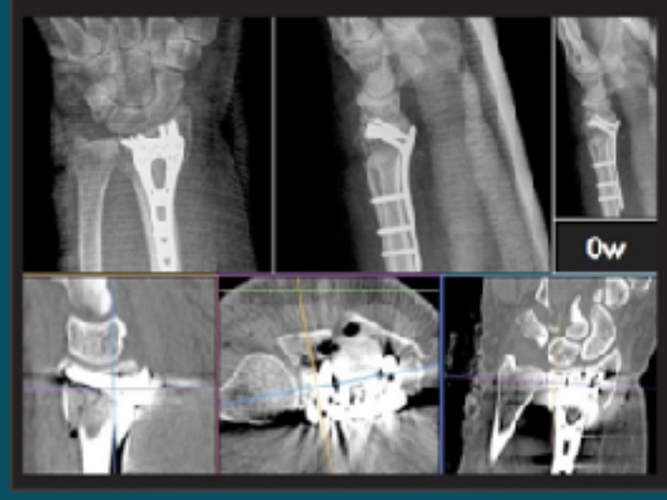
< 1 Week

Open

SURGICAL APPROACH
Volar approach. Variable angle plate.

SUMMARY
Short distal fragment.

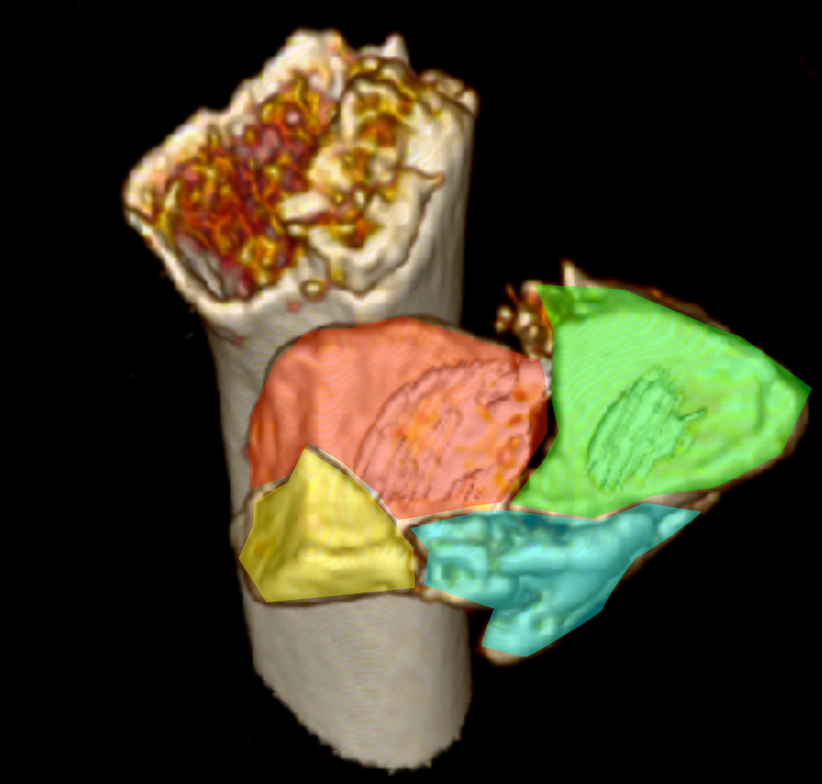


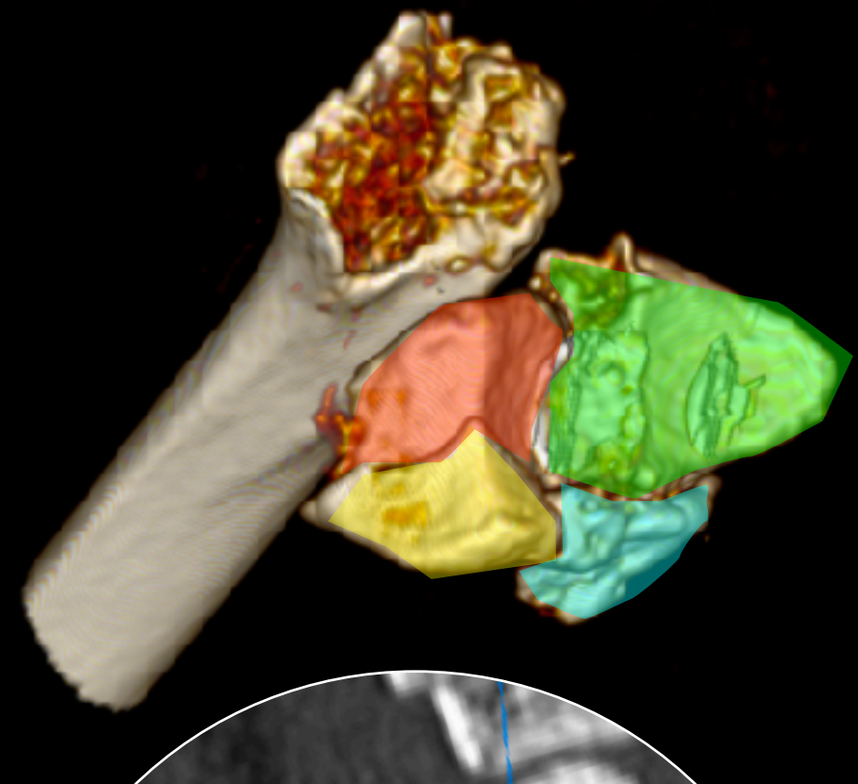


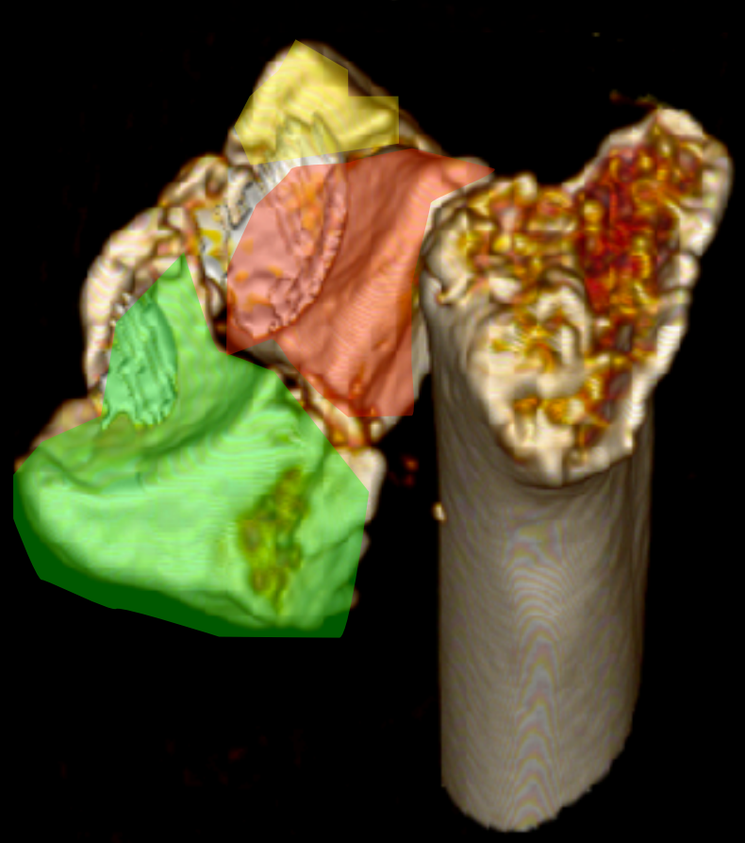
DISPLACEMENT ●●●
COMPLEXITY ●●●
REDUCTION ●●●
IMPLANT POSITION ●○○

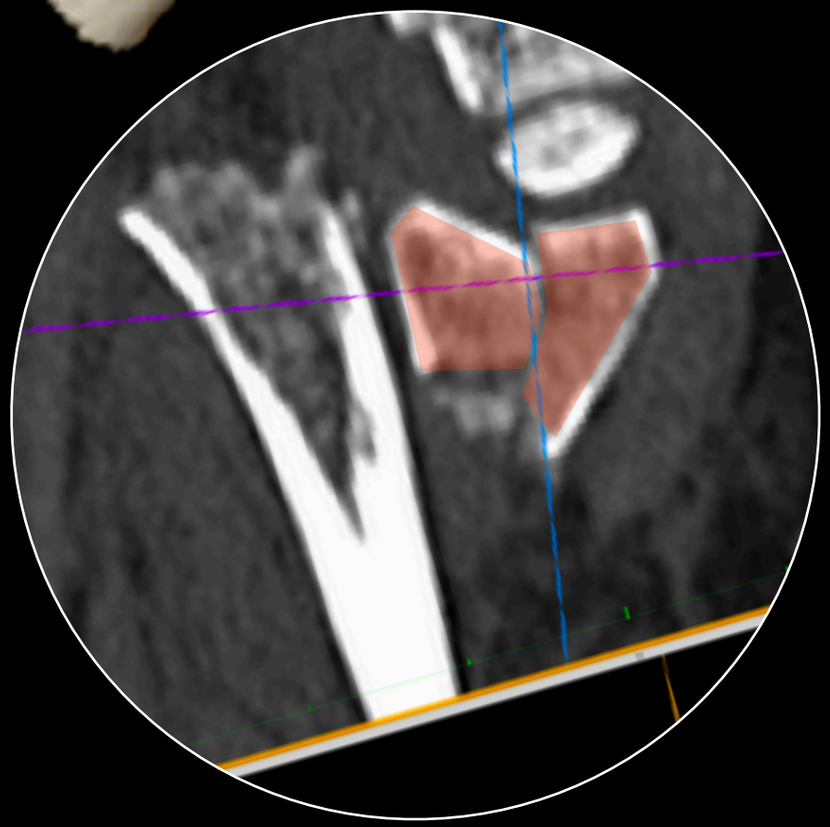
Ulnar Corner | Central Impaction | Complex | Extra Articular | Simple

Here has a very displaced multi articular fracture...





