Pinch and Grasp Strength: Standardization of Terminology and Protocol

(hand, prehension, tests)

Roger O. Smith   Margie Wadlington Benge

We implemented a tridirectional survey to begin the standardization process for grasp and pinch terminology and protocols for testing and to improve the communication between rehabilitation professionals who assess hand strength. We surveyed the literature, occupational therapy clinics across the country, and occupational therapy educational programs. Our results reveal the current use, teachings, and recommendations of pinch and grasp strength measurement. The results confirm that the standardization of grasp and pinch terminology and protocols for testing are vitally needed. Specific recommendations to continue this standardization process are recommended.

Grasp and pinch strengths are commonly measured in hand function evaluations. They have achieved a high degree of face validity because of the objectivity of measurement devices, the relative simplicity of administration, and the establishment of normative data. However, grasp and pinch terminology and protocols for testing are not standardized and differ widely from clinic to clinic. This significantly detracts from the reliability and validity of using grasp and pinch strength tests. This study determines the consistency of terminology, equipment, and protocols used by occupational therapists in testing pinch and grasp.

Literature Review

The literature reveals that many different protocols are available for evaluating grasp and pinch strength. For example, in 1970, Kellor and others (1) published norms for grasp and pinch, which were later published by Sister Kenny Institute (2). The protocols on which Kellor's norms are based include giving each subject two trials for grasp and then recording the highest measurement. One trial was given for pinch, and the highest measurement was recorded. Subjects could rest their forearms on the table, but could not allow the dynamometer to touch anything. Otherwise, arms could be positioned to comfort, with elbows either flexed or extended. Her terminology for pinch testing includes three-point, lateral, and palmar.

In her book on physical disability, Trombly (3) uses the norms from Kellor's (1, 2) article. Their protocols for testing are basically the same; however, they are more specific in that they recommend two to three minutes of rest in between dynamometer readings. Their terminology includes tip, palmar, and lateral.

The American Society for Surgery of the Hand recommends three trials for grasp and pinch (4). All three trials are recorded, along with the calculated percentage relative to pretreatment value and to

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the other hand, Jamar dynamometer position is generally kept at the second notch, but no other instructions regarding patient positioning are provided. Pinch terminology recorded is lateral and tip.

The book Rehabilitation of the Hand (5) refers to grip and pinch testing in several chapters. In chapter 8, Swanson and others recommend three trials for both tests. The Jamar dynamometer handle is spaced at 6 cm, and the extremity is not supported. Pinch terminology includes chuck pinch (three-digit pinch), pulp pinch with separate fingers, and lateral pinch. Chapter 8 also documents the use of normative data developed by Swanson and others. In chapter 5, Fess (6) recommends that three trials for both pinch and grasp testing be done and that their average be recorded. The dynamometer handle is kept at the second notch. Pinches tested include key and tip.

Instructions for the Jamar dynamometer (7) do not provide any specific protocols or norms. However, they do hint at using two trials with five minutes of rest in between.

Melvin (8) specifically addressed protocols for the arthritis population. She stated that every method conceivable for testing grasp has been suggested, but she recommends a specific protocol. She advocates using the sphygmonometer rather than the dynamometer and suggests three trials with a specific positioning protocol. All trials and the average are reported.

A variety of grasp and pinch measurement devices are available from rehabilitation equipment distributors (9, 10), and research projects have designed other specialty meters (11–14). The literature also reveals the existence of numerous sources of normative data (2, 5, 15–18). The diverse use of terminology is also evident in the literature. AOTA's book Sample Forms for Occupational Therapy (19) shows the common use of different names for pinch. In this book, four prominent hospitals list six different names for the types of pinch they measured.

The literature shows a wide variety of procedural differences regarding number of trials given, scores documented, measurement devices, normative data sources, and terminology usage. Furthermore, most references do not detail any protocol used for body placement or equipment calibration. Written sources provide little guidance in selecting the most appropriate pinch and grasp testing methods.

Methods

We sent a survey questionnaire to 510 occupational therapy clinics and 115 occupational therapy schools in the United States. Questionnaires were sent to all clinics listed in AOTA's 1975 Facilities Directory (20) under the categories of general medicine and surgery or physical disabilities. All schools listed in AOTA's 1983 brochure on educational programs (21) were included. The rate of return was greater than 30%. The survey included the following four specific sections: a) terminology, b) equipment, c) protocol and d) rationale.

Results

Demographics

Of the 195 valid questionnaires returned, 31 originated in educational programs and 164 in physical disabilities clinics. Responses from nonphysical disability occupational therapy clinical settings were omitted from the analysis. Thirty-eight states were represented, with the majority of the respondents being from California (10.8%), Texas (8.7%), New York (7.7%), Wisconsin (7.7%), and Ohio (6.7%). Clinics identified themselves as serving a general hospital (51.8%), a rehabilitation facility (39%), and a hand clinic (14.4%). The schools represented large and small occupational therapy programs and had a mean of 34 graduates per year. Responding clinics' staffing averaged 7.9 positions, with a range of 1–43 therapists. The average clinic hosted 5.8 affiliating students per year.

