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## A Survey to Determine the Reliability of Dynamometer and Pinch Gauge Dial Readings Among Certified Hand Therapists

### Abstract

Using a cross-sectional descriptive study design, surveys were mailed to 200 randomly selected certified hand therapists of the American Society of Hand Therapists (ASHT) to determine how they document analog dynamometer and pinch gauge dial readings. Three different needle settings for the dynamometer and pinch gauge were presented in picture format. For each instrument, one needle setting was just above a gauge marker, one was just below a gauge marker, and one was set exactly between two gauge markers. A total of 126 out of 200 surveys were returned for a participation rate of 63%. For the dynamometer readings, therapists estimated the exact strength reading between the two gauge markers 78.3% of the time. For the pinch gauge readings, therapists rounded to the nearest dial marker 76.5% of the time when the needle was just above or just below a dial marker and 61.9% of the time they estimated the reading when the needle was placed exactly between two dial markers.

### Keywords

Hand, Hand Strength, Dynamometer, Pinch Gauge

### Credentials Display

Theodore I. King II, Ph.D., L.Ac.

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Grip and pinch strength are important measures for occupational therapists working with patients who may have compromised strength. Grip and pinch strength norms have been developed by many authors based on age and gender using a variety of analog measurement devices (Bear-Lehman et al., 2002; Mathiowetz et al., 1985; Mathiowetz Wiemer, & Federman, 1986; Surrey et al., 2001). The American Society of Hand Therapists (ASHT) published recommendations on standardized procedures for measuring hand strength using a hydraulic analog dynamometer (ASHT, 1992). None of these sources indicate how strength readings were recorded for dynamometer measurements with analog devices using a needle gauge with five-pound increments while only two of the studies noted that readings on the pinch gauges were recorded on the needle side of the red marker (Mathiowetz et al., 1985; Mathiowetz et al., 1986). An online psychometric text states that it is important to “be clear and consistent on the ‘rounding’ rules” (Hale, 2011, p. 187) when recording the results of an assessment.

The purpose of this study was to survey certified hand therapists of ASHT to determine whether they estimate or round the results of strength measurements when reading the needle positions shown on the dials of analog dynamometers and pinch gauges. An estimated number is one that is approximated between two points on the gauge. A rounded number is one that is used because the needle is close to that number on the gauge. This study may benefit therapists by standardizing the procedure for recording results

when measuring grip and pinch strength in patients. Standardized procedures will help to reflect accurate measurements for documentation purposes and ensure appropriate comparison with measurements taken by another therapist or with prior measurements on the same patient or to established norms.

## **Method**

### **Participants**

Using a cross-sectional descriptive study design, a survey was sent to a randomized sample of ASHT certified hand therapists. The investigator obtained subjects for the study by purchasing a randomized sample of 200 address labels from ASHT, representing certified hand therapists.

### **Procedures**

The Institutional Review Board of the university where the investigator is employed approved this study. A cover letter was sent to potential subjects noting that their participation was completely voluntary. Returned surveys did not include information that would identify the subjects.

### **Instrument**

The survey included a picture of the dial on a hydraulic dynamometer that indicated three specific needle positions (see Fig. 1). The first needle position was slightly above the 65 lbs dial marker. The second needle position was slightly below the 110 lbs dial marker. And, the third needle position was exactly between the 125 and 130 lbs dial markers. The survey requested that participants note how they would record the three readings for documentation purposes. The survey also included a picture of the dial on a mechanical

pinch gauge that indicated three specific needle positions (see Fig. 2). The first needle position was slightly above the 16 lbs dial marker. The second needle position was slightly below the 18 lbs dial marker. And, the third needle position was exactly between the 21 and 22 lbs dial markers. The survey asked participants to note how they would record the three readings for documentation purposes.

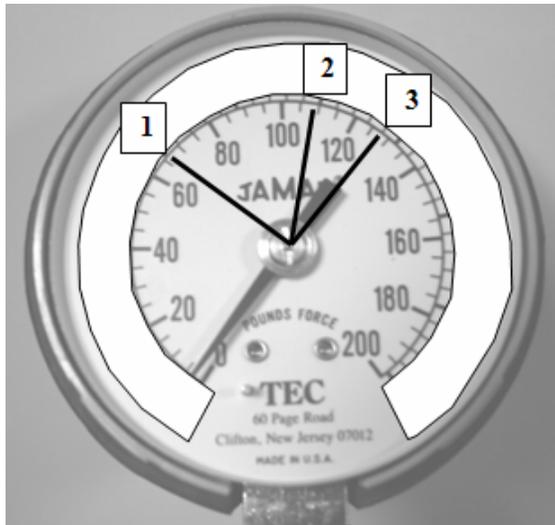


Figure 1. Survey Dynamometer Readings.

