Application of 10% rule in pinch strength, hand dominance on Indian population

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Abstract

Aims & Objectives: To Find the mean difference between Dominant & Non-dominant hand with respect to tip-to-tip, lateral & three jaw chuck pinch.

Methodology: 125 Subjects were selected. They were divided in five groups-50 school going children, 50 adults& 25 left handed subjects. They were briefly interviewed for their age& dominance. Standard position was demonstrated for assessing the pinches with dominant hand & non –dominant hand. Three major pinches were considered. These were tip-to-tip, lateral & three jaw chuck. Pinch strength readings were assessed from standard baseline pinch gauze, first from dominant & then from non –dominant hand.

Rational: Purpose of this study was to test the utility of 10 % rule in hand rehabilitation. According to Bechtol there is usually a 5% to 10% difference between normal dominant & non-dominant Hand. This rule has been used for grip strength for many years. I have chosen this study to find out if it is applicable to pinch strength as well.

Result:

1. For right hand dominant subjects, dominant hand pinch is stronger by 11 to 14 %.
2. For left handed subjects it varied from 14% to 32% depending on pinch mode.
3. Pinch strength increases with age.
4. Three jaw chuck pinch of each person is strongest of all followed by lateral pinch and tip-to-tip, that is the weakest pinch among all three modes.

Conclusion: From 125 subjects increase was observed from almost 11 to 14 % that violates 10% rule.

Introduction

Measurement of pinch strength is one of the important components of hand therapy. These are considered to be the predictors of upper extremity strength because they are based on the evaluation of functional hand’s limitation. Reliable and valid evaluation of hand strength is of importance in determining the affectivity of different procedure. It is widely accepted that, pinch strength measurement provides the objective index of functional integrity of upper extremity.

Baseline Pincho-meter by B &L Engineering co. is reported to be the most accurate and acceptable measures of pinch strength.

Therapist often uses the 10% rule as general guideline for goal settings. 10% rule dates back to 1954 when Bechtol observed that most patient presented a difference of 5% to 10% between dominant and non-dominant hand. Recent studies have attempted to provide a definitive picture of difference between dominant & non-dominant hand strength. Crosby et.al investigated normative values of hand grip, pulp and key pinch and claimed that the population as a whole demonstrate significant differences between dominant and non-dominant hand.

Several studies have since been conducted to establish normative data for grip strength measurement to be used on treatment guidelines. But this rule is being used to grip strength for many years. Purpose of this study is to find out if this rule is applicable to pinch strength as well.

Aims and objective:

To find the relationship of dominant and non-dominant hand pinch strength with respect to tip-to-tip, three- jaw chuck and lateral pinch modes.
Rational:
Sufficient strength is necessary to initiate all types of prehension pattern. Prehension can be accomplished through thumb opposition against four long fingers which allows different types of prehension. Both grasp and pinch strength, pulp to pulp of thumb and index finger may be diminished after the hand injuries. Both the parameters are often measured to establish the invalidity and to assess the improvement as well as to compare the effectiveness of various surgical procedure. If the relationship between the two hand’s pinch strength is established it become easier for the therapist to establish the goal for improvement of injured hand.

Review of literature:
1. Bechtol observed that most of patient presented a difference of 5% to 10% between their dominant hand and non-dominant hand.
2. Petersen et al. questioned whether 10% rule could be applied to whole population they found that average grasp strength in dominant hand was 12.7% stronger for Rt. Handed people. Left handed subject shared no such differences between dominant and non-dominant hand.
3. Nurgul Arinci Incel et al. conducted a study included 149 volunteers of dept. of a Ankara Research & education Hospital & concluded that pinch strength value were significantly stronger at dominant hand. Percentage of higher non-dominant pinch scores were 28.12% and 28.27% for Rt. & Lt. handers respectively.
4. Nitesh a physiotherapist conducted a study on 100 healthy (both Rt. Handed & Lt. hand subject between the age group 18-25 years. He concluded that there was overall hand - grip strength difference of 7.2% in favour of dominant hand.
5. Carl A. Corshy et al studied normal hand strength and difference between dominant and non-dominant hand. 214 volunteers were tested. A pinch gauge was used to assess Key and pulp pinch. Height, sex, hand dominance and hobby demands were predicted of maximum grip. Key pinch average was 22% while Pulp pinch average was 16% of maximum grip. Majority of Rt. Handed subjects have 10% stronger grip strength on dominant side. In left handed subjects, mean grip was same for both the hands. The non-dominant hand was stronger in 5% on Left- handed subject.