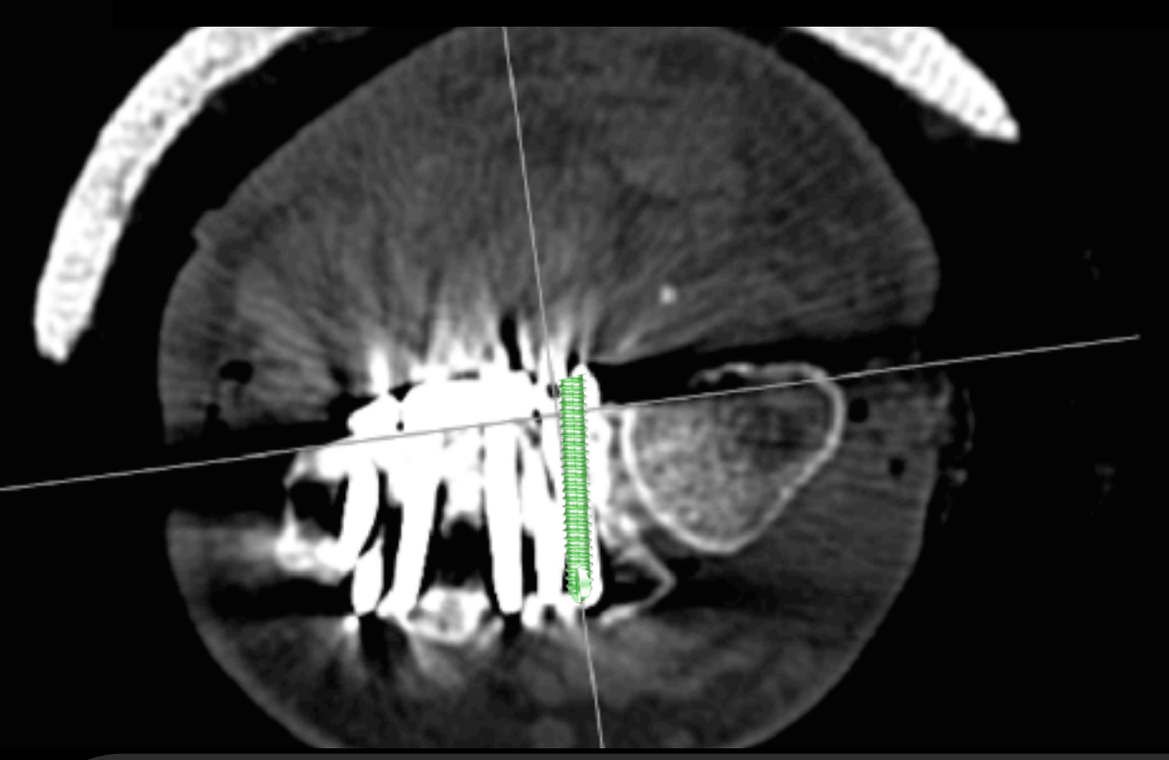


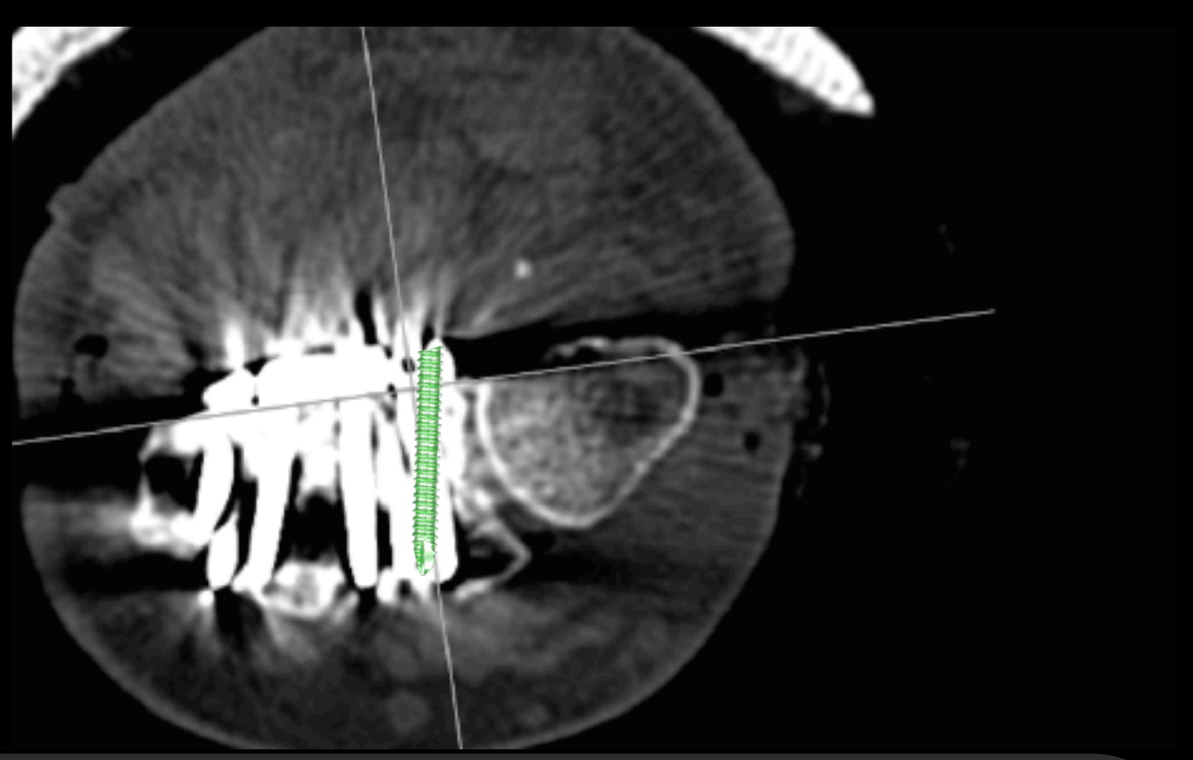


.....as you see illustrated in these fracture fragments in color, but an unacceptable position, we would say from the plate, with the screw capturing this fragment very well.

PROTRUDING PLATE - 100% Screw length

NOT PROTRUDING PLATE - 100% Screw length

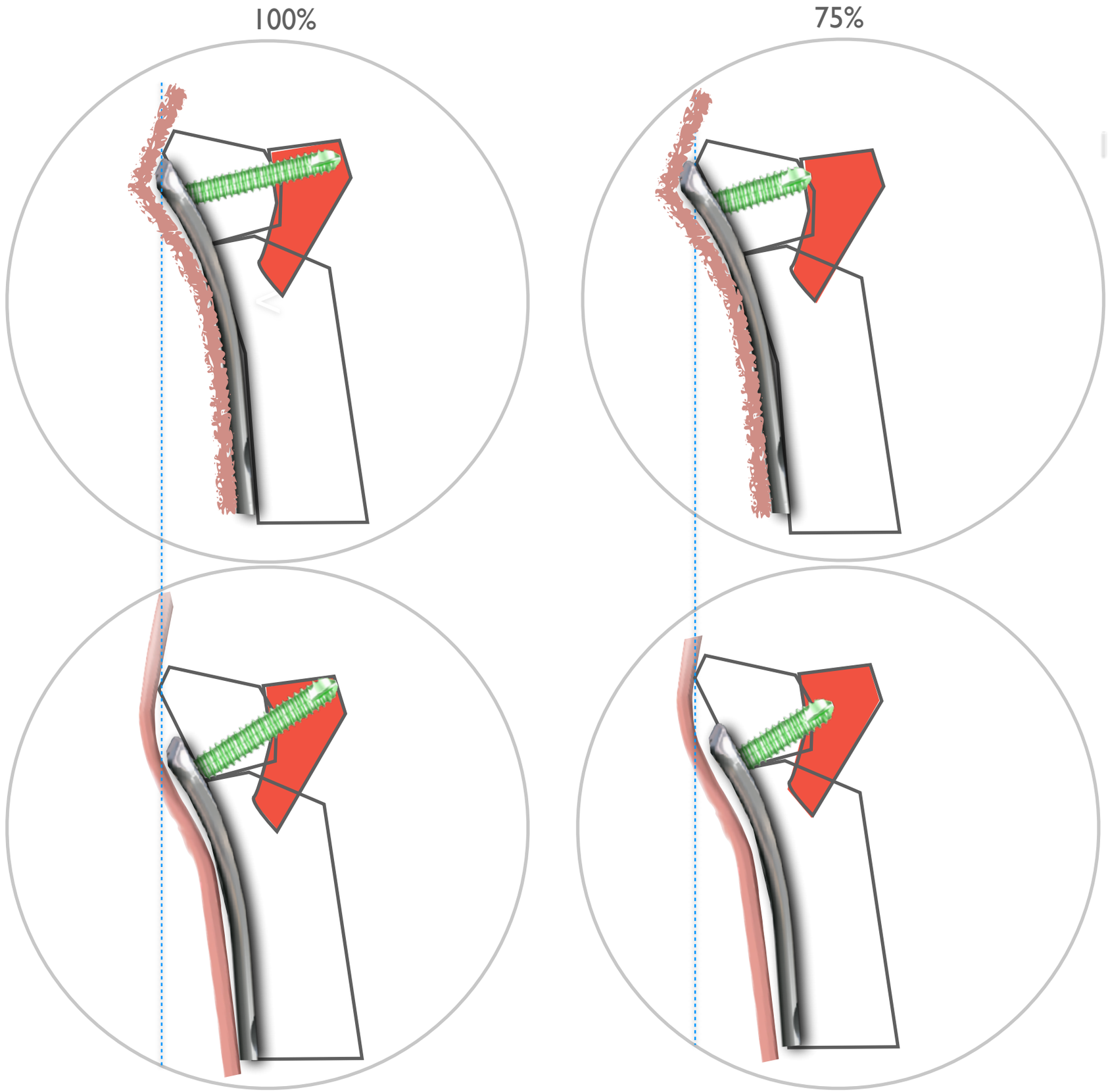




And in these schematics, with the plate changed in the overlay, perhaps you can do the same with a more appropriate position at the plate.And here in the real-life CT we see that plate screws are capturing that fragment effectively.

