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Comparative study of two resisted exercise for the improvement of grip strength in dentist

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Abstract

Overview: Dentists hand function is a necessity to ensure safe and effective patient care. Hand is the functional unit of the dentist and is used in keeping firm holding of instruments and tools. Hence measuring and improving the hand grip of dentists is important aspect of their field.

Methods: 30 participants were included and divided into two groups A & B. Each group consisted of 15 participants. The hand grip was evaluated at the beginning with hand dynamometer and subjects of group A & B were given two different sets of exercises for a period of 4 weeks for 4 days per week and after 4 weeks grip strength was measured.

Result: Individual exercises were effective but on comparison between two groups there was no significant difference in hand grip strength.

Conclusion: Both exercises were equally effective in improving hand grip strength.

Keywords: grip strength, hand dynamometer, theraputty, pulley, dentists

1. Introduction

Dentists are licensed health care providers whose care focuses on preventing and treating oral diseases. Dentists use a variety of small instruments including dental hygiene scalars, curettes and ultrasonic scalars to perform their job successfully. Dentists must be expert in working with their hands and using very precise tools. Dentists depend on their hand function to identify and take out any calculus, polish teeth, operate an ultrasonic scalar, handle clinical and laboratory apparatuses, and floss teeth. Dentists hand function is essential to ensure safe and effective patient care. Hand function includes strength to move muscles, dexterity to perform precise movements, and eye hand coordination when handling objects [1].

Hand is the functional unit of the dentist and is used in keeping steady holding of instruments and tools. Hand grip is the amount of static force that the hand can squeeze around dynamometer or an index of the power which the hand can exert [2]. The hand function is based on the two basics grips 1.Power grip and 2.Precision grip. Power grip is a grip which requires firm control of holding an object while performing any activity (e.g. handling a hammer). This is achieved not only by true anatomical flexion of the fingers but also by the components of rotation and ulnar deviation towards the thenar eminence. The thumb takes up side position and controls the leverage. This is further improved by the wrist occupying the position of extension with ulnar deviation. However an activity like holding a bag requires only real digital flexion as seen in mass grasp Precision grip basically needs perfectly coordinated interaction of the small muscles of the hand. It has four types [3]. Strength can be altered by gender (male>female), age (peaked at 4th decade), dominant more than non-dominant hand. Various positions may also alter hand grip strength: elbow during measurement (extension>flexion90%), supported forearm more than unsupported and standing position more than sitting. Grip strength is used to assess functional activity of hand. The measurement of hand grip strength is used to detect whole upper arm strength [2].

There are 35 muscles involved in activity of the forearm and hand, with several of these involved in gripping activities. During gripping actions, the muscles of the flexor mechanism in the hand and forearm form grip strength while the extensors of the forearm stable the wrist. There are four major joints of the hand, Carpometacarpal, Inter metacarpal, Metacarpophalangeal, and inter phalangeal joint, with extrinsic muscles that cross the wrist and 10 intrinsic muscles with their attachments distal to the wrist. These muscles comprise the pronator radii trese, flexor carpi radialis, flexor carpi ulanris, flexor sublimis digitorum, and Palmaris longus on the extrinsic layer, the flexor profundus digitorum, flexor policus longus, pronator quadratus, flexor pollicus brevis, and abductor pollicus brevis on the intrinsic layer and all of these muscles are functional during gripping activities. According to German Sports Scientist Jurgen Wei.nick, "the characteristic structure of the hand is related to its purpose as a grasping tool. Grasping ability is made possible by the fact that the thumb can be opposed to the fingers. The fingers and the thumb act as a versatile pair of pliers. They need the palm of the hand as an even base, on which the object gripped can be held" From this statement, it can be concluded that the anatomy of the hand is more geared toward flexion than extension [4].

Therefore, evaluating and improving the hand grip of dentists is important part of their field and the most common method of measuring the grip strength is the use of a hand held dynamometer. This is a method of what is referred to by Dal Monte and Dragan as a biomechanical measurement. Hand

held grip strength dynamometry is used to quantify the muscular force produced by flexor mechanism of the hand and forearm. There are three main types of handgrip dynamometers. According to Waldo, "since grip is a force, not a pressure, it should be measured in pounds or kilograms. When measuring grip strength there are many variables that need to be normalized before testing. The testing protocols need to be consistent with respect to time of day, posture, anthropometric measures and dynamometer adjustments. The simple method of handgrip dynamometry has been found to expose more than an individual's handgrip strength. From nutritional status to physical functioning, this process of assessment can provide the practitioner with a cost effective, non-invasive screening tool to evaluate client's well-being [4].