Methodology:
Subject Design:
Subject sample size - A total of 125 subjects were considered. They were divided in 5 groups and 3 sections - children, Adult & Left handers.
Children section consist of two groups, each having 25 subjects one for girls and one for boys, in adult section also have two groups, one for 25 ladies and other for 25 gents, third section consist of Lt Handers having mixed population of 25 persons.
In Indian population most of the persons were found to be Right handers. Therefore two sections were from Right handed population and only one section was from Left handed dominant subjects.

Source of subject: Govt. public school & general population.
Sample Design Random Sampling (lottery method)
Inclusion Criteria:
1. Normal adult subjects in age group 20-65 yrs.
2. Healthy subjects of age group 7-8yrs
3. Person with right or left hand-dominant.
(Dominant hand is defined as the hand with one prefer for daily activities like writing, eating and handling heavy objects etc).
Exclusion criteria:
1. Restriction of movement in upper limb
2. Any history of inflammatory joint disease of upper extremity
3. Any neurological disorders.
4. Any injury to upper Extremity
5. Ambidextrous individual.

Tools used:
1. Baseline pinch-gauge
2. Recording sheet

Procedure:
A Brief interview of age & dominance of each participant before preceding for each test, was conducted in order to determine if subject met the above criteria. Each Participant was first seated on the chair with straight back, without arm, feet resting flat on the floor, shoulder adducted & neutrally rotated, elbow flexed to 90°, forearm in neutral position & wrist between 0° to 30° extension, 0°-15° ulnar deviation (as per ASHT). Protocol of photographs was used to demonstrate to the participant, the standardized seating & pinch strength. Three major pinches were used to assess strength, first from dominant hand & then from non-dominant hand among all the three sections.

Section-1 - (Rt. handed dominant ) children aged 7-8yrs-25 girls 25 boys
Section-2 - (Rt. hand dominant ) adults-20 –65yrs. 25 ladies 25 gents.
Section-3 - (Lt. hand dominant)- 25 adults, mixed.

Mode of pinches used to assess the strength were tip-to-tip, three jaw chuck, lateral pinch.

Time of testing: Measurement were taken for all subjects around midday i.e. 11:00to 12:30 hrs as it proved to significantly stronger at these times.
Instruction: Instruction to subjects were given in the same tone and volume in order to discourage the over–bearance of instruction on the brain.

Number of trials & rest period: Each participant was instructed to provide three firm controlled pinches of each pinch position. Between each reading, 60 seconds of inter-trial rest was provided to avoid fatigue. Three consecutive maximum scores were recorded in each trial and the mean of each pinch was calculated.

Length of Contraction Time: Three attempts for each subject were conducted alternating right and left hands with one minute rest between two attempts to overcome fatigue. To counterbalance any order effect of starting hand, every other subject began the test with dominant, while those in between begin with non-dominant hand. Same researcher read the pinch-gauge dial to record various attempt to avoid human error. The gauge was reset to zero prior to each recording of pinch strength. Subjects were asked to give maximum effort.

Data analysis:

Mean is the average value of random variable, so mean of all five groups were calculated with the formula $\bar{x} = \frac{\sum x_i}{n}$. Percentage increase of each section was calculated with formula:

$$% \text{ increase} = \left( \frac{\text{Mean(dominant hand)} - \text{mean(non-dominant hand)}}{\text{mean(nondominant)}} \right) \times 100$$

For each mode of pinch.

Table 1 given below represents the mean and modes of pinches with Pneumonics.

**TABLE1:**
Details of means and pinch modes pneumonics

<table>
<thead>
<tr>
<th></th>
<th>M1 MEAN OF CHILDREN GROUP (RIGHT HANDED) (GIRLS)</th>
<th>M2 MEAN OF CHILDREN GROUP (RIGHT HANDED) (BOYS)</th>
<th>M3 MEAN OF ADULT GROUP (RIGHT HANDED) (LADIES)</th>
<th>M4 MEAN OF CHILDREN GROUP (RIGHT HANDED) (GENTS)</th>
<th>M5 MEAN OF LEFT HANDED (MIXED)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TT</td>
<td>TIP TO TIP PINCH</td>
<td>TIP TO TIP PINCH</td>
<td>TIP TO TIP PINCH</td>
<td>TIP TO TIP PINCH</td>
<td>TIP TO TIP PINCH</td>
</tr>
<tr>
<td>3JC</td>
<td>THREE JAW CHUCK PINCH</td>
<td>THREE JAW CHUCK PINCH</td>
<td>THREE JAW CHUCK PINCH</td>
<td>THREE JAW CHUCK PINCH</td>
<td>THREE JAW CHUCK PINCH</td>
</tr>
<tr>
<td>LAT</td>
<td>LATERAL PINCH</td>
<td>LATERAL PINCH</td>
<td>LATERAL PINCH</td>
<td>LATERAL PINCH</td>
<td>LATERAL PINCH</td>
</tr>
</tbody>
</table>

All the mean of five groups are given in table-2, 3 & 4 with the help of this data.