PROTRUDING PLATE

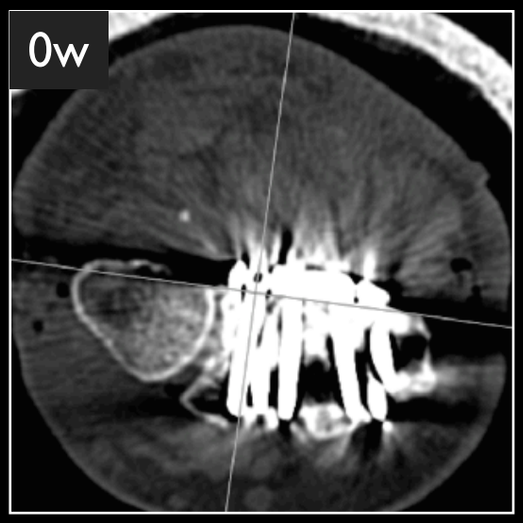
NOT PROTRUDING PLATE



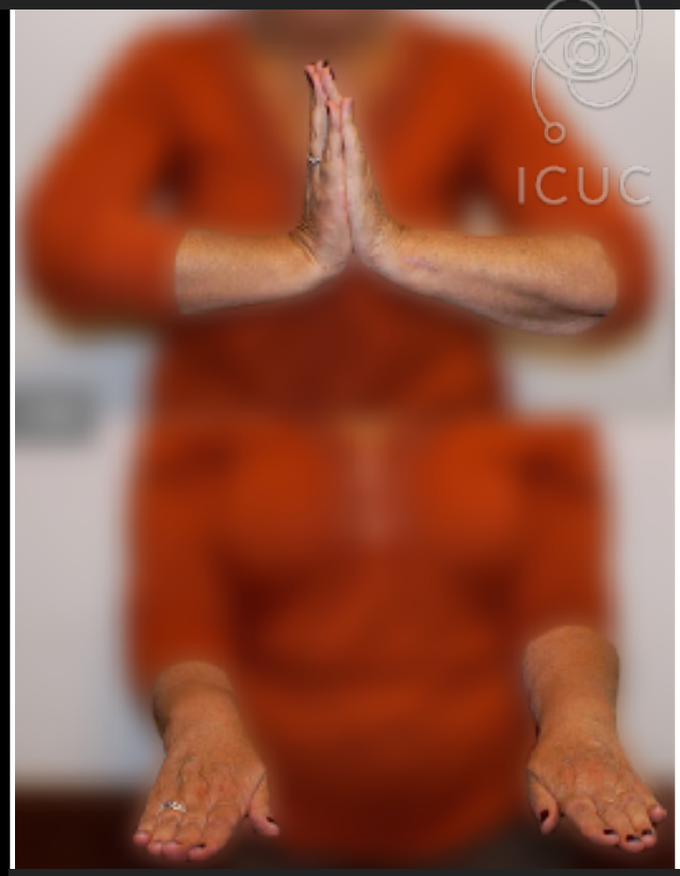
But once again in this illustration with a plate in a dangerous position you see the screw into the dorsal fragment, but we can do the same with a plate screw construct in the volar side in a more appropriate position, recognizing that many implants provide the ability of variable angle placement; and so even from this position using a variable angle we can get this in a better position.

PRE

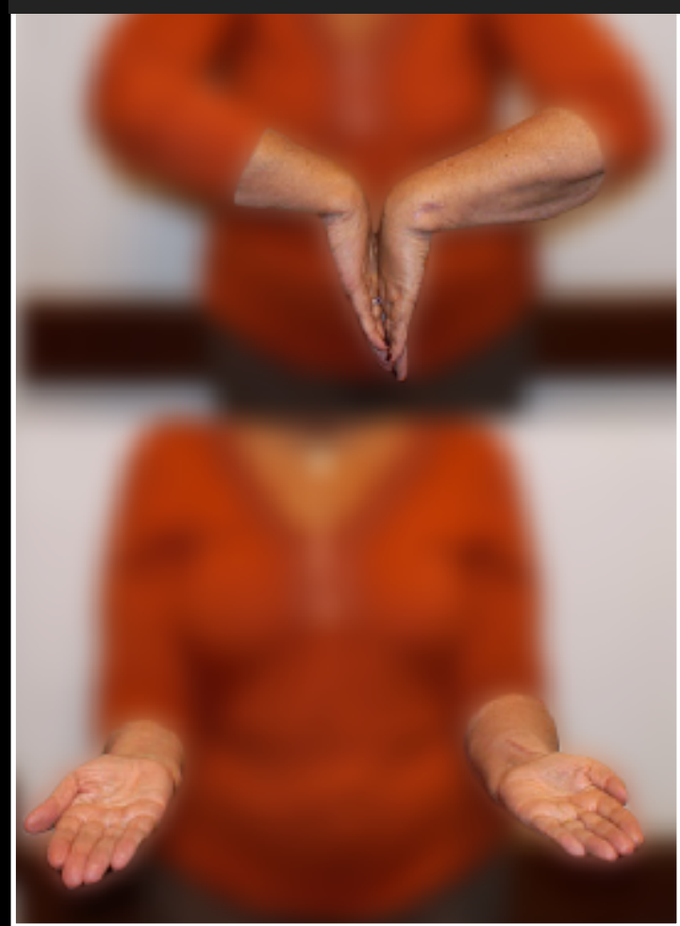
0w



57w



ICUC® Score: FL=0 | P=0



We include a few case images to promote discussion on the subject.

ID: 23-DC-954

ID: 23-DC-256

ID: 23-DC-250

ID: 23-DU-968

ID: 23-DU-958

ID: 23-DU-212

ID: 23-DC-250 / 70y

Overall Assessment: Recommended

AO: 23-C

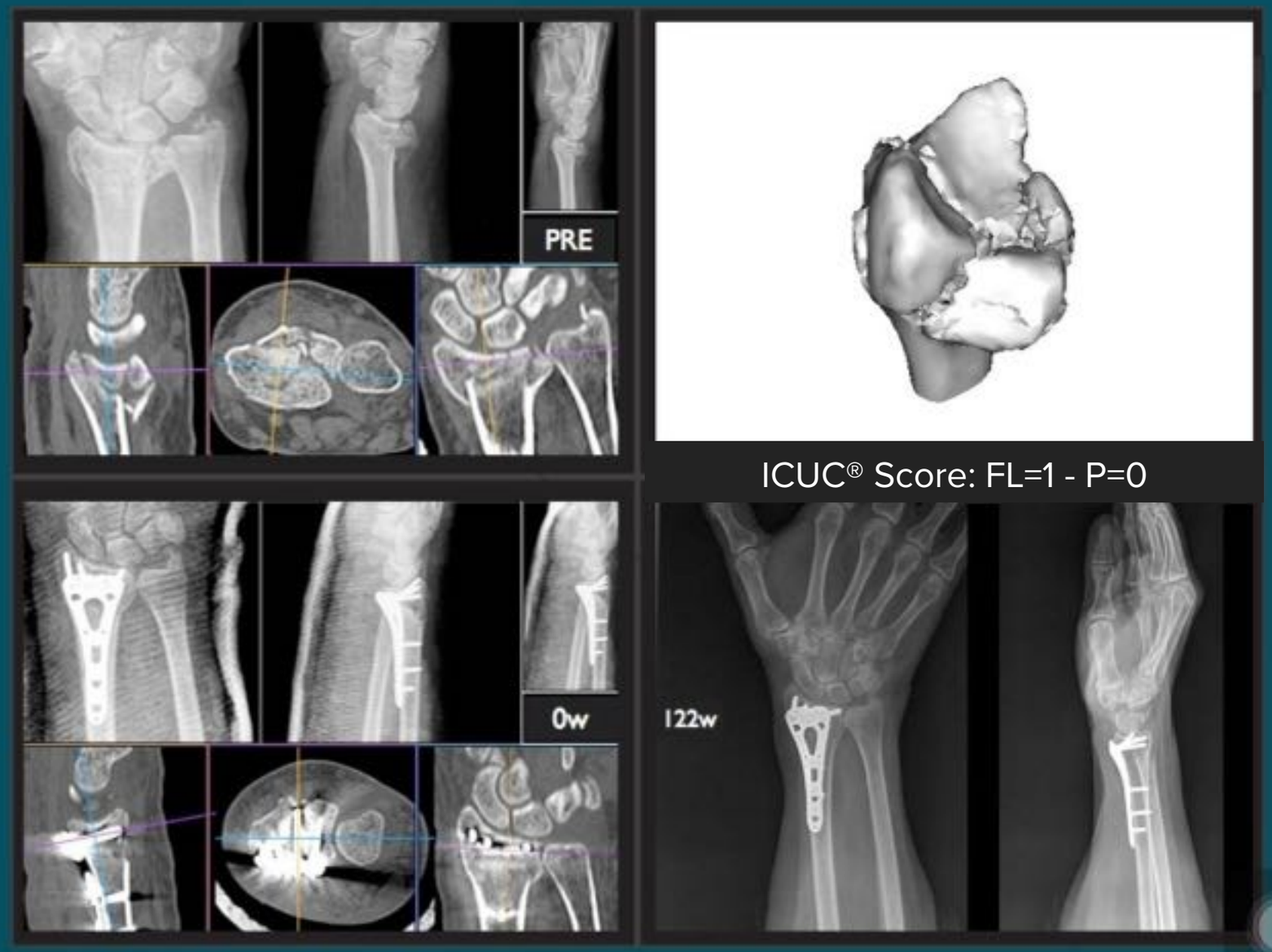
< 1 Week

Broken Ulnar Styloid

SURGICAL APPROACH
Volar approach. Variable angle plate.

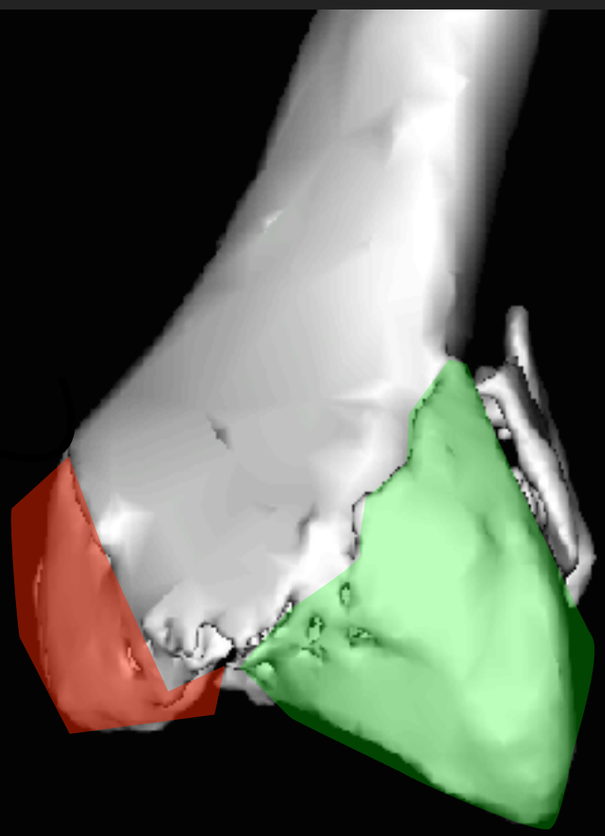
SUMMARY
Short distal fragment. Intraoperative screw exchange.