Improvement of hand strength is very important for better performance in occupations that includes hand activity. It is well known that muscle strength can be enhanced with a strength training program. Strength training is usually considered to be progressive resistance exercise but any intervention that involves attempted repetitive effortful muscle contractions can result in increased motor unit activity, thereby potentially increasing strength. There are various types of exercises to increase hand muscle strength like power web, Theraputty, hand gripper, table with pulleys, free weights etc. [5]. To the general public, the training of one's grip strength has been mostly limited to spring loaded hand squeeze devices or variations of tennis ball squeezes. Though these are few ways of strengthening ones grip, there are many less conventional approaches, but possibly more productive methods of improving grip strength. Another method of increasing ones grip strength is through the use of grip enhancers such as free weight bars to fingers by using finger pulley's which gives resistant training and use of therapeutic putty. Weight training is a regular type of strength training for evolving the strength of skeletal muscles. It uses the force of gravity (in the form of weighted bars, dumbbells or weight stacks) to oppose the force generated by muscle through concentric or eccentric contraction [4].

Resistive Hand Exercise is designed to provide effective resistive therapy in a wide variety of exercises for the fingers, hand, wrist, and forearm. With regular routine, there is improvement in grip strength, increase dexterity and mobility [5]. Doing putty exercise is a great form of finger and grip strength training. Using putty to train your fingers is very low impact and as a result can be done more often with lower risk of injury [6]. Thera Putty can be formed into the various illustrated shapes, providing a well-balanced exercise program. Strengthening contrasting muscles maintains a subtle muscular balance which improves one's dexterity and coordination [5]. So in this study we used Theraputty as it delivers a simple, effective resistance based training routine which helps to develop a strong, capable grip. In patients with fine motor skill difficulties, theraputty exercise program begin with the tan (XX Soft) or yellow (X-Soft) and progressively increase the resistance as hand gains strength, but as we took the participants according to selection criteria, dentists are normal individuals and they have average grip strength so we started their strength training program with blue colour theraputty as it has firm resistance according to their resistance grading. It also consisted of Pulley table exercises as it is also a form of resisted exercise and the weights in the pulley can be progressively increased according to participant's tolerance and strength.

1.1 Statement of Problem:

Grip strength is the force applied by the hand to pull on or suspend from objects and is a specific part of hand strength. Dentists use a variety of small instruments including dental hygiene scalars, curettes and ultrasonic scalars to perform their job successfully. Dentists must be skilled in working with their hands and using very precise tools. Hand is the functional unit of the dentist and is used in keeping firm holding of instruments and tools. Therefor measuring and improving the hand grip of dentists is important aspect of their field. There are very few studies done on improvement of hand strength in dentists. Hence the need of this study was undertaken to evaluate and to compare the effect of two resisted exercises in the improvement of grip strength in dentists.

1.2 Research Question

Will there be any significant difference in grip strength in 30 participants using resisted exercises within four weeks?

Hypotheses

- **Null Hypothesis (H0):** There will be no significant difference in grip strength by using resisted exercises in dentists.
- **Alternative Hypothesis (H1):** There will be significant difference in grip strength by using resisted exercises in dentists.

1.3 Limitation of Study

1. Small sample size.
2. Only Female dentists were included.
3. Long term effects could not be evaluated.
4. Age Group was limited to 22-25years.
5. Normal sedentary individuals were included, not the patients.
6. Only one geographical area was covered.
7. The study conducted was of short duration.

2. Materials and Methods

The Prospective and Comparative Study included 30 Female dentists (22- 25years) from the Rural Dental College, Pravara Institute of Medical Sciences, Loni. Subjects with any musculoskeletal disorders, hand and wrist pathologies, surgical records, and individuals not willing to participate were excluded. The participants were briefed about the nature of study, the duration of intervention and the intervention being used in the language best understood by the participants. They were encouraged to clarify queries regarding the study, if any. An informed written consent form was then obtained from the participants.

The participant's demographic details such as age, dominance, height and weight of each participant were noted before proceeding in the study. The participants were randomly divided into two groups A & B. The hand grip was evaluated at the beginning and end of four weeks with hand dynamometer. Each group included 15 participants where group A consisted of resistance exercises i.e. with Theraputty (Blue color) for 20 repetitions of each exercise per day with a rest period of 5 minutes in between the two exercises. Group

B was given Pulley table exercises whereby the participants had to pull a suitable amount of weight as per their tolerance for 3 times per session with 20 repetitions with a rest period of 5 minutes each time. The grip strength was reassessed after 4 weeks and with the help of instat graph pad.

