

# Utility of Augmented Reality for Presurgical Planning in Complex Pediatric Elbow Fractures

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# Disclosures

- Co-founder of an AR company Sira Medical

# Take Home Points

Augmented Reality (AR) can be helpful for surgical planning, can potentially decrease OR times/complications rates, and increase surgeon confidence.

Cases that require understanding of complex anatomy, or in which anatomy dictates surgical approach may benefit most from 3D planning.

3D presurgical planning is becoming more readily available, either through 3D printing techniques, or AR/VR visualization.

The radiologist can increase value by introducing these advanced visualization techniques to referring clinicians.

# Introduction

Repair of complex distal humeral fractures is challenging in pediatric patients as it depends on the orientation of osseous fragmentation<sup>1</sup>.

Adolescents are particularly challenging, since they do not easily fall into a juvenile pattern of supracondylar fractures, nor do they exactly demonstrate adult fracture patterns.

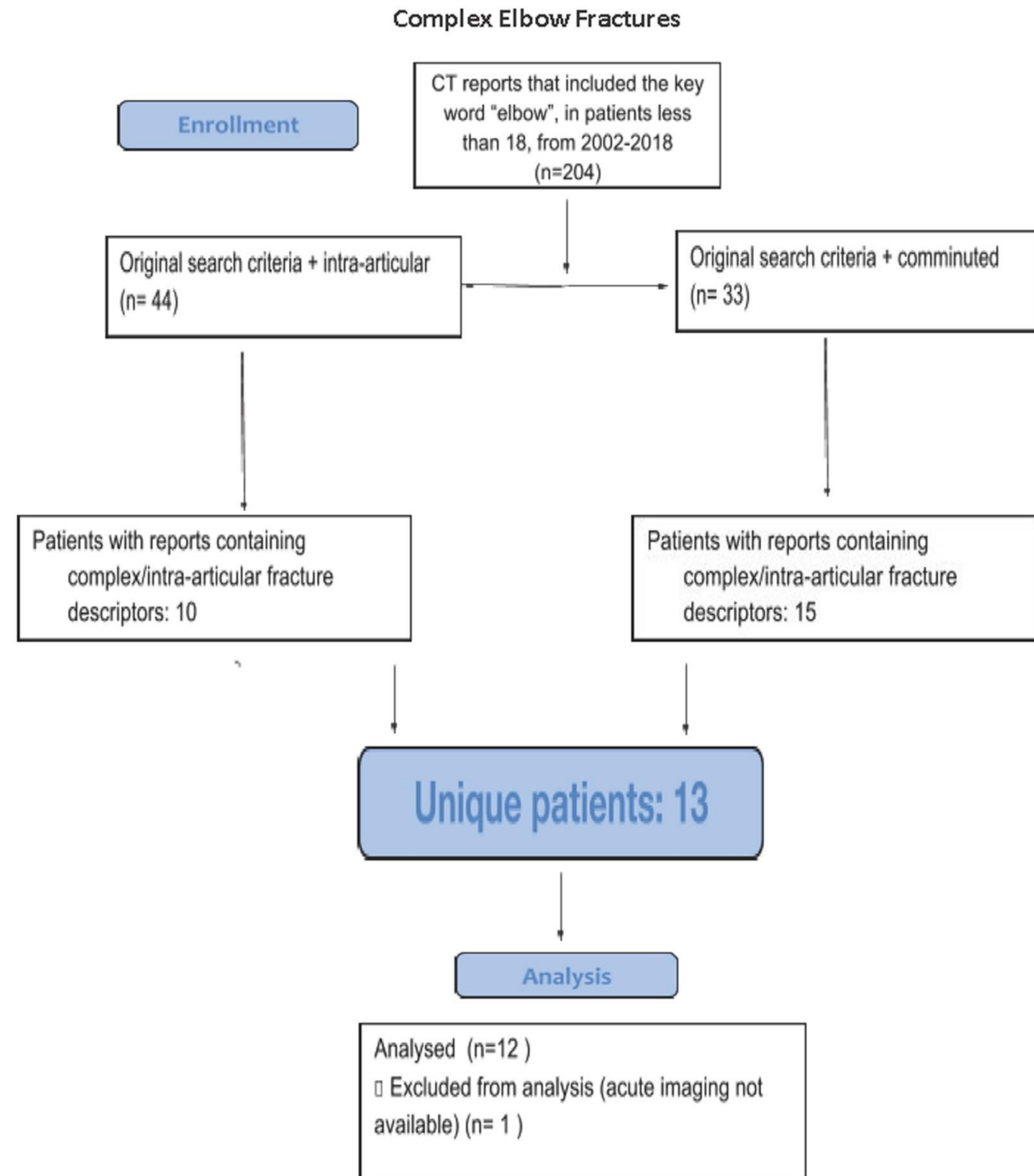
We hypothesized that improved 3D visualization of complex fractures may help surgeons in these complex cases.