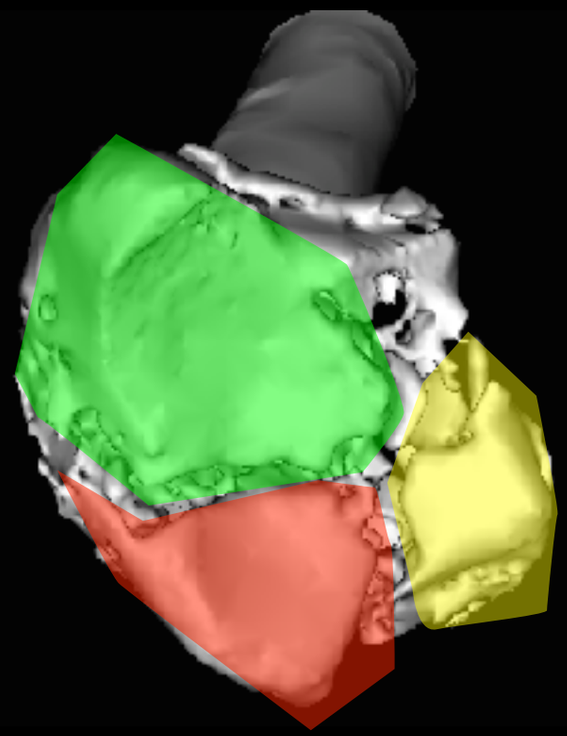
DISPLACEMENT ●●●
COMPLEXITY ●●●
REDUCTION ●●●
IMPLANT POSITION ●●●

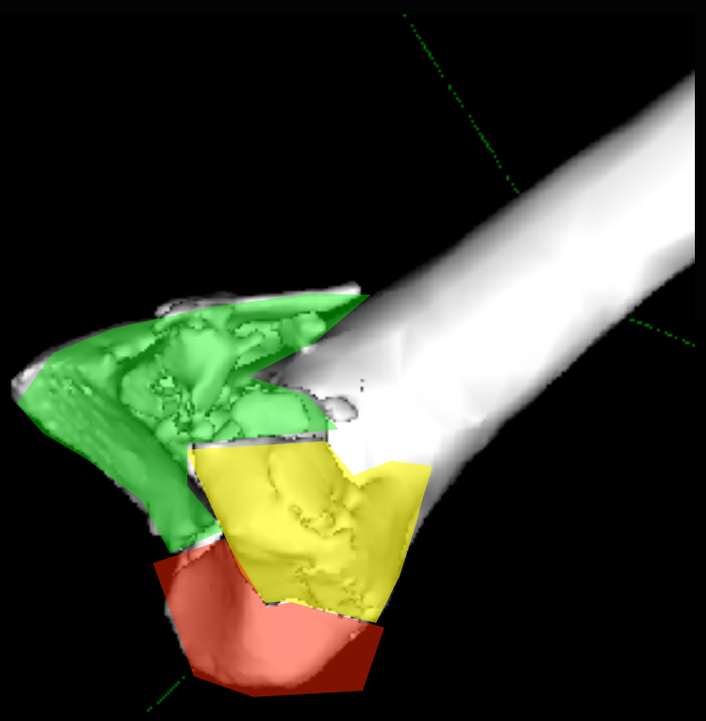


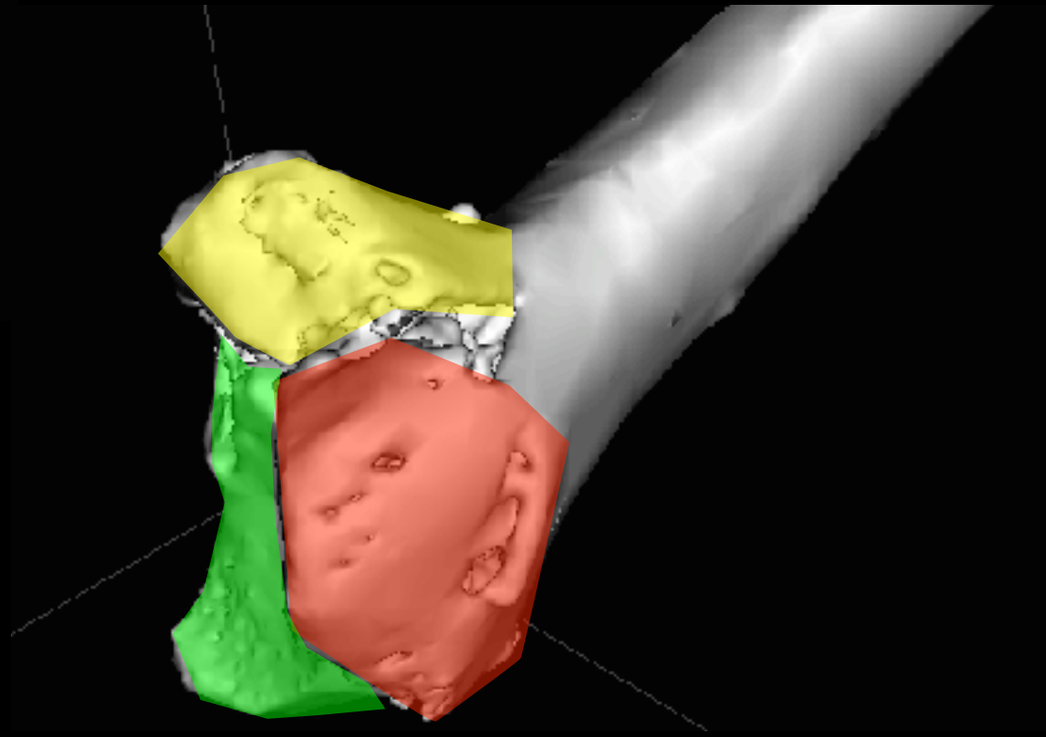
ICUC® Score: FL=1 - P=0

Ulnar Corner | Central Impaction | Complex | Extra Articular | Simple

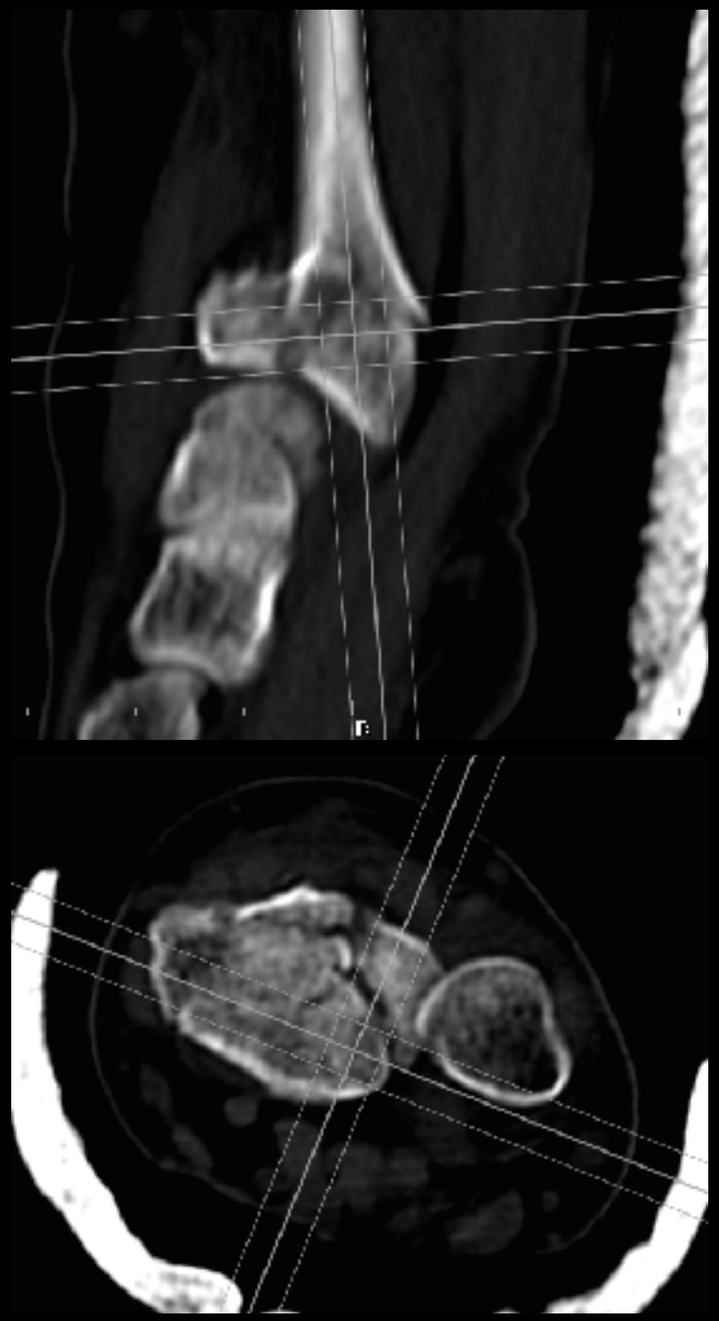


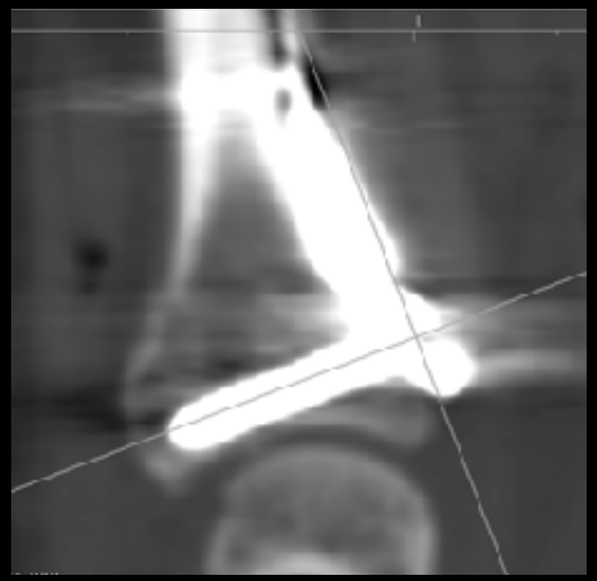


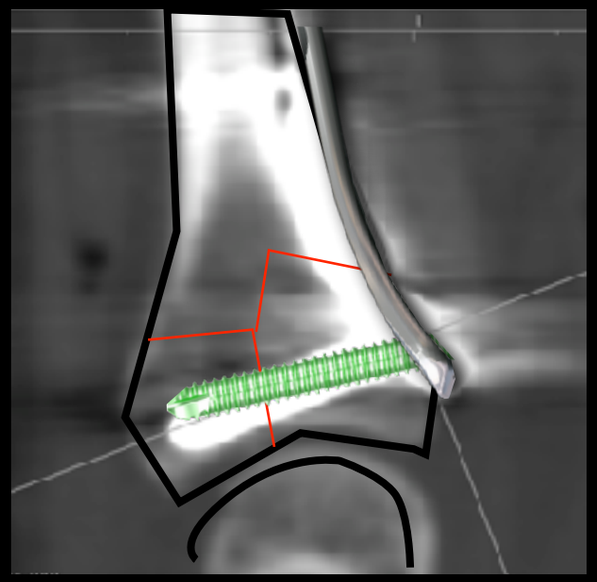


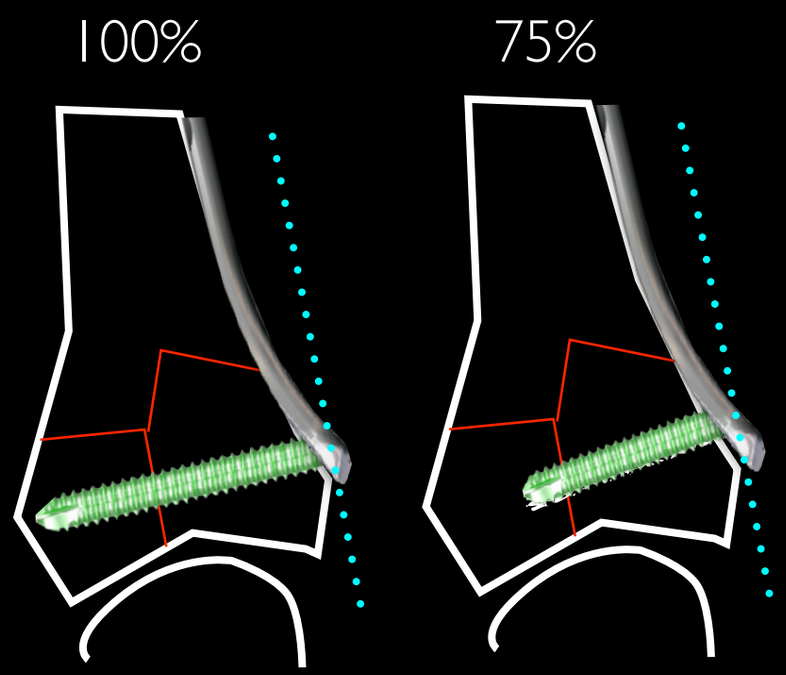


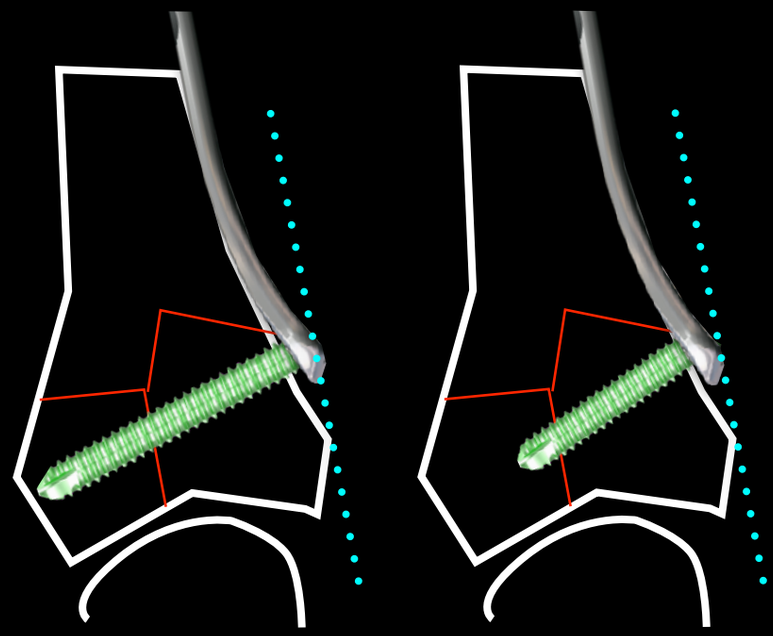
Once again we'll illustrate this in a four-part articular fracture and this is the illustration.



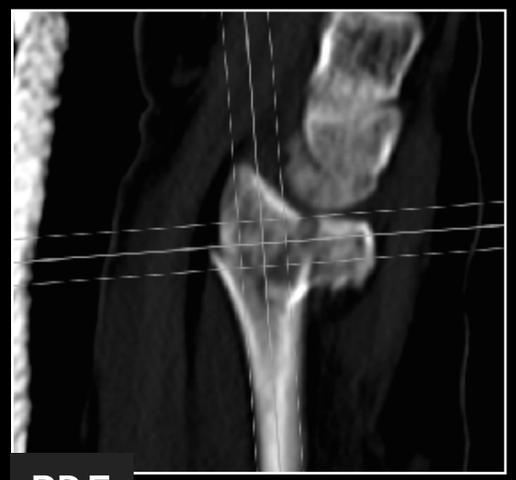




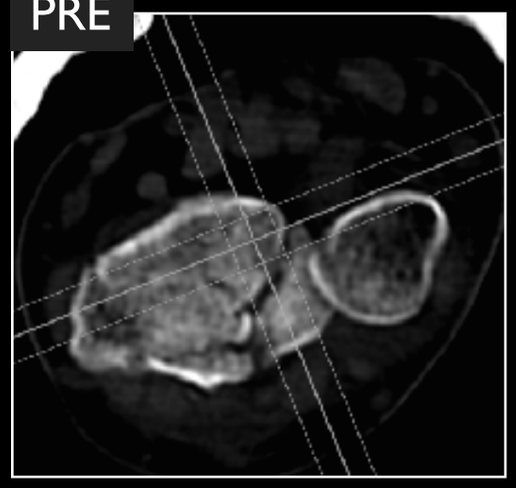




We see here from the plate in a risky position, just extending beyond the safe line, capturing it the same way with the plate in a safer position, angling the screws more distally.