Fig 1: Hand Grip Strength Assessment

Fig 2: Pulley table exercise

Fig 3: Pulley table

Fig 4: MP Flexion

Fig 5 Finger Extension

Fig 6 Finger flexion

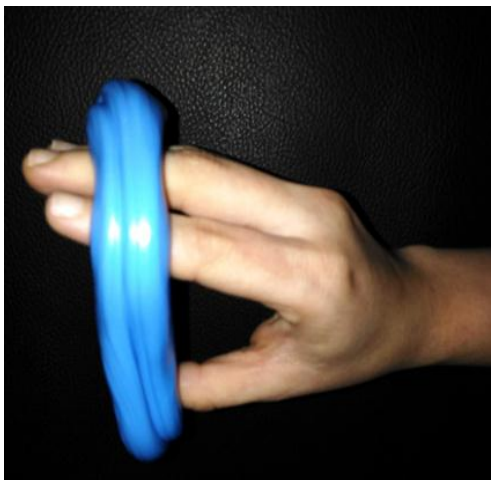


Fig 7 Finger Extension

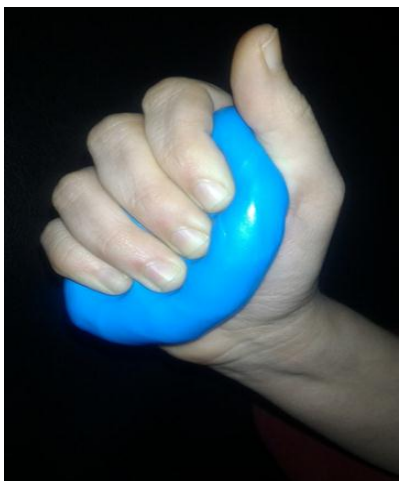


Fig 8: Finger IP Fisting

Fig 9: Finger IP Extension

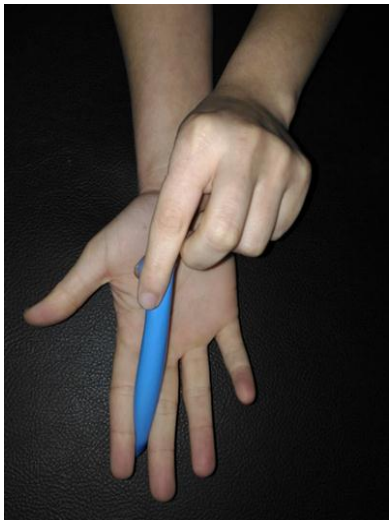


Fig 10: Finger abduction

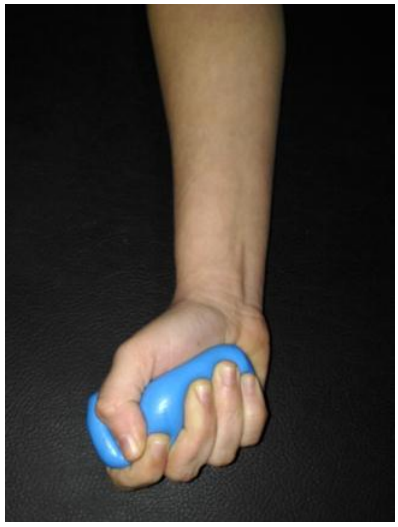
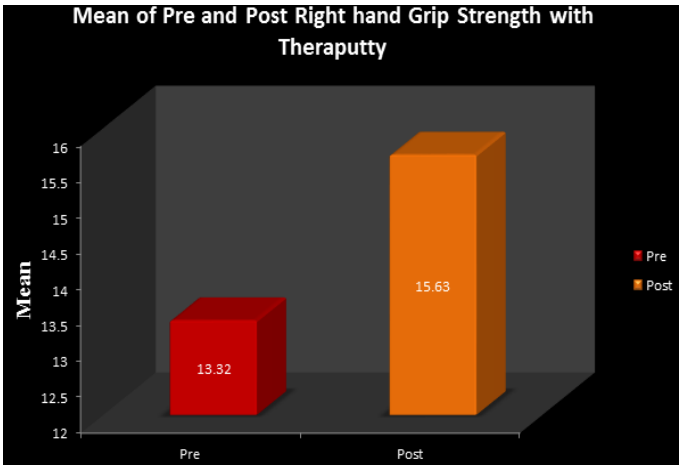


