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Hand Strength Changes Following a Clinical Rotation in Hand Therapy: A Pilot Study

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Hand Strength Changes Following a Clinical Rotation in Hand Therapy: A Pilot Study

Abstract

Background: Hand therapy clinical rotations are 12 weeks, and one common anecdotal change frequently expressed is an increase in hand strength. Quantifiable measures of change are not documented in the literature. The purpose of this study is to determine if students experience significant increases in strength during a clinical rotation.

Methods: This study is a quasi-experimental, double-blinded, non-randomized sample of convenience. Grip and pinch strength were assessed pre, mid, and post clinical rotation. Demographic data were collected and reported. Paired t-tests were used to compare means between groups. SPSS 27.0 was used for data analysis.

Results: After removing incomplete data sets, n = 12. Grip strength in the left hand showed a significant increase from pretest to posttest. Grip strength in the right hand showed no difference. Significant increases occurred in both right and left tripod pinch and lateral pinch strength from pretest to posttest. A significant increase was not observed for 2-point pinch strength.

Discussion: This study provides insight into the changes in hand strength in students after a clinical rotation in hand therapy. Significant changes in grip and pinch strength do occur during this time. Increased load in grip and pinch patterns may have clinical implications for therapists practicing long term.

Comments

The authors declare that they have no competing financial, professional, or personal interest that might have influenced the performance or presentation of the work described in this manuscript.

Keywords

cumulative trauma disorders, ergonomics, hand injury, hand therapy, health occupations, upper extremity

Cover Page Footnote

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Credentials Display

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In the United States, occupational and physical therapy students complete clinical rotations in the field after completing their required degree coursework. Students can complete a clinical rotation in a specialty field, and hand therapy is an area some students choose. Typical clinical rotations are 12 weeks, and one anecdotal, physical change frequently expressed by students is an increase in hand strength. Quantifiable measures of this change, however, are not currently documented in the literature.

Typical hand therapy daily practice requires frequent loading into the hands. In a 2014 study on hand therapy practice patterns, hand therapists reported spending the majority of their work time (80%) providing direct patient care (Keller et al., 2016). Respondents reported that over half (54%) of direct patient care involves the provision of hands-on therapeutic interventions. When rating the frequency of interventions used on a 1–5 scale (1 = *never*, 5 = *several times daily*), activities requiring loading through the hands were rated at high frequencies: manual therapy techniques (4.6), scar and edema management (4.3), and orthosis fabrication (3.0). No evidence of the impact of these forces on hand strength is reported (Keller et al., 2016).

In a study comparing the grip strength of manual and non-manual workers, manual laborers were identified as having greater grip strength; however, there is no documentation in the literature about the timeframe in which this change occurs (Saremi & Rostamzadeh, 2018). Several studies have documented an increase in hand strength to be possible in a timeframe of 4 to 12 weeks following structured training protocols (Dogu et al., 2013; Kong et al., 2014; Manning et al., 2014; Speed & Campbell, 2012). It should be noted that the aforementioned studies involved individuals with both acute and chronic conditions. A more recent study found a significant increase in hand grip strength in healthy adults following a training program of 8 weeks (Gerodimos et al., 2021). Though students completing hand therapy clinical rotations do not follow a structured hand strengthening program like those previously cited, there is anecdotal information to suggest grip strength change can occur over a short period. Literature supporting the influence of unstructured strengthening activities on hand strength has, to date, not been identified. The purpose of this study is to determine if students completing a hand therapy clinical rotation have statistically significant increases in hand strength over the course of 12 weeks.

Method

This study is a prospective, quasi-experimental, double-blinded, non-randomized sample of convenience that was conducted with clinical rotation students in hand therapy clinics across the United States. The Northern Arizona University Institutional Review Board approved the study, and informed consent was obtained from all participants.

Study Participants

Participants were recruited via virtual contact (email or phone call). The primary investigators contacted clinical rotation coordinators from various therapy programs across the United States to identify students assigned to a hand therapy placement as a part of their academic clinical rotation placements. The primary investigators also contacted individual hand therapists and hand therapy clinics that offer student clinical rotation opportunities with institutions not directly identified by the primary investigators. Finally, a clinic's Instagram account was used to recruit participants. Each of these three recruitment methods yielded broad geographic representation.

Sixteen participants were identified and completed the presurvey and initial measurements from January 2020 to December 2021. After removing four incomplete data sets, n = 12 for data analysis. Six of the participants attended the same university as the investigators but had no contact with the investigators at any time throughout the study.