PRE

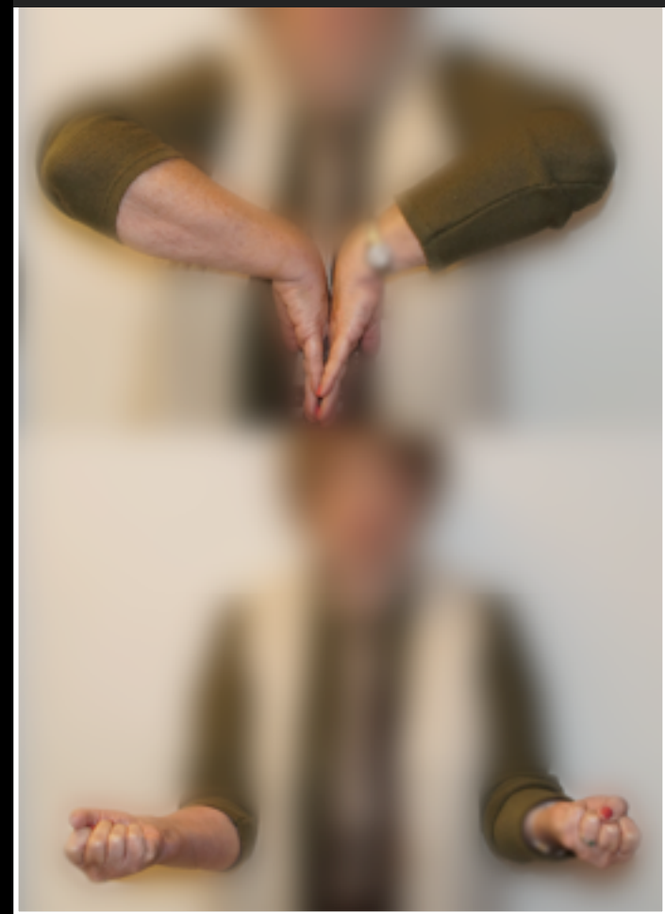


0w

122w

Does this screw provide stability of the fragment? In a fragment this size it certainly does and therefor is strategically relevant to do that.

ICUC® Score: FL=1 - P=0



We include a few case images to promote discussion on the subject.

ID: 23-DC-954

ID: 23-DC-256

ID: 23-DC-250

ID: 23-DU-968

ID: 23-DU-958

ID: 23-DU-212

Another case; these are all very complex cases with very displaced dorsal lunate facet components. Plate strategically, is in an adequate position.

ID: 23-DU-968 / 60y

Overall Assessment: To be discussed

AO: 23-C

< 1 Week

Broken Ulnar Styloic

SURGICAL APPROACH

Volar approach. Variable angle plate

SUMMARY

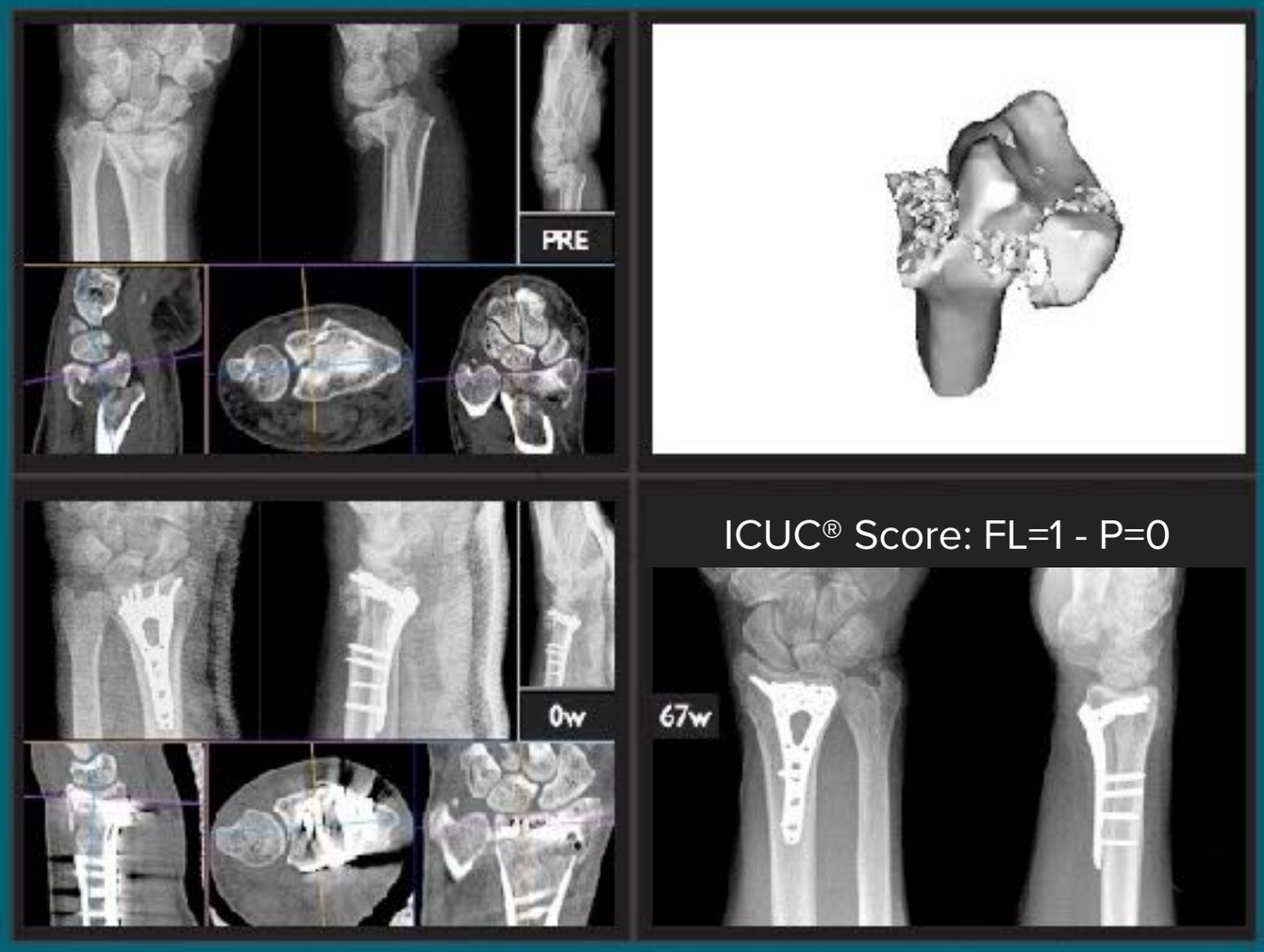
Short distal fragment. Multiple intraoperative screw exchanges.