Bar graph (I&II) of each mean was also plotted with representation for right hand dominant subject and left hand dominant separately.

**TABLE 2**
Percentage strength increase

<table>
<thead>
<tr>
<th></th>
<th>TT (DOM)</th>
<th>TT (NOND DOM)</th>
<th>% INC (TT)</th>
<th>LAT (DOM)</th>
<th>LAT (NOND DOM)</th>
<th>% INC (LAT)</th>
<th>3JC (DOM)</th>
<th>3JC (NOND DOM)</th>
<th>% INC (3JC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>2</td>
<td>1.804</td>
<td>10.86475</td>
<td>2.556</td>
<td>2.256</td>
<td>13.29787</td>
<td>3.172</td>
<td>2.784</td>
<td>13.93678</td>
</tr>
<tr>
<td>M2</td>
<td>2.38</td>
<td>2.088</td>
<td>13.98467</td>
<td>2.668</td>
<td>2.396</td>
<td>11.35225</td>
<td>3.268</td>
<td>2.884</td>
<td>13.31484</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2.19</td>
<td>1.946</td>
<td>12.53854</td>
<td>2.61</td>
<td>2.325</td>
<td>12.25806</td>
<td>3.22</td>
<td>2.83</td>
<td>13.78092</td>
</tr>
<tr>
<td>M4</td>
<td>6.532</td>
<td>5.844</td>
<td>11.77276</td>
<td>7.524</td>
<td>6.776</td>
<td>11.03896</td>
<td>8.068</td>
<td>7.216</td>
<td>11.8071</td>
</tr>
</tbody>
</table>
TABLE 3
Comparison of means of right-handed dominant subject

<table>
<thead>
<tr>
<th>MEAN</th>
<th>TT (DOM)</th>
<th>TT (NONDOM)</th>
<th>LAT (DOM)</th>
<th>LAT (NONDOM)</th>
<th>3JC (DOM)</th>
<th>3JC (NONDOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>2</td>
<td>1.804</td>
<td>2.556</td>
<td>2.256</td>
<td>3.172</td>
<td>2.784</td>
</tr>
<tr>
<td>M2</td>
<td>2.38</td>
<td>2.088</td>
<td>2.668</td>
<td>2.396</td>
<td>3.268</td>
<td>2.884</td>
</tr>
<tr>
<td>M3</td>
<td>4.12</td>
<td>3.692</td>
<td>5.088</td>
<td>4.524</td>
<td>5.728</td>
<td>5.168</td>
</tr>
<tr>
<td>M4</td>
<td>6.532</td>
<td>5.844</td>
<td>7.524</td>
<td>6.776</td>
<td>8.068</td>
<td>7.216</td>
</tr>
</tbody>
</table>

TABLE 4
Comparison of means of left-handed dominant subject

<table>
<thead>
<tr>
<th>MEAN</th>
<th>TT (DOM)</th>
<th>TT (NONDOM)</th>
<th>LAT (DOM)</th>
<th>LAT (NONDOM)</th>
<th>3JC (DOM)</th>
<th>3JC (NONDOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>3.556</td>
<td>2.692</td>
<td>3.924</td>
<td>3.356</td>
<td>4.296</td>
<td>3.812</td>
</tr>
</tbody>
</table>

Results:

Following results were concluded from the above data

1. For right-handed-dominant subjects, dominant hand pinch is stronger by 10.8 to 14%
2. For left handed subjects it varied from 12.7% to 32.1% depending on pinch mode
3. Pinch strength increases with age
4. Three jaw chuck pinch of each person is strongest of all followed by lateral pinch hand tip-to-tip, which is the weakest pinch among all three modes.

Conclusion & Discussion:

For right hand subjects, dominant hand pinch strength was found to be stronger almost 10.8 to 14%, where as for left hand subjects wide variations are observed since it varied from 12.7 to 32.1%. Three jaw chuck pinch is stronger than the other two modes of pinches viz. lateral & tip to tip.

References:


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