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Introduction

Accurate first time diagnosis of distal radius buckle fractures is increasingly important as management continues to transition from specialty care to the primary care setting.

More severe distal radius fractures treated as buckle fractures may be at greater risk for nonunion, malunion, and growth disturbance.

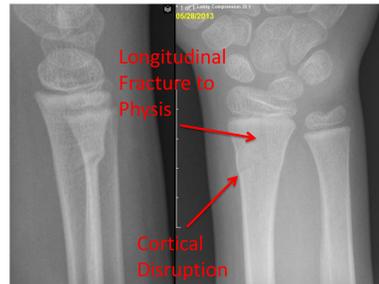


Figure 1: Misdiagnosed distal radius fracture. Non-buckle fracture. (CCHMC 2013)

Specific Aims

This study sought to 1) determine the frequency of misdiagnosis of distal radius fractures via radiographic review, and 2) assess the sensitivity and specificity of radiologists' and treating physicians' wrist x-ray interpretations.

This study hypothesizes that buckle fractures are frequently misdiagnosed on plain radiographs at a pediatric tertiary care center.

Method

In this retrospective review, patients under age 18, diagnosed with a distal radius fracture within a 6 month period were selected. Exclusion criteria included bilateral fractures, significant joint/bone deformity, previous wrist surgery, systemic diseases, multiple traumas, infections.

Three blinded raters, specialized in interpreting pediatric musculoskeletal radiographs, independently rated 676 radiographs to assess whether or not each distal radius fracture was a buckle fracture. A buckle fracture was diagnosed if there was buckling of the cortex on both the AP and lateral views without evidence of cortical disruption, indicative of complete fracture, or longitudinal radiolucency to the physis, indicative of a Salter-Harris II fracture. Accuracy was determined by comparing the diagnosis made by the radiologist and treating physician to the reference diagnosis.



Figure 2A: Multi-Rater Assessment: Buckle fracture. (CCHMC 2013)



Figure 2B: Multi-Rater Assessment: Non-buckle fracture. (CCHMC 2013)

Results

- 585 patients (309 males, 276 females) with unilateral distal radius fractures were diagnosed during the six month period.

TABLE I Accuracy of Pediatric Distal Radius Buckle Fracture Diagnosis

	Radiologist		Physician	
	N (%)		N (%)	
True positive	20%	(115/585)	21%	(124/585)
False positive	16%	(92/585)	18%	(105/585)
True negative	60%	(351/585)	58%	(338/585)
False negative	5%	(27/585)	3%	(18/585)
Sensitivity	81%	(115/142)	87%	(124/142)
Specificity	79%	(351/443)	76%	(338/443)
Positive predictive value	56%	(115/207)	54%	(124/229)
Negative predictive value	93%	(351/378)	95%	(338/356)

- Misdiagnosed non-buckle fractures were more likely to be treated with a splint (6%, 6/105) than correctly diagnosed non-buckle fractures (2%, 6/338) (p=0.041, Table II).

TABLE II Pediatric Distal Radius Buckle Fracture Treatment based on Diagnosis

	Splint	Below Elbow Cast	Above Elbow Cast	Surgery
	N (%)	N (%)	N (%)	N (%)
Buckle fracture	16 (11%)	99 (70%)	27 (19%)	0 (0%)
True positive	16 (13%)	86 (69%)	22 (18%)	0 (0%)
False negative	0 (0%)	13 (72%)	5 (28%)	0 (0%)
Non-buckle fracture	12 (3%)	214 (48%)	212 (48%)	5 (1%)
True negative	6 (2%)	132 (39%)	195 (58%)	5 (1%)
False positive	6 (6%)	82 (78%)	17 (16%)	0 (0%)

- Misdiagnosed non-buckle fractures were also more likely to be treated with a below elbow cast than an above elbow cast (83%, 82/99 vs. 40%, 132/327) (p<0.001, Table II).

Conclusion

Fractures with cortical buckling but also with evidence of cortical disruption or physeal injury were frequently mistaken for benign buckle fractures in children. These more severe non-buckle fractures are at risk for significant complications including displacement and subsequent malunion and Salter-Harris II fractures are at risk for growth arrest and deformity. Careful attention must be taken to ensure the proper diagnosis of buckle fractures in children. Using rigid diagnostic criteria, appropriate diagnosis can be readily made, which will help limit treatment complications and adverse outcomes.

References

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Acknowledgements

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