DISPLACEMENT

COMPLEXITY

REDUCTION

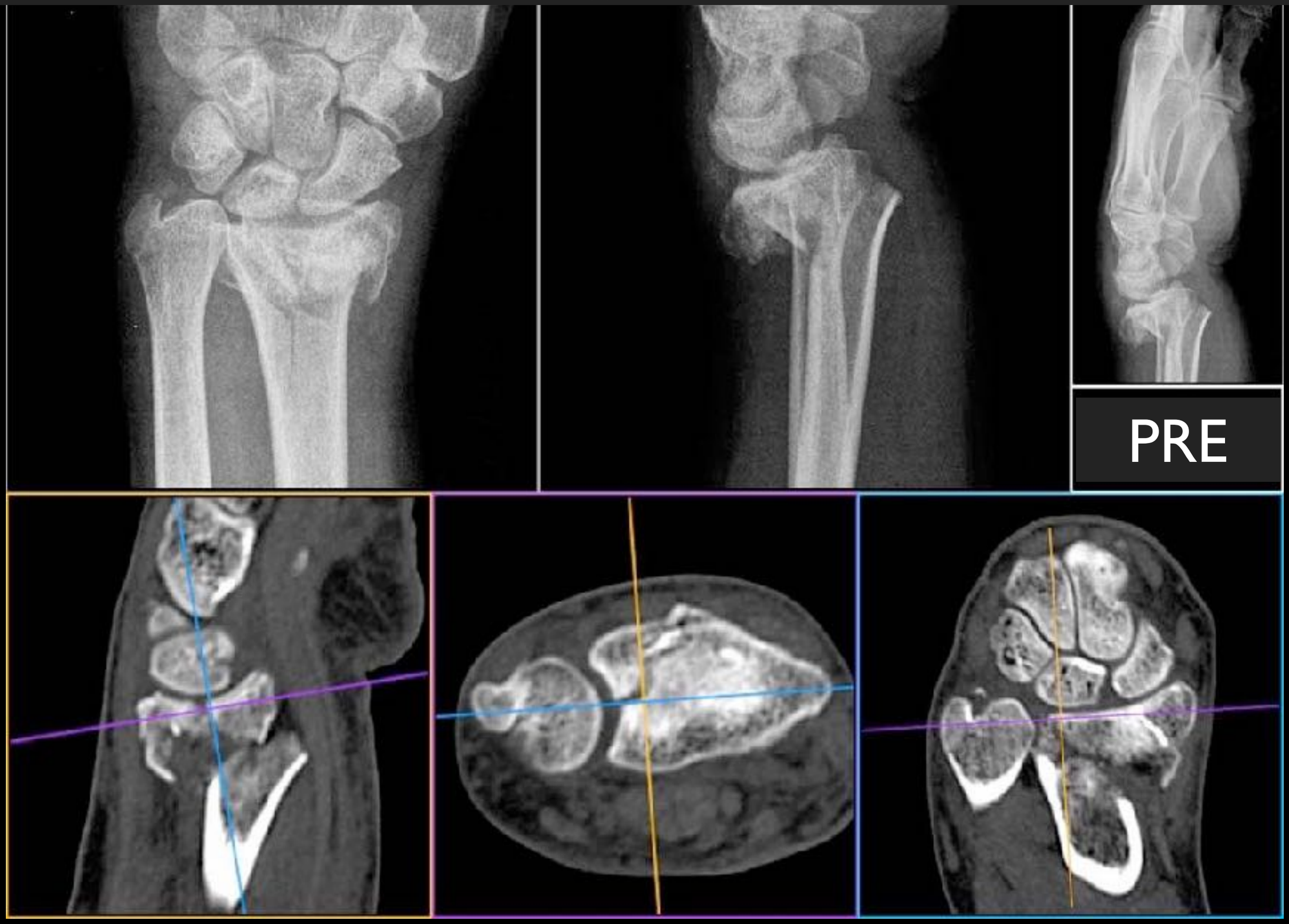
IMPLANT POSITION



ICUC® Score: FL=1 - P=0

Extra Articular | Simple | Ulnar Corner | Central Impaction | Complex

Another case; these are all very complex cases with very displaced dorsal lunate facet components. Plate strategically, is in an adequate position.



Another case; these are all very complex cases with very displaced dorsal lunate facet components.

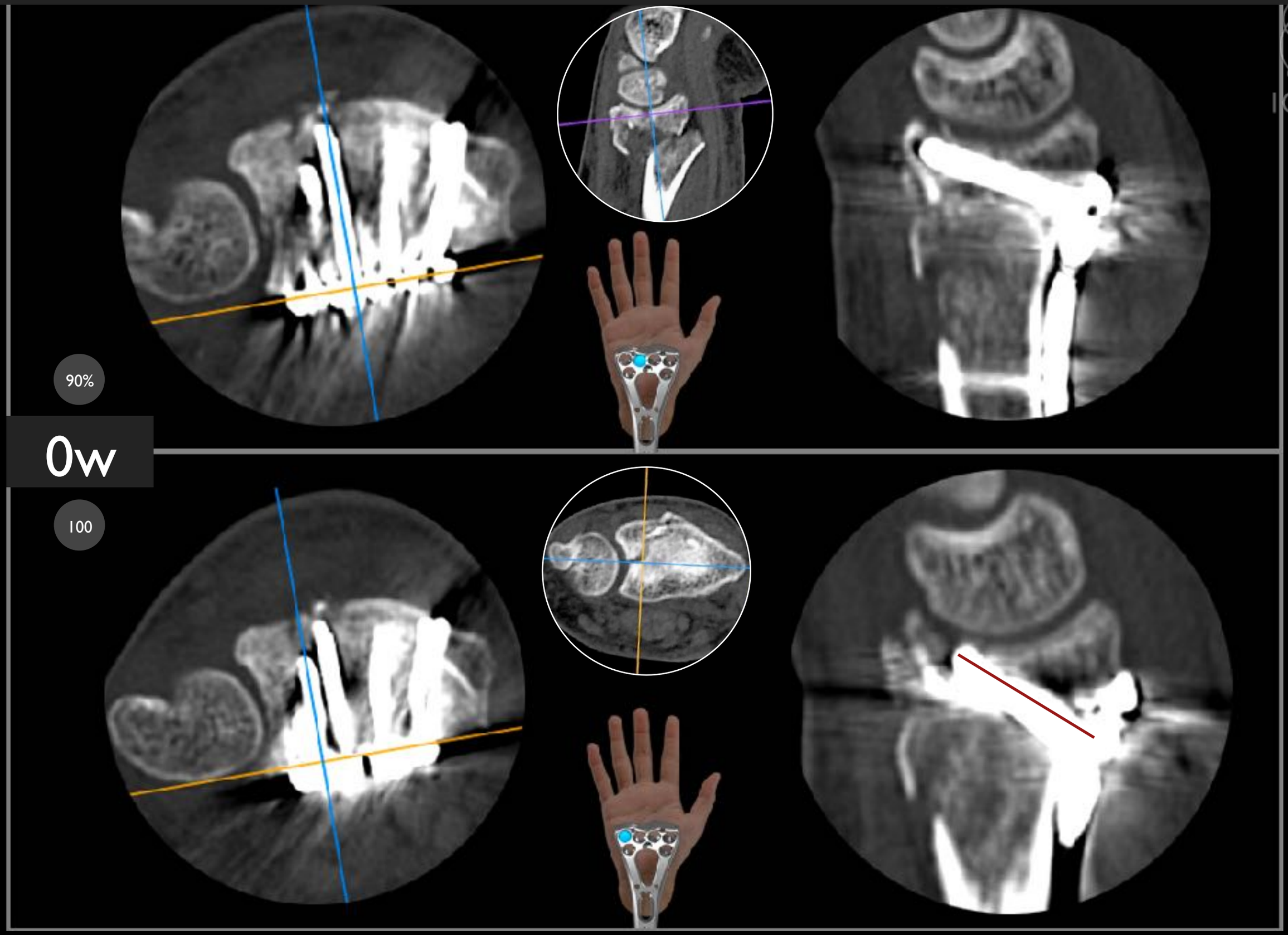
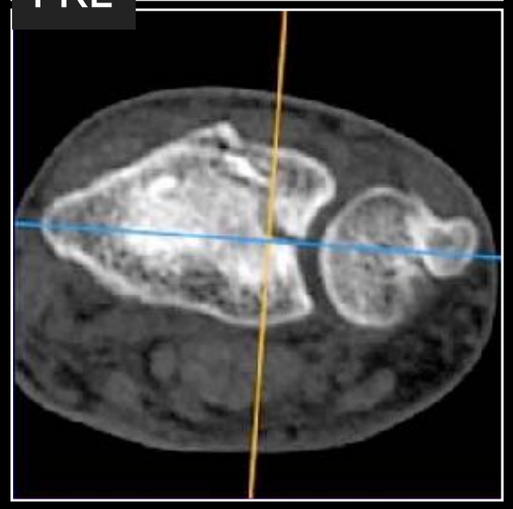
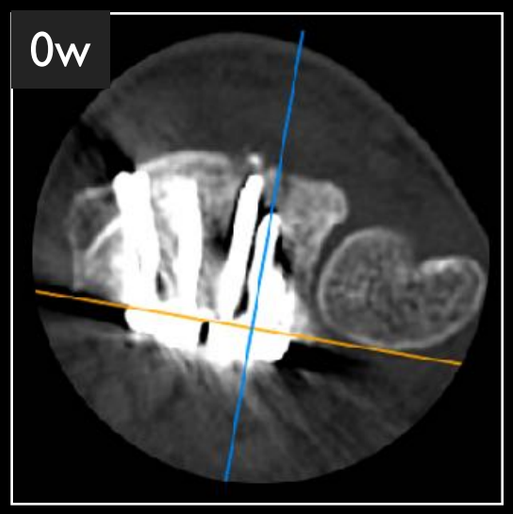


Plate strategically, is in an adequate position.