Terminology

Respondents were asked to identify pinch diagrams according to the terminology used in their setting. Table 1 shows diagram 1, for which 29 variations of terminology were listed, and gives the higher percentage responses. The many terms describing diagram 1 varied greatly from the higher percentage responses. They included:

a) true pinch,
  b) neat tip prehension, and
  c) fingertip two point.

Table 2 depicts diagram 2, for which 46 variations of terminology were listed, and gives the higher percentage responses. Varied responses included:

a) radial digital,
  b) cylindrical radial palmar, and
c) palmar tripod.

Table 3 portrays diagram 3, for which 48 variations of terminology were suggested, and gives the higher percentage responses. Variations included:

a) terminal prehension with fingertips,
  b) inferior radial, and
c) superior forefinger.

Seven different terms described diagram 4. Table 4 shows diagram 4 and gives the higher percentage
responses. Varied responses included:

- a) scissor,
- b) inferior, and
- c) pad to side.

Besides giving names to pinch, respondents tested different combinations of pinch. Table 5 reports the percentage of respondents standardly testing the pinch portrayed in the four diagrams.

### Grasp Equipment

Surveyed settings listed the use of nine different brands of dynamometers. Approximately 40% of the respondents indicated they used more than one type of meter. Over 79% stated that the Jamar dynamometer was the meter most commonly used in their settings.

Most dynamometers were purchased from Preston (31.3%), Fred Sammons (28.7%), and Abbey Medical (5.6%). The measurement scales used were pounds (76.9%), both pounds and kilograms (10.5%), and only kilograms (4.6%).

Over two dozen sources of normative data were identified. Many respondents mentioned using more than one source. More than 54.2% of the respondents use norms from Trombly and Scott (3), Sister Kenny (2), or Kellor (1), all of which originated with Kellor.

### Grasp Protocol

The majority of respondents indicated that they used a consistent strength testing protocol. However, 38.4% stated that they had inconsistent use of their protocol or had none at all.

Over half of the respondents stated that patient comfort was used to determine hand fit of the dynamometer. No other major percentage response was noted regarding specifications of hand fit to the grasp meter. However, some settings listed use of only certain notches of the dynamometer, with no consistency between the settings as to which notch. Other respondents explained that their determination of hand fit was based on the muscle groups they planned to evaluate.

Neutral forearm placement was used by 80.5% of the settings—8.7% used patient comfort as a guide to forearm placement. Over half of the respondents said that elbows should be flexed 90° for grasp strength measurement—

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**Table 1**

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent Used in Conjunction With Other Terms</th>
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</thead>
<tbody>
<tr>
<td>Three jaw or three jaw chuck</td>
<td>41.4</td>
</tr>
<tr>
<td>Three point</td>
<td>13.6</td>
</tr>
<tr>
<td>Palmar</td>
<td>8.4</td>
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* Many settings responded with more than one name for this type of pinch.

**Table 2**

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent Used in Conjunction With Other Terms</th>
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<tbody>
<tr>
<td>Tip</td>
<td>32.8</td>
</tr>
<tr>
<td>Tip to tip</td>
<td>16.1</td>
</tr>
<tr>
<td>Fingertip</td>
<td>11.5</td>
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</table>

**Table 3**

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent When Used in Conjunction With Other Terms</th>
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<tbody>
<tr>
<td>Palmar</td>
<td>31.0</td>
</tr>
<tr>
<td>Pad to pad</td>
<td>11.1</td>
</tr>
<tr>
<td>Two point</td>
<td>8.2</td>
</tr>
</tbody>
</table>

**Table 4**

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent</th>
<th>Percent When Used in Conjunction With Other Terms</th>
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</thead>
<tbody>
<tr>
<td>Lateral</td>
<td>79.8</td>
<td>95.3</td>
</tr>
<tr>
<td>Key</td>
<td>4.1</td>
<td>18.1</td>
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**Table 5**

<table>
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<tr>
<th>Percentage of Pinches Used in Standardized Testing</th>
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<tbody>
<tr>
<td>Diagram 1</td>
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<tr>
<td>Diagram 2</td>
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<tr>
<td>Diagram 3</td>
</tr>
<tr>
<td>Diagram 4</td>
</tr>
<tr>
<td>Other</td>
</tr>
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</table>
32.4% of these did not support the elbow and 20.5% did. Some respondents (14.1%) said they tested with the elbow extended, and the same percentage said they used patient comfort to determine arm placement. The majority of hand strength testing was performed sitting (80.5%), some during standing (1.6%), and some without any particular instructions (9.5%).