# Materials/Methods

- Patients aged 10-18
- Imaging was obtained within 24 hours of trauma

Patient	Fracture Type	Mechanism	Patient age (years)	Patient weight (kg)	Patient Gender
1	Sequela of prior elbow dislocation with anteriorly displaced medial condyle avulsion fracture and small impaction fracture at the posterior aspect of the lateral condyle	Fall on an outstretched hand.	12	78.5	Female
2	Left distal humeral lateral condylar fracture with superior displacement of the capitellum.	Fall on an outstretched hand.	12	40	Female
3	Supracondylar fracture with posterior displacement and disruption of the anterior and posterior cortex.	Fall onto left elbow, axial load, swing	14	55	Male



# Materials/Methods

- We developed novel AR visualization software to convert and optimize DICOM data into AR, built on a Unity platform.
- DICOM converted and reviewed by 5 fellowship trained pediatric orthopedic surgeons.
- Surgeons were then asked to complete a survey after review of cases



**1. Does this model accurately display the bone structures as portrayed by the CT dataset?**

*Mark only one oval.*

1      2      3      4      5

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Extremely accurate                  Not at all accurate

**2. How would review of this model before surgery change your surgical plan?**

*Mark only one oval.*

- Negatively impact my plan (5)
- Minor negative deviation in my plan (4)
- No impact on my surgical plan (3)
- Minor improvement in my surgical plan (2)
- Major positive change in my surgical plan (1)

**3. Would review of this model before surgery improve your confidence in your surgical plan?**

*Mark only one oval.*

- Negatively affect my confidence (5)
- Minor negative affect in my confidence (4)
- No impact on my confidence in my surgical plan (3)
- Minor improvement in confidence in my surgical plan (2)
- Major improvement in confidence in my surgical plan (1)

**4. Would review of this model before surgery improve your confidence in your hardware selection?**

*Mark only one oval.*

- Negatively affect my confidence (5)
- Minor negative affect in my confidence (4)
- No impact on my confidence in my hardware selection (3)
- Minor improvement in confidence in my hardware selection (2)
- Major improvement in confidence in my hardware selection (1)

**5. Would review of this model before surgery improve your confidence in your hardware fit?**

*Mark only one oval.*

- Negatively affect my confidence (5)
- Minor negative affect in my confidence (4)
- No impact on my confidence in hardware fit (3)
- Minor improvement in confidence in hardware fit (2)
- Major improvement in confidence in hardware fit (1)

**6. Is review of A.R. models useful for presurgical planning?**

*Mark only one oval.*

- Very unhelpful (5)
- Mildly unhelpful
- Neither helpful nor unhelpful
- Mildly helpful
- extremely helpful (1)

**7. If this would change time, how much time do you estimate (in minutes)? (use + for time added in the O.R. and - for time reduced in the O.R.)**

# Materials/Methods







# Results

Surgeons rated models “highly accurate”: (median=1, mode=1, Interquartile range (IQR)=0).

Raters noted no overall change in surgical plan: (median=3, mode=3, IQR=1).

Confidence scores:

Hardware selection were mildly increased: (median=2, mode=1, IQR=1)

Hardware fit were mildly increased: (median=2 mode=1, IQR=1)

Utility for planning for specific fracture type was mildly increased: (median=2, mode=1,IQR=1).

Overall average estimated intra-operative time savings for all fracture types= 14.1 minutes.

# Conclusion

- Gap between current technology and ultimately the type of visualization surgeons want.
- AR can potentially solve many of these problems.
- Current limitations include hardware limitations preventing rendering of high fidelity models, difficulty in segmentation (particularly of soft tissues), and accessibility.
- VR/AR/3D printing all have their potential use cases, and we as a field should continue to adopt these imaging technologies as they can potentially provide value both for clinicians and patients.

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# Acknowledgements

- Jesse Courtier