Coronal Remodeling Potential of Pediatric Distal Radius Fractures

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Purpose: Distal radius fractures in the pediatric population are common injuries with a remarkable capability to remodel. The degree of angulation that can reasonably be expected to remodel is controversial though, particularly when it comes to angulation in the coronal plane. The purpose of this study was to quantify the rate of remodeling via the distal radius physis present in a retrospective cohort of skeletally immature patients with coronally angulated distal radius fractures.

Methods: A retrospective chart review was performed to identify skeletally immature patients treated for an angulated distal radius fracture at a single institution by either a pediatric orthopaedic surgeon or an orthopaedic trauma surgeon from 2006-2018. Coronal angulation was measured at every visit where radiographs were available from time of injury to the final follow-up visit to determine the rate of remodeling.

Results: Thirty-six patients with distal radius fractures with a mean age of 7.93 years (range 4 to 12 years) at time of injury were identified. The mean rate of remodeling from maximum angulation to final follow-up was 2.30° per month in the coronal plane. The median peak angulation in the coronal plane was 17° (range 12.4° to 30.4°). At final follow-up, the median coronal angulation was 3.35° (range 0.24° to 14.0°). At the 95% confidence level, remodeling rates ranged from 2.00° per month to 2.59° per month. The mean follow-up period was 6.4 months from the time of maximum angulation to the final visit. The median time from cast removal to final follow-up was 26.36 weeks and ranged from 10 weeks to 34.86 weeks.

Conclusion: Distal radius fractures have a large capacity to remodel in the coronal plane in the pediatric population. This remodeling occurs in a predictable and

Descriptive Statistics of Time-Invariant Predictors (n = 36)	
Variable	**Summary Measure**
Age at Injury, Mean (SD)	7.93 years (2.09)
Age at Final Visit, Mean (SD)	8.53 years (2.10)
Maximum Coronal Angulation, Median (IQR)	17.00° (15.08-21.70)
Final Coronal Angulation, Median (IQR)	3.35° (2.10-5.40)
Maximum Sagittal Angulation, Median (IQR)	18.65° (11.06-23.75)
Final Sagittal Angulation, Median (IQR)	5.50° (3.48-10.00)
Difference Between Maximum & Final Coronal Angulation, Mean (SD)	13.30° (5.16)
Difference Between Maximum & Final Sagittal Angulation, Mean (SD)	11.27° (7.07)
Rate of Coronal Remodeling Over 6 Months, Median (95% CI)	**2.30°/month (2.00° - 2.59°)**

Figure 1. *Descriptive statistics of cases included in analysis, highlighting the rate at which coronal remodeling was seen to occur.*

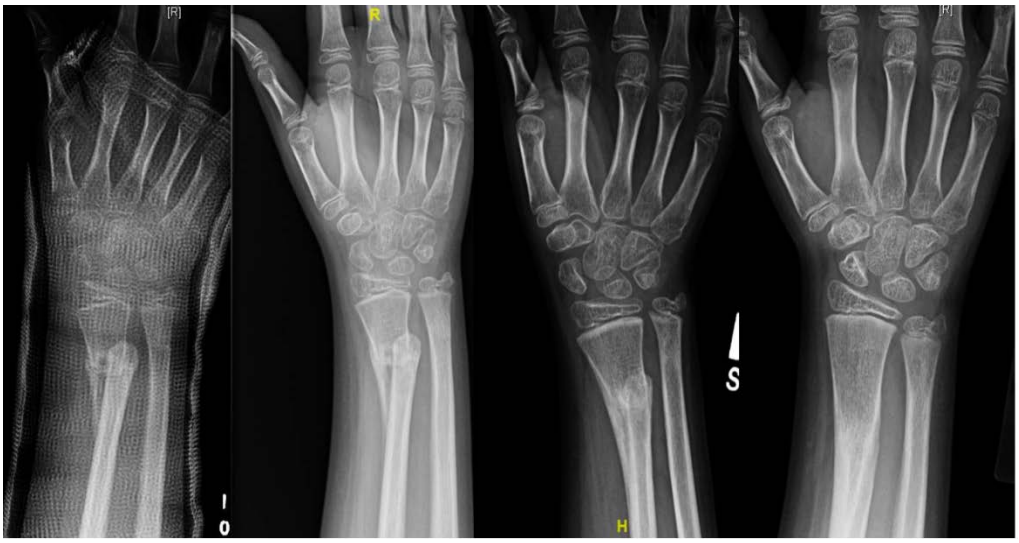

Figure 2. *Example of the progression from maximum coronal angulation and the eventually resolved angulation at final follow-up without intervention. Nine-year-old male showing maximum angulation on the left (19.6°) and angulation at final follow-up on the right (2.9°). Time between maximum angulation and final follow-up was approximately 7 months.*