The number of grasp trials used was also varied: three trials (61.9%), two trials (14.3%), one trial (13.8%), or a combination of the above (9.5%).

The strength score therapists documented varied: some documented the mean (44.4%), some documented the highest score (35.4%), and some documented multiple figures (10%).

The length of rest periods in between trials was also inconsistent as follows: Some provided rest by alternating hands (35.9%), some had no protocol for rest periods (32.8%), and some listed a specific resting time frame varying from 2 to 180 seconds between trials (13.1%).

Verbalizations used by the settings during testing also varied as follows: Patients verbalized only instructions (34.7%), patients received encouragement through coaching (64.2%).

Pinch Equipment and Protocol

Pinch equipment and protocol were generally similar to grasp. Ten different pinch gauges were used with over 50% of respondents using a pinch gauge measuring 0–30 lbs. Less than 5% of the respondents listed variations of pinch testing protocols from grasp protocols.

Rationale

A significant number of respondents indicated that they had no particular reason for using the specific terminology (35%), equipment (35%), or protocols (27.4%) that they used.

Demographic Analysis

Responses were additionally analyzed in their relationships to demographic characteristics. Independent variables included regions, respondent types, and the existence of protocols. No important regional differences were discovered, nor were any differences noted between respondents who used protocols consistently and those who did not. However, whether a respondent was a clinic or a school, did result in differences. “Eyeballing” the data showed that generally educational programs taught a wider assortment of terms than were used by clinics. Normative data used by schools also were more varied, and a high percentage of norms were from textbooks. In contrast, clinics tended to use normative data from clinical settings.

Discussion

The measurement of grasp and pinch strength is in desperate need of standardized terminology and protocols. The poor continuity in grasp and pinch terminology and protocol has severe implications for the quality of occupational therapy assessment. In a clinic, this inconsistency reduces the reliability of testing between therapists. When patient records are transferred between clinics, inconsistent terms and protocols make interpretation of scores unreliable and consequently invalid. Additionally, it is becoming more frequent for hand occupational therapists to provide legal testimony. The consequences of such testimony can reach far: The professional interpretation of an “objective” occupational therapy test can alter the course of a patient’s life.

Our literature review, combined with survey information from occupational therapy schools and clinics nationwide, suggests strongly that specific actions are needed to standardize the methods by which therapists measure pinch and grasp strength. Dozens of terms were used to name just four diagrams of pinch. This clearly indicates that therapists throughout the country do not use or teach consistent terminology.

The survey reveals not only that multiple normative data sources are used by respondents but also that a large proportion are used incorrectly. There is a significant discrepancy between the number of respondents using Kellor’s (1, 2) normative data and the number of respondents using the protocol she used in collecting the data. More than 54.2% of respondents use norms originating from Kellor, who used the highest score of two trials. In contrast, 75% of the survey respondents use one or three trials, and only 35.4% document the highest score. In fact, many protocols overtly suggest using Kellor’s norms but recommend conflicting protocols despite Kellor’s specific instructions to the contrary. Furthermore, Kellor’s norms are based on using a Jamar dynamometer; in practice, however, her norms are used with various types of dynamometers.

The survey information points out that large numbers of schools and clinics do not have consistent protocols. Those that do have protocols differ significantly from each other.

The collected information enables us to make several recommendations. First, more research is
needed to specify the advantages and disadvantages of various aspects of types of equipment and protocols. We need more empirical studies on appropriate protocols for grasp and pinch strength measurement.

Second, AOTA and national rehabilitation associations need to facilitate the acquisition of the most advantageous terminology, equipment, and protocols. When adequate guidelines for pinch and grasp protocol are obtained, formal association recommendations should be adopted.

Third, occupational therapy educational programs need to teach specific protocols to their students, along with the rationale for their use. This would replace the smorgasbord of information currently presented to students.

Finally, we recommend the consideration of guidelines for pinch terminology and protocols. Because of the obvious lack of logic in pinch terminology, which results in countless numbers of actively used terms, we suggest an anatomically descriptive base for pinch terminology. The following exemplifies such a descriptive and consistent base for terms:

- two-point tip pinch,
- three-point tip pinch,
- two-point pad pinch,
- three-point pad pinch, and
- lateral pinch.

We do, however, acknowledge the current use of pinch terms. Thus, adopting the frequently used terms three-jaw chuck, tip pinch, and lateral pinch might be the second best choice.

We abstain from recommending any specific protocol for testing as long as we do not have more data supporting certain methods. However, we strongly encourage the consistent application of the exact protocols used in obtaining the normative data when normative data charts are used.

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REFERENCES