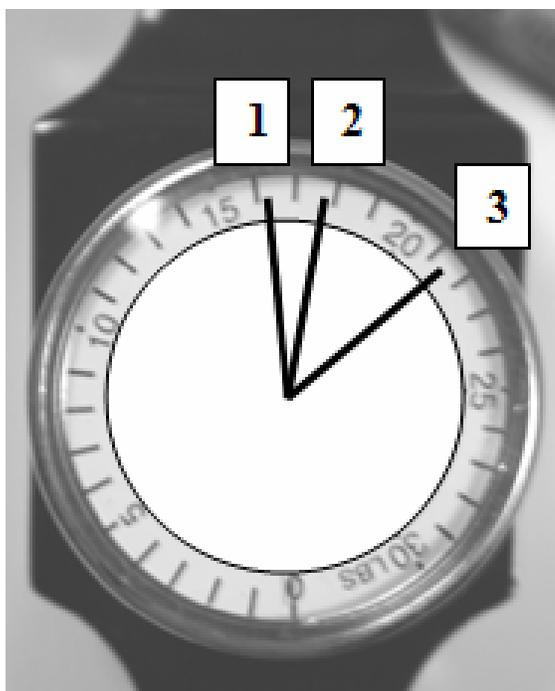


Figure 2. Survey Pinch Gauge Readings.

## Data Analysis

As the study was a survey, it employed only descriptive statistics noting the percentage of survey participants who rounded readings on the dynamometer and pinch gauge to the nearest dial marker and those who estimated the reading to a number between the dial markers.

## Results

The researcher received a total of 126 out of the 200 surveys for a participation rate of 63%. See Table 1 for the results of the survey pertaining to the dynamometer readings. In each of the three needle settings, survey participants tended to estimate the reading to a number between the dial markers rather than round to the nearest marker. Sixty-nine percent estimated the reading for the dial position slightly above 65 lbs. Eighty-one percent estimated the reading for the dial position slightly below 110 lbs. And approximately 85% estimated the reading for the dial position set exactly between 125 and 130 lbs. Table 2 summarizes the results of the survey pertaining to the pinch gauge readings. In this case, the majority (62%) estimated rather than rounded the readings for the dial position set exactly between 21 and 22 lbs. When the dial reading was slightly above 16 lbs, the majority (80%) rounded rather than estimated to the 16 lbs marker. When the dial reading was slightly below 18 lbs, the majority (73%) rounded rather than estimated to the 18 lbs marker.

Table 1

*Dynamometer Readings by Survey Participants*

| <b>Needle Position (see Fig. 1)</b> | <b>Rounded to a Marker</b> | <b>Estimated Reading</b> |
|-------------------------------------|----------------------------|--------------------------|
| Slightly Above 65 lbs.              | 39 (31%)                   | 87 (69%)                 |
| Slightly Below 110 lbs.             | 24 (19%)                   | 102 (81%)                |
| Exactly Between 125 & 130 lbs.      | 19 (15.1%)                 | 107 (84.9%)              |

Note.  $n = 126$

Table 2

*Pinch Gauge Readings by Survey Participants*

| <b>Needle Position (see Fig. 2)</b> | <b>Rounded to a Marker</b> | <b>Estimated Reading</b> |
|-------------------------------------|----------------------------|--------------------------|
| Slightly Above 16 lbs.              | 101 (80.2%)                | 25 (19.8%)               |
| Slightly Below 18 lbs.              | 92 (73%)                   | 34 (27%)                 |
| Exactly Between 21 & 22 lbs.        | 48 (38.1%)                 | 78 (61.9%)               |

Note.  $n = 126$

### Discussion

As grip and pinch strength measurements are a common and useful tool to determine the level of disability and treatment outcomes in therapy, it is important that therapists measure and record these

data in a consistent manner. Reviewing the literature related to the development of grip and pinch strength norms gives no direction as to how to record readings on an analog dynamometer or pinch gauge dial when the needle indicator falls between two dial markers. As indicated by this survey study, most therapists estimate the reading between two markers on a dynamometer dial probably because the difference between two markers is five pounds. With the pinch gauge, most therapists rounded the reading to the closest dial marker unless the needle rested exactly between two dial markers. This is probably due to the fact that the distance between two dial markers on a pinch gauge indicates only one pound.

The results of this study indicate inconsistencies in reading and recording analog dial readings on dynamometers and pinch gauges, and shows that a standardized procedure should be established. Based on this study, it seems appropriate to develop a standard to estimate the reading between two dial markers on the dynamometer as there is a five-pound difference between the markers. Whereas, it is best to round to the nearest marker on the pinch gauge unless the needle appears to be exactly between two markers.

### Limitation

The survey participants were certified hand therapists of the ASHT, which may not reflect how occupational therapists in general may record dynamometer and pinch gauge readings. The study did not collect demographic data on the subjects (viz., age, years in practice, or profession), which

may influence the interpretation of dynamometer and pinch gauge readings.

**Implications for Further Research in Occupational Therapy**

Lack of reliability has been demonstrated by this study related to the reading and documentation

of the results in using analog dynamometers and pinch gauges. Further inter-rater reliability studies including demographic data of the subjects would be helpful in developing standardized procedures.

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