ICUC® app ID: 23-DU-968

PRE





0w

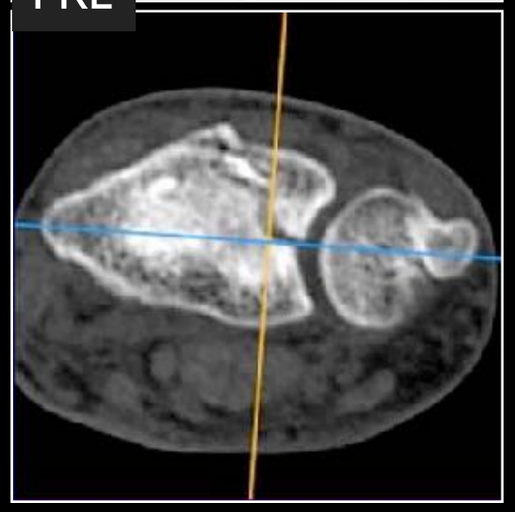
67w

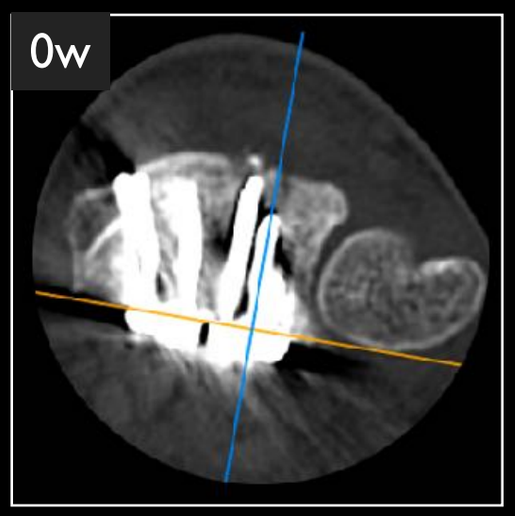
ICUC® Score: FL=0 - P=0

Plate strategically, is in an adequate position.

ICUC® app ID: 23-DU-968

PRE

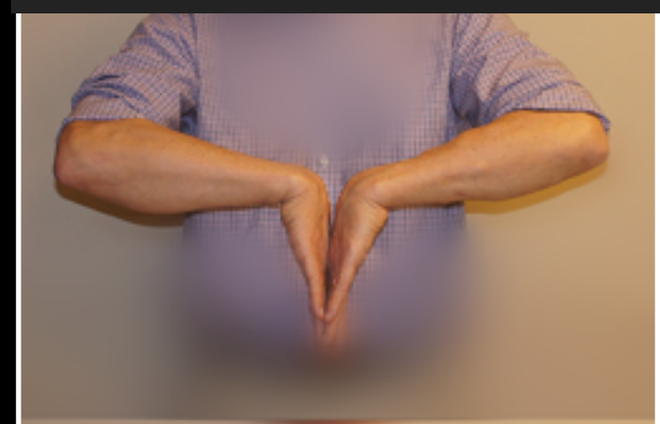


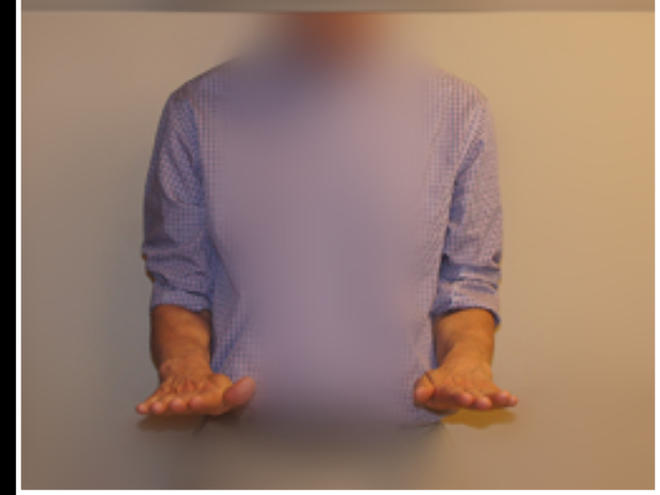


0w

0w after Implant removal

21w after implant removal
ICUC® Score: FL=1 - P=0





Good function. Plate was removed electively,
see a maintenance of a nice position and nice result.

We include a few case images to promote discussion on the subject.

ID: 23-DC-954

ID: 23-DC-256

ID: 23-DC-250

ID: 23-DU-968

ID: 23-DU-958

ID: 23-DU-212

One more case will illustrate and this is a clear dorsally displaced fracture with a major component of the lunate.

ID: 23-DU-958 / 50y

Overall Assessment: Recommended

AO: 23-C

< 1 Week

SURGICAL APPROACH
Volar approach. Variable angle plate.

SUMMARY
Intraoperative screw exchange. Was it necessary?