Procedures

Before beginning the rotation, the participants completed a presurvey regarding their current physical activity levels and experience in the hand therapy setting. The participants completed a measurement of 3-point, 2-point, lateral pinch, and grip strength, following the Clinical Assessment Recommendations of the American Society of Hand Therapists (MacDermid et al., 2015). A hand-held dynamometer was used to record grip strength, and a pinch gauge was used to record lateral, tripod, and 2-point pinch strength over three trials, with the average used for statistical analysis. Both the hand-held dynamometer (grip strength) and pinch meter (pinch patterns) are valid and reliable performance measurement tools (Hamilton et al., 1992; MacDermid et al., 2001; Mathiowetz et al., 1984; Mathiowetz, 2002). Because change scores were analyzed, intrarater reliability was prioritized.

The participants' grip and pinch strength were measured before and after participating in the work tasks expected of a clinical rotation student over three time points: The start of the participants' rotation to the midpoint, from the midpoint to the conclusion of their rotation, and from the start of the rotation to the end of the participant's clinical rotation. The clinical instructors for each participant administered the strength testing. The participants also completed a postsurvey at the end of the rotation. For the duration of the rotation, the participants documented their experiences providing manual therapy and fabricating orthoses; these recorded experiences were reviewed by the research team in the postsurvey. Fewer than half of the participants completed the documentation logs and postsurvey; therefore, these findings were not analyzed because of inadequate numbers to present meaningful data or clinical relevance confidently.

Statistical Analysis

Data were collected and deidentified by one researcher. Data analysis was conducted by other members of the research team blinded to the participants. Descriptive statistics were used to report categorical demographics.

Data were intended to be stratified by prior activity level, self-identified gender, and hand dominance to determine if outcomes differed categorically. Several of the participants did not complete the survey, citing activity levels, and there was not an adequate sample to control for handedness or gender because the sample was predominantly right-handed and female. Considering group differences were limited, data were analyzed in one complete group (n = 12). SPSS 27.0 was used for data analysis.

Results

All participants included in this study completed a 12-week clinical rotation. Ages ranged from 23 to 35 years of age with a mean age of 25.642 (sd = 2.977). See Table 1 for demographics. Measurements of strength were gathered at pretest, mid-test, and posttest. See Table 2 for the summary of change between pre and posttest measures.

Table 1
Demographics

Self-Identified Gender	Male = 2	Female = 10
Handedness	Right = 12	Left = 0

Table 2

Summary of Change (Difference in Pre and Post Measures)

Variable	n	Mean	Std. Dev.	Min	Max	p-value at 95% CI
Right Grip	12	3.268833	7.891767	-6.46	17.76	0.179
Left Grip	12	5.019333	5.502021	-4.694	16.08	0.009
Right 2-point Pinch	12	0.8	2.35985	-3	3.7	0.265
Right Tripod Pinch	12	1.4475	2.253479	-3	5.3	0.047
Right Lateral Pinch	12	2.370833	3.091632	-2.33	7.3	0.022
Left 2-point Pinch	12	0.97	1.977023	-2.3	4.7	0.090
Left Tripod Pinch	12	2.371667	2.709246	-3	6	0.011
Left Lateral Pinch	12	1.5725	2.420102	-2	6.3	0.045

Note: A negative value indicates a loss in strength where the participant had a higher prescore than postscore.

Grip strength in the left hand showed a statistically significant increase from pretest to posttest ($p = 0.009$). Grip strength in the right hand showed no statistically significant difference. Statistically significant increases occurred in both right ($p = 0.047$) and left ($p = 0.011$) tripod pinch and right ($p = 0.022$) and left ($p = 0.045$) lateral pinch strength from pretest to posttest. A statistically significant increase was not observed in left 2-point pinch at the 95% confidence interval ($p = 0.090$); however, statistically significant changes would be observed at the 90% confidence interval. No significant increase was observed in right 2-point pinch strength.

Discussion

To the best of our knowledge, this is the first study of its kind to examine the impact of hand therapy clinical rotations on student grip and pinch strength. It should be noted that this study examines outcomes in hand therapy-specific clinical rotations only. The results are not compared to, nor are they a reflection of, hand strength changes for clinical rotations in other occupational or physical therapy settings. The students included in this study experienced statistically significant changes in grip (left hand) and pinch (right and left lateral and tripod) strength over 12 weeks. These findings are supported by previous literature citing improved hand strength to be possible in a short period of time (Dogu et al., 2013; Kong et al., 2014; Manning et al., 2014; Speed & Campbell, 2012). Dogu et al. (2013), Manning et al. (2014), and Speed and Campbell (2012) identified notable increases in grip strength following structured training programs for individuals with rheumatoid arthritis for a duration of 6 and 12 weeks, respectively (Dogu et al., 2013; Kong et al., 2014; Manning et al., 2014; Speed & Campbell, 2012). In addition, Gerodimos et al. (2021) found statistically significant changes in grip strength in healthy adults following an 8-week structured training program.