Fig 11: Finger grip strengthening

3. Data Analysis and Interpretation

Table 1: Comparison of Pre and Post intervention right hand grip strength in group A

Group	Mean+-SD	t Value	p Value
Pre	13.32+-3.384	10.434	<0.0001 extremely significant
Post	15.68+-2.977		

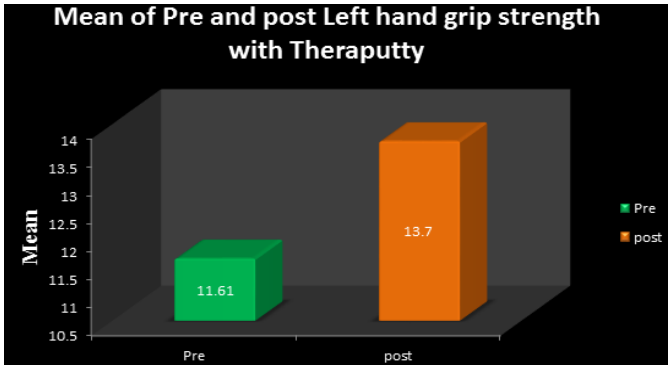


Graph 1: Shows comparison of Pre and Post Right hand grip strength with Theraputty.

Result 1: The above graph shows that on comparison of pre and post intervention right hand grip strength with Theraputty which has mean value of pre exercise 13.32 and standard deviation +-3.384. Mean value for post exercise was 15.68 and standard deviation was +-2.977. t value was 10.434 and p value was <0.0001; which indicates there was extremely significant difference between pre and post values

Table 2: Comparison of Pre and Post intervention Left hand grip strength in group A.

Group	Mean+-SD	t value	p value
Pre	11.61+-3.152	14.972	<0.0001 extremely significant
Post	13.70+-2.876		

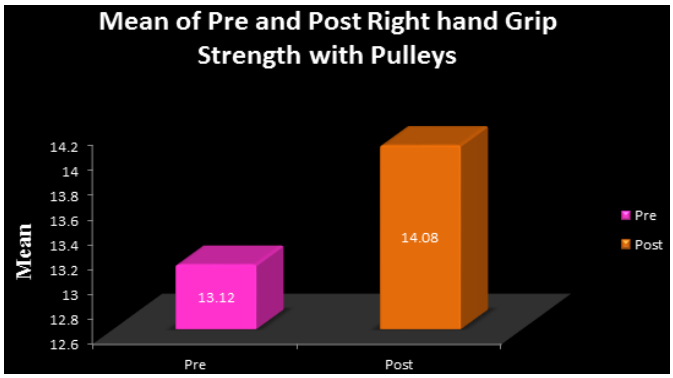


Graph 2: Shows comparison of Pre and Post left hand grip strength with Theraputty.

Result 2: The above graph shows that on comparison of pre and post intervention left hand grip strength with Theraputty which has mean value of pre exercise 11.61 and standard deviation +-3.152. Mean value for post exercise was 13.70 and standard deviation was +-2.876. t value was 14.972 and p value was <0.0001; which indicates there was extremely significant difference between pre and post values.

Table 3: Comparison of Pre and Post intervention right hand grip strength in group B.

Group	Mean+-SD	t Value	p Value
Pre	13.12+-2.944	7.432	<0.0001 extremely significant
Post	14.08+-2.830		

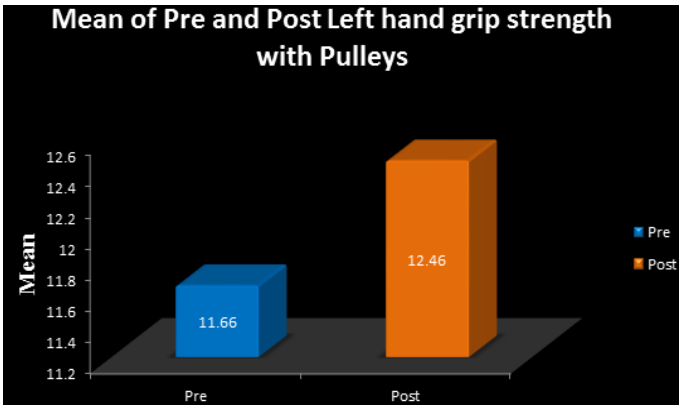


Graph 3 Shows comparison of Pre and Post Right hand grip strength with Pulleys

Result no. 3: The above graph shows pre and post intervention right hand grip strength with Pulleys which has mean value of pre exercise 13.12 and standard deviation was +-2.944. Mean value for post exercise was 14.08 and standard deviation was +-2.830. t-value was 7.432 and p was value <0.0001; which indicates there was extremely significant difference between pre and post values.

Table 4: Comparison of Pre and Post intervention Left hand grip strength in group B.

Group	Mean+-SD	t Value	p Value
Pre	11.66+-3.063	6.877	<0.0001 extremely significant
Post	12.46+-2.993		

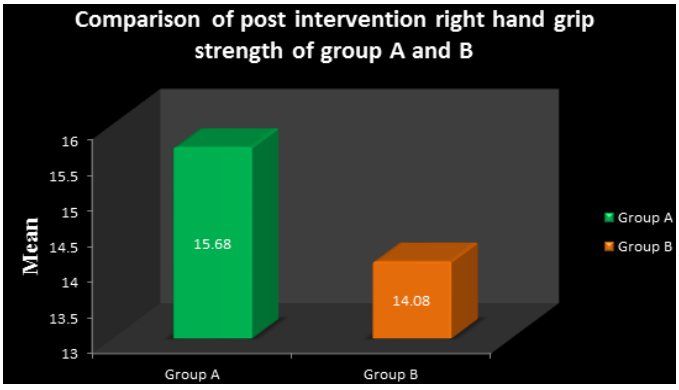


Graph 4: Shows comparison of Pre and Post left hand grip strength with Pulleys

Result 4: The above graph shows pre and post intervention left hand grip strength with pulleys which has mean value of pre exercise 11.66 and standard deviation was +-3.063. Mean value for post exercise was 12.46 and standard deviation was +-2.993. t value was 6.877 and p value <0.0001; which indicates there was extremely significant difference between pre and post values.

Table 5: Comparison of post intervention values of right hand grip strength of group A and B.

Group	mean+-sd	t value	p value
Group a	15.68+-2.977	1.509	0.1425 not significant
Group b	14.08+-2.830		

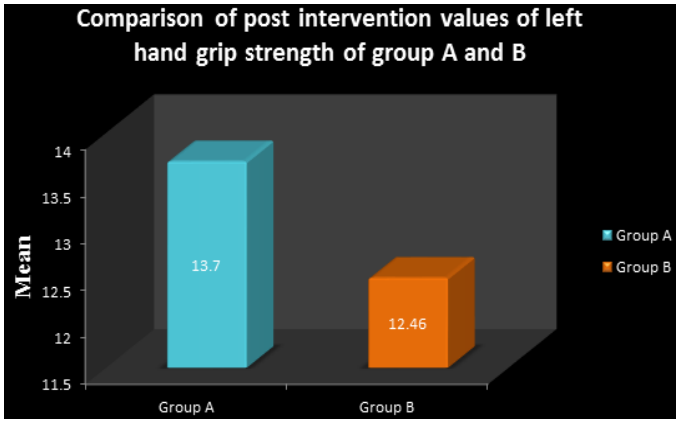


Graph 5: Shows comparison of Post values of right hand grip strength of group A and B.

Result 5: The above graph shows comparison of post intervention values of right hand grip strength with Theraputty and Pulleys, with the t values of 1.509 and p value of 0.1425; it was considered not significant.

Table 6: Comparison of post intervention values of left hand grip strength of group A and B.

Group	mean+-sd	t Value	p Value
Group a	13.70+-2.876	1.163	0.2548 not significant
Group b	12.46+-2.993		



Graph 6: Shows comparison of Post intervention values of left hand grip strength of group A and B.

Result 6: The above graph shows comparison of post intervention values of left hand grip strength with Theraputty and Pulleys, with the t values of 1.163 and p value of 0.2548; it was considered not significant.

4. Discussion

The present study aimed at finding out the effect of two different forms of resisted exercises on hand grip strength in dentists. There were two groups, Group A was given resistance exercises i.e. with blue Theraputty for 20 repetitions of each exercise per day with a rest period of 5 minutes in between the two exercises, to avoid the muscle fatigue. Group B was given Pulley table exercises whereby the participants had to pull a suitable amount of weight as per their tolerance for 3 times per session with 20 repetitions with a rest period of 5 minutes each time. The grip strength was reassessed after 4 weeks and analyzed. Training included resistance exercises which enhance the strength and endurance of the hand muscles. Strength initially increases due to