DISPLACEMENT ●●○

COMPLEXITY ●●○

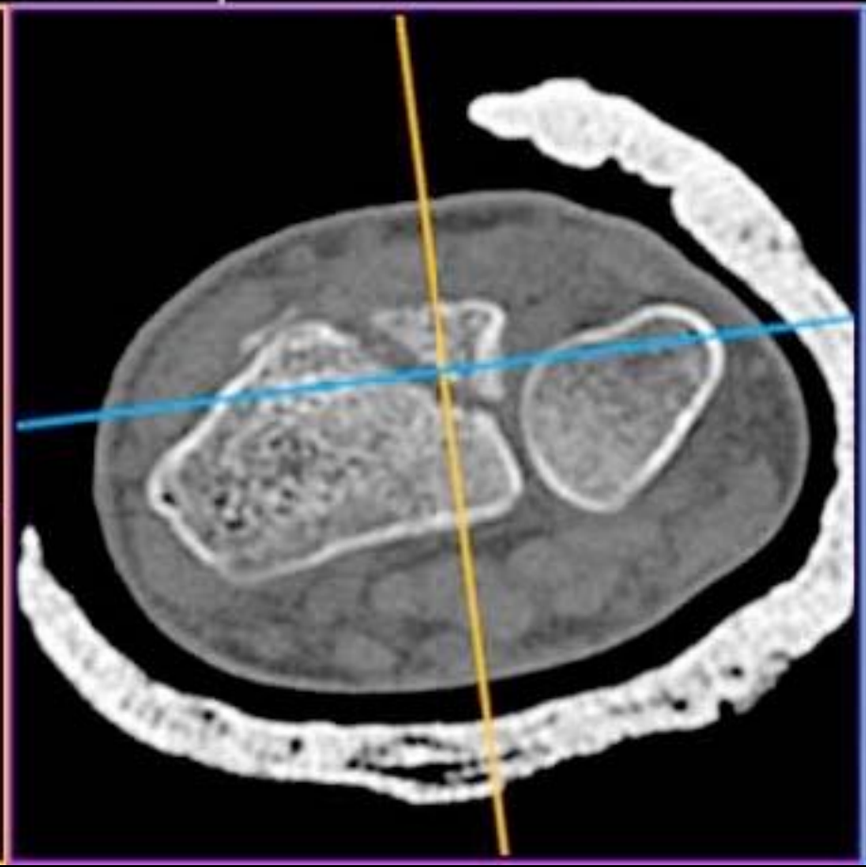
REDUCTION ●●○

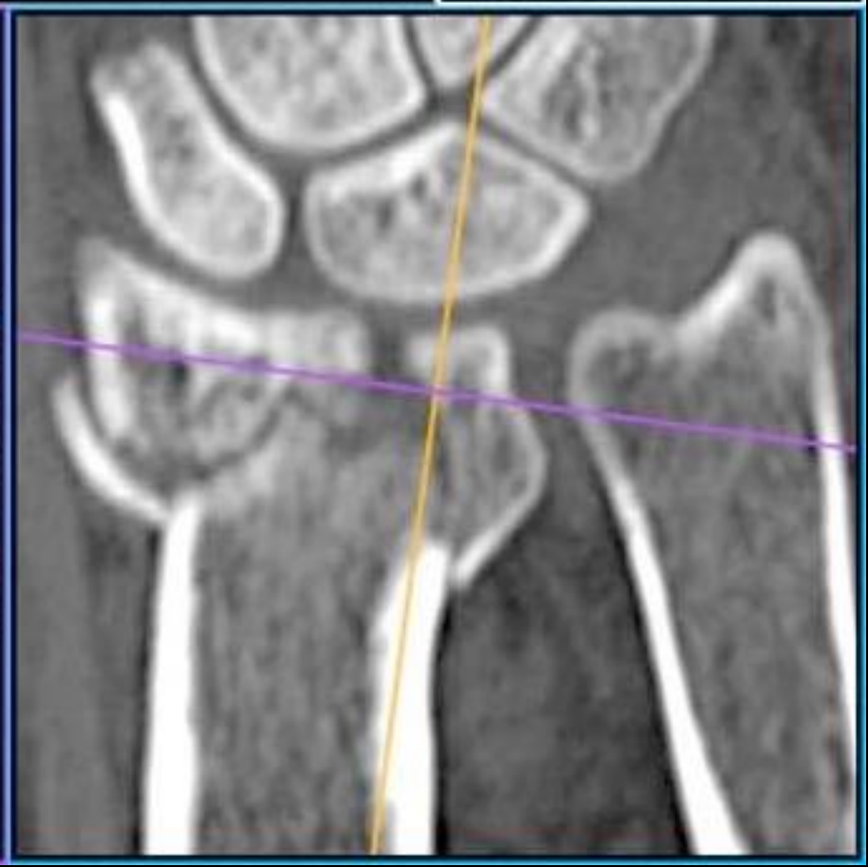
IMPLANT POSITION ●●○

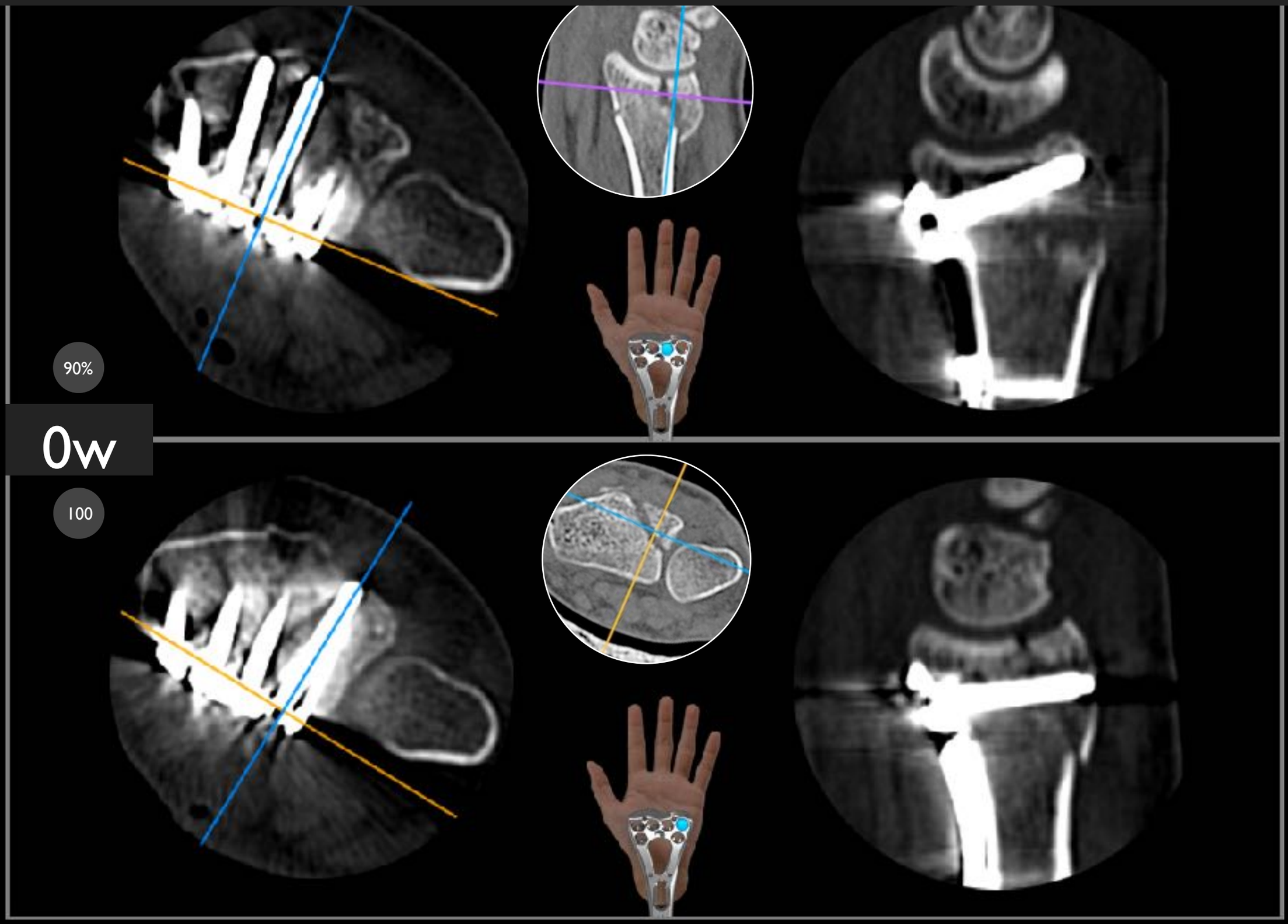
ICUC® Score: FL=1 - P=1

Extra Articular | Simple | Ulnar Corner | Central Impaction | Complex

PRE



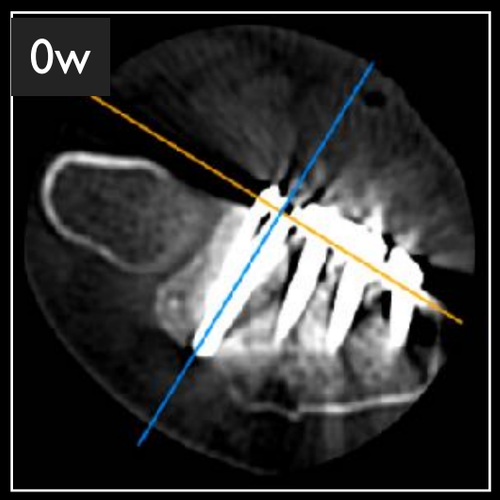




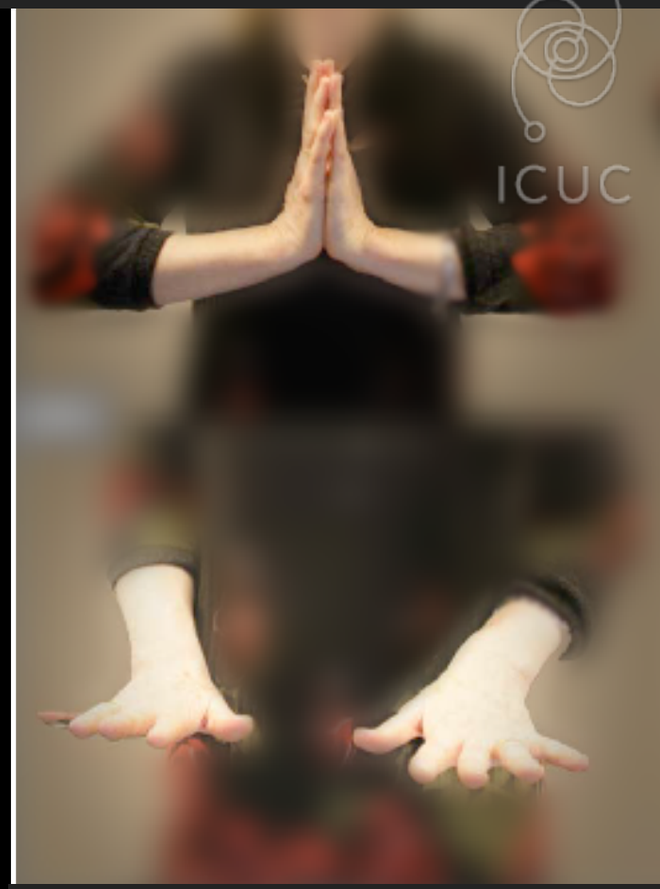
We see the plate placed here and the screw capturing it going just through the dorsal cortex in the post-op CT scan;

ICUC® app ID: 23-DU-958

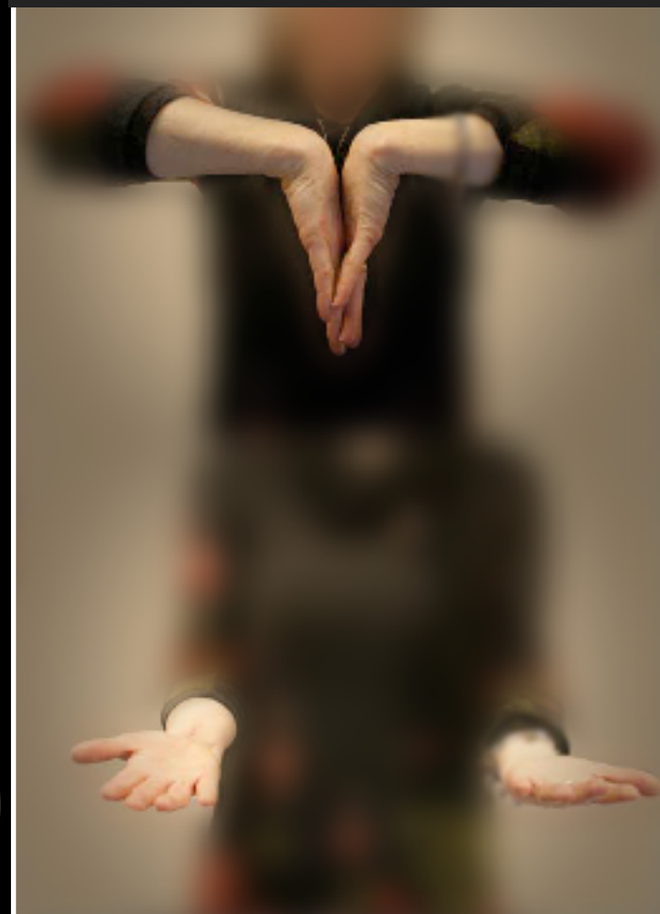
PRE



26w



ICUC® Score: FL=1 - P=1



The functional outcome Illustrated

Further Readings

The effects of screw length on stability of simulated osteoporotic distal radius fractures fixed with volar locking plates

Lindley B. Wall, Michael D. Brodt, Matthew J. Silva, Martin I. Boyer, Ryan P. Calfee

Orthopaedic Surgery, Center of Regenerative Medicine, Division of Biology and Biomedical Sciences, Institute of Clinical and Translational Sciences

Research output: Contribution to journal › Article

Published - Mar 1 2012

Volar Locking Plate Implant Prominence and Flexor Tendon Rupture

Soong, Maximillian, MD[1]; Earp, Brandon E., MD[2]; Bishop, Gavin, MD[3]; Leung, Albert, BS[2]; Blazar, Philip, MD[2] **Author Information**

JBJS: February 16, 2011 - Volume 93 - Issue 4 - p 328-335
doi: 10.2106/JBJS.J.00193

J Hand Surg Eur Vol. 2018 Feb; 43(2): 137–141.
Published online 2017 Aug 21. doi: 10.1177/1753193417726636 PMCID: PMC5791519 / PMID: 28825371

Relationship between plate removal and Soong grading following surgery for fractured distal radius

Caroline A. Selles,[1] Sam T.H. Reerds,[2] Gert Roukema,[2] Kees H. van der Vlies,[2] Berry I. Cleffken,[2] and Niels W.L. Schep[2,3]

Comparative Study
J Bone Joint Surg Am
2011 Feb 16;93(4):328-35. doi: 10.2106/JBJS.J.00193. Epub 2011 Jan 14. PMID: 21239658

Volar locking plate implant prominence and flexor tendon rupture

Maximillian Soong [1], Brandon E Earp, Gavin Bishop, Albert Leung, Philip Blazar

K. Mader • D. Pennig

The treatment of severely comminuted intra-articular fractures of the distal radius

Received: 29 September 2006 / Accepted: 30 October 2006 / Published online: 14 December 2006

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