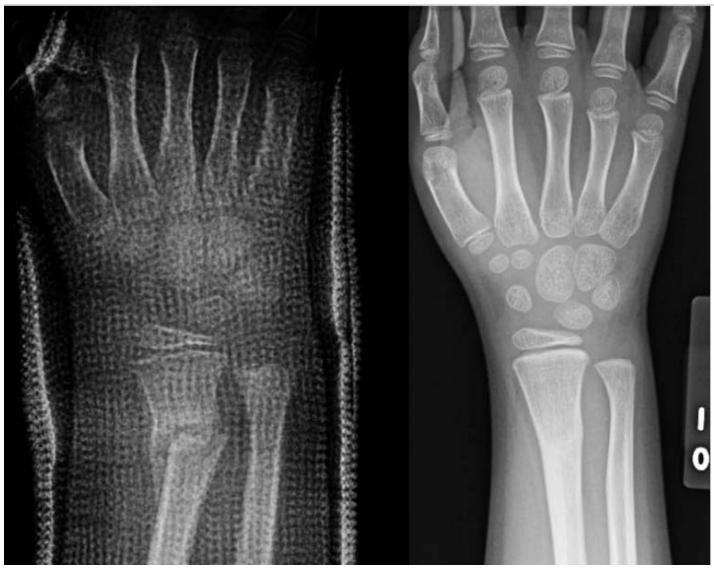

Figure 3. *Example of maximum coronal angulation and resolved angulation at final follow-up. Six-year-old male showing maximum angulation (22.2°) and angulation at final follow-up (3.6°). Time between maximum angulation and final follow-up was approximately 6 months.*

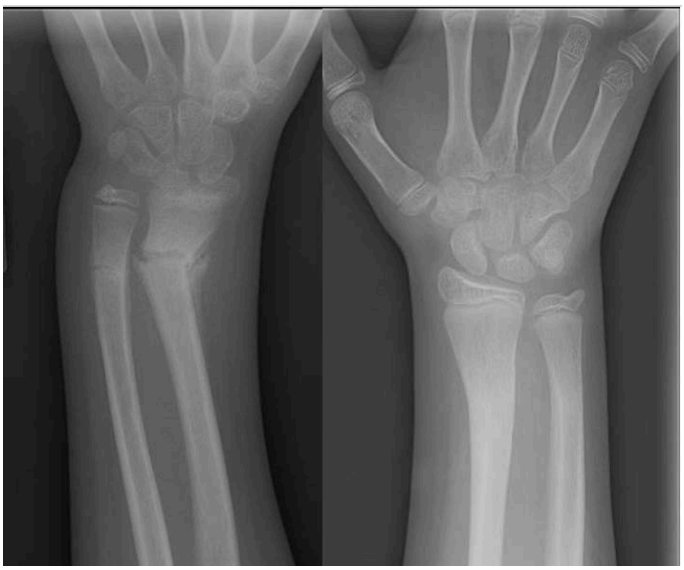

Figure 4. *Example of maximum coronal angulation and resolved angulation at final follow-up. Twelve-year-old male showing maximum angulation (13.94°) and angulation at final follow-up (3.73°). Time between maximum angulation and final follow-up was approximately 4 months.*

reliable fashion. These injuries should be expected to remodel at a rate of 2° per month. Repeat manipulation is not indicated in patients where the maximum coronal angulation is less than 24°, which provides a conservative estimate of the amount of remodeling that can be expected to occur in the first year following fracture.

Significance: These findings provide a standard for acceptable coronal plane angulation, which should reduce treatment variability among orthopaedic surgeons and limit the number of surgical interventions that likely are not necessary given the distal radius' ability to remodel.