Metacarpal Length Prediction via Adjacent Metacarpals without Computational Aid

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INTRODUCTION: The purpose of this study is to generate validated prediction rules for metacarpal lengths that can be applied without the need of computation tools to assist with restoration of anatomic length after fracture and utilizes only ipsilateral metacarpals. With the prediction rules anatomic length will be able to be determined when contralateral images are not present or when contralateral radiographs were obtained in different enough conditions such that the lengths may not be representative of the hand of interest.

METHODS:
The anatomic lengths of all hand bones in 50 hands (25 men, 25 women) were used along with linear regression subset analysis to determine which metacarpals are the most predictive of each other. The most predictive metacarpals were then used to generate simple addition and subtraction prediction rules via simplifying the linear equation generated by the linear regression analysis. Those rules were then applied to subsequent test cases and percent accuracy within various cutoffs were analyzed and compared to the accuracy when using the contralateral side.

RESULTS: The prediction rules (Table 1) were generated and were found to be identical for both men and women. When applied to the test cases the estimated metacarpal lengths were within 3mm of the actual value in 97.5% of the cases for women and 90% of the cases for men compared to 95% when using the contralateral side (Table 2).

DISCUSSION AND CONCLUSION: The simple additional and subtraction rules generated in this analysis were as good or superior to using the contralateral side in all cases for women and were as good or superior to using the contralateral side in for metacarpals 3-5 for men.

Table 1: Final Prediction Rules for Each Metacarpal

	M2	M3	M4	M5
Men	M3+0.2cm	M4+0.75cm	M3-0.75cm	M4-0.5cm
Women	M3+0.2cm	M4+0.75cm	M3-0.75cm	M4-0.5cm

Figure 1: Radiograph with Metacarpal Lengths Highlighting an Example of a Hand Following the Prediction Rules

Table 2: Percent Accuracy of Estimated Metacarpal Lengths of the Test Set Using Both the Prediction Rules and the Contralateral Side. The Highest Accuracy for Men is in Blue and Green for Women for Each Threshold

	Percent Within mm Range			
Within 3mm	M2	M3	M4	M5
Men Estimate	80	100	100	80
Women Estimate	100	100	100	90
Contralateral	100	100	100	80
Within 2mm				
Men Estimate	80	90	80	70
Women Estimate	100	90	90	80
Contralateral	100	80	80	40
Within 1mm				
Men Estimate	30	40	40	50
Women Estimate	70	70	70	70
Contralateral	50	60	40	40