Distinguishing between stable buckle fractures and unstable distal radius fractures: Testing radiologist and orthopedist diagnostic accuracy at one institution

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Learning Objectives

1. Name different types of distal radius fractures in children
2. Describe acceptable treatment pathways for stable versus unstable distal radius fractures in children after initial visit
3. Recognize that differentiating between stable and unstable distal types can be challenging even for experienced radiologists and orthopedists
Purpose

- To test radiologist and orthopedist diagnostic accuracy for distinguishing between stable buckle fractures and other unstable distal radius fractures using a series of test cases.
Background

• Buckle fracture
  – Common
  – Stable
  – Treatment trend
    • Removable splint
    • Home management
    • No scheduled follow-up
Background

- Other Distal Radius fractures in children
  - Common
  - Unstable
  - Current treatment
    - Immobilization/casting
    - Orthopedic management
    - Follow-up appts.
    - Follow-up imaging
Background
Current practice

• All wrist fractures immobilized at initial visit and scheduled for follow-up in orthopedic clinic

• Radiology reports do not distinguish between stable and unstable fracture types
Background
Proposed future practice

• Discharge buckle fractures with removable splint for home management after initial visit

• Immobilize unstable non-buckle fractures and schedule orthopedic follow-up
Background

• Diagnostic accuracy is imperative
  – removable splint appropriate only for stable buckle fractures
  – immobilization required for unstable, distal forearm fractures in children

• Radiologists must distinguish between fractures types at the initial visit
Background

• One institution reports a high misdiagnosis rate\(^1\)
• 16% False Positive and 5% False Negative Dx of Pediatric Distal Radius Buckle Fractures
• Fractures with cortical buckling and evidence of cortical disruption or physeal injury were frequently mistaken for benign buckle fractures in children

Methods

• Multi-department institutional QI project
• IRB waived
• 26 test cases
  – Children $\geq 3y$ with open phyes
  – 2-view wrist
  – All had a distal radius fracture $+$ distal ulna fracture
Methods

• Readers
  – 22 pediatric radiologists
  – 9 pediatric orthopedists
  – Answer: buckle fracture (BF) or other fracture (NBF)

• Reader answers compared to the final diagnosis
  – Reference standard
    • Consensus: 1 pediatric radiologist + 1 pediatric orthopedist

• Chi Square and Fleiss Kappa statistics
Results

22 radiologists

Mean correct score: 91% (range 73-100%)
Median correct score: 85%
Sensitivity: 97%
Specificity: 60%
Accuracy: 84% ($X^2$ p<0.0001)
Inter-rater agreement: $k = 0.56 \pm 0.01$ (moderate)
<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
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<tbody>
<tr>
<td>Mean correct score</td>
<td>92% (range 85-100%)</td>
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<tr>
<td>Median correct score</td>
<td>92%</td>
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<td>Sensitivity</td>
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</tr>
<tr>
<td>Inter-rater agreement</td>
<td>(k = 0.60 \pm 0.01) (moderate)</td>
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**Results**

9 orthopedists
Results

• Buckle fractures
  – 0 BFs correctly identified by all radiologists
  – 4 BFs (44%) correctly identified by all orthopedists

• Non-Buckle fractures
  – 10 NBFs (59%) correctly identified by all radiologists
  – 13 NBFs (76%) correctly identified by all orthopedists
Discussion

• High sensitivity for detecting unstable fractures
• Both groups: radiologists and orthopedists
• Few unstable fractures would have been recommended for removable splint and no scheduled follow-up
Discussion

- Lower specificity
- Both groups: radiologists and orthopedists
- Stable buckle fractures would have been recommended for conservative treatment
  - Unnecessary immobilization which has risks
  - Unnecessary orthopedic follow-up
  - Increased expenses: orthopedic and imaging resources
  - Increased time / inconvenience for families
Limitations

• 2-view examinations are performed at our institution
• Lack of third oblique view may miss subtle cortical disruption demonstrated only on 1 view
• Sub-optimal positioning of lateral view may also miss cortical disruption
Conclusion

• Both radiologists and orthopedists had high sensitivity and lower specificity for detecting unstable distal radius fractures and distinguishing them from stable buckle fractures

• Additional education is planned before our institution will begin a home management splint program for buckle fractures based on initial radiology interpretation
Acknowledgments

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none