



# Comparison of the Validity of Goniometer and Visual Assessments of Angular Joint Positions of the Hand and Wrist

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## Objectives

**Primary objective:** Compare goniometric and visual assessments of angular hand and wrist joint positions. We hypothesize that visual estimation is similar to goniometric measurements using standard hand radiographs of 3 sets of metacarpal phalangeal (MP), proximal interphalangeal (PIP), and wrist joint positions of a single volunteer.

**Secondary objective:** Compare both goniometric and visual assessments of angular MP joint, PIP joint, and wrist joint positions with measurements obtained from plain hand radiography (x-ray).

## Methods

The wrist, MCP, and PIP joints were evaluated in different positions by 40 observers: 20 board certified hand surgeons and 20 certified hand therapists.

Each observer visually estimated the position of each wrist, MCP, and PIP joint followed by goniometer measurement.

The control measurement was determined by obtaining multiple plain radiographs of the hand and wrist positioned in each splint.

Authors and study volunteers were blinded to the results of control measurements.

A pre-defined acceptable difference between visual and goniometer assessed joint angles was defined as  $\pm 5$  degrees compared to radiograph controls.

## Results

Neither visual assessments nor goniometer assessments were significantly closer to the control measurements. (Table 1)

Goniometer measurements tended to be closer to radiographic assessments overall when compared to visual assessments but were not significant except for the PIP joint ( $p < 0.001$ ). (Table 1).

Differences in measured joint angles between visual and goniometer assessments were not statistically different among assessments made by surgeons and hand therapists (Table 2).

**Table 2: Comparison of differences of visual and goniometer measured joint angles between surgeons and hand therapists**

Joint angle measure	Surgeons (N=20)		Hand therapists (N=20)		P-value
	Median (Range) Absolute Difference	No. (%) of absolute differences $\leq 5$ degrees	Median (Range) Absolute Difference	No. (%) of absolute differences $\leq 5$ degrees	
PIP orthosis 1	5 (0, 36)	16 (80%)	5 (0, 42)	15 (75%)	0.97
PIP orthosis 2	5 (0, 24)	12 (60%)	10 (0, 30)	8 (40%)	0.20
PIP orthosis 3	10 (0, 23)	9 (45%)	10 (0, 25)	8 (40%)	0.94
MP orthosis 1	5 (0, 42)	12 (60%)	5 (0, 30)	14 (70%)	0.92
MP orthosis 2	5 (0, 30)	11 (55%)	5 (0, 50)	11 (55%)	0.78
MP orthosis 3	5 (0, 30)	15 (75%)	5 (0, 15)	13 (65%)	0.96
Wrist orthosis 1	3 (0, 30)	14 (70%)	5 (0, 50)	11 (55%)	0.24
Wrist orthosis 2	5 (0, 12)	14 (70%)	5 (0, 12)	14 (70%)	0.55
Wrist orthosis 3	5 (0, 40)	13 (65%)	5 (0, 15)	15 (75%)	0.18

PIP=proximal interphalangeal. MP=metacarpal phalangeal. P-values result from a Wilcoxon rank sum test.

**Table 1: Comparison of accuracy as measured by x-ray between visual and goniometer measured joint angles for all observers**

Joint angle measure	Visual measurement vs. x-ray measurement		Goniometer measurement vs. x-ray measurement		P-value
	Median (Range) Absolute Difference	No. (%) of absolute differences $\leq 5$ degrees	Median (Range) Absolute Difference	No. (%) of absolute differences $\leq 5$ degrees	
PIP joint angle orthosis 1	8 (2, 32)	9 (23%)	3 (2, 25)	22 (55%)	<0.001
PIP joint angle orthosis 2	11 (1, 41)	2 (5%)	6 (0, 41)	10 (25%)	0.005
PIP joint angle orthosis 3	8 (2, 23)	15 (38%)	3 (2, 12)	23 (58%)	<0.001
MP joint angle orthosis 1	10 (0, 30)	14 (35%)	15 (0, 45)	9 (23%)	0.69
MP joint angle orthosis 2	7 (2, 17)	14 (35%)	3 (2, 38)	24 (60%)	0.35
MP joint angle orthosis 3	11 (1, 21)	6 (15%)	6 (1, 21)	9 (23%)	0.015
Wrist joint angle orthosis 1	10 (0, 45)	9 (23%)	6 (0, 25)	11 (28%)	0.084
Wrist joint angle orthosis 2	7 (2, 32)	17 (43%)	7 (1, 35)	19 (48%)	0.85
Wrist joint angle orthosis 3	7 (0, 28)	19 (48%)	7 (0, 28)	16 (40%)	0.56

PIP=proximal interphalangeal. MP=metacarpal phalangeal. P-values result from a Wilcoxon signed rank test.

## Discussion

The use of hand held goniometers to measure joint positions of the hand and wrist in a busy hand surgery practice can be time consuming and subject to variability. Over the course of years of clinical practice, hand surgeons and hand therapists, in particular, will have measured a plethora of difference joint angles and it is hypothesized that they have the capacity to accurately measure joint angles visually. The findings of this study support our original hypothesis with the exception of measurements of the PIP joint.

## Conclusions

There is a statistical advantage to measuring the angular position of the PIP joint with a goniometer compared to visual estimation.

There is no statistical advantage to measuring the angular position of the MCP or wrist joint with a goniometer compared to visual estimation.

There was no difference in the accuracy when comparing board certified hand surgeons and certified hand therapists

## References

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