While some changes seen after 12 weeks were statistically significant, right-hand grip strength and bilateral 2-point pinch strength were not observed to significantly increase at a 95% confidence interval. Of note, existing literature provides mixed evidence of short-term change in dominant hand grip strength. Several studies have found statistically significant changes in both the dominant and non-dominant hands following training programs of varying lengths (Gerodimos et al., 2021; Kong et al., 2014; Speed & Campbell, 2012). However, one study provided results similar to those in this study, citing a statistically significant change in non-dominant hand grip strength but no change in grip strength of the dominant hand

(Manning et al., 2014). The inconsistency in such results may be attributed to the difference in the rigor of a structured training program versus daily manual labor, the small sample size in our study, or time spent performing relevant strength tasks.

There are several possible explanations for the discrepancy in changes between dominant and non-dominant hand strength in this study. All of the participants who completed the data collection in this study were right-hand dominant. It is cited that right-handed people have a significant difference in the strength of their dominant hand (approximately 10% more) compared to the left hand; however, this same difference is not observed in left-hand dominant individuals (Incel et al., 2002). To our knowledge, research to account for this difference has not been conducted. It can be speculated that this difference may be influenced by the design of most tools and instruments, which favor use with the right hand, causing the right hand to be used with load forces more often than the left on a daily basis.

Furthermore, the principles of strength and conditioning inform the loading required to achieve strength gains. The variation in load required to gain strength is dependent on an individual's one repetition maximum (1RM), which describes the maximum load a person can move during a specific exercise (Haff et al., 2015). Individuals with a higher 1RM will require a greater load to increase strength (Haff et al., 2015). In our study, it is possible that because of their right-handedness, subjects had sufficient strength (a higher 1RM) in the right hand before beginning the rotation, and the loads endured were not forceful enough to result in a statistically significant change in grip strength over the short time of a clinical rotation.

The strength gains observed in grip and pinch strength remain relevant for discussion of clinical implications for students completing hand therapy clinical rotations and therapists practicing in a hand therapy setting long term. College students spend significant time before clinical rotations physically inactive (Devereaux et al., 2021; Keating et al., 2005; Moulin et al., 2021). The sudden shift from relatively sedentary, low-load activities required in the classroom toward more active use of hands for manual tasks in a clinical setting appears to contribute to changes in hand strength in students following a hand therapy clinical rotation.

The same loads that contributed to changes in hand strength for the students in this study are also present for clinicians working in hand therapy settings for extended periods. Hand therapists consistently use their hands for forceful and repetitive tasks (e.g., manual therapy, scar and edema management, orthotic fabrication) in daily practice, applying loads across ligamentous, musculotendinous, and bony structures (Keller et al., 2016). Both force and repetition in the workplace are associated with an increased risk of various nerve-related and musculotendinous distal upper extremity disorders (Keir et al., 2021; Moulin et al., 2021).

For therapists specifically, the potential exists that this input, across an extended time frame, may cause damage to the structures of the hands. It is currently known if repeated mechanical exposure to the arms and hands at work leads to an increased risk of long-term sick leave. In a study by Caragianis (2002), 110 questionnaires were completed by therapists, finding that 73 of these therapists were experiencing or had experienced an injury to their upper extremity, with 75% of these injuries reported as work-related. Harmon et al. (1997) found that therapists are at an increased risk of experiencing cumulative trauma disorders (CTD). The risk of developing a CTD increases with the number of years the therapist has been practicing and the modalities they use in practice (Harmon et al., 1997).

Therapists should be aware of these possibilities and follow joint preservation and energy conservation techniques throughout the day. Hammond found that implementing joint protection

strategies may reduce the risk of hand pain and dysfunction in individuals at risk for musculoskeletal injuries because of repetitive use (Hammond, 2004). The findings in this study suggest future research may investigate the potential risks, incidences, and consequences of working in the field of hand therapy. Determining these factors could potentially serve as a basis to create safe guidelines for how one should be introduced to the field of hand therapy and for sustainability in the profession.

Limitations

Limitations of this study include a small sample size and limited follow-through of students completing all data points. The age of the participants was relatively homogeneous, which increases the internal validity of results; however, it decreases external validity relative to age. The participants were not blinded to the purpose of the study, which could create a bias. Finally, different dynamometers were used for data collection, and calibration of the instruments could not be verified. The same dynamometers were used in each clinic; therefore, change values would be consistent between trials. Future research with a larger sample may be beneficial to corroborate results for implications on practice for hand therapists and to control for hand dominance, gender, and age.

Conclusion

This pilot study provides insight into the changes in student grip and pinch strength after a 12-week clinical rotation in hand therapy. This study identified several statistically significant changes in grip and pinch strength. Statistically significant change may be attributed to the students' sudden exposure to demanding daily hand use required in hand therapy practice. The same loads that increase strength in students over 12 weeks may translate to an increased risk for injury hand therapists. Increased load in grip and pinch patterns over time may have clinical implications for therapists practicing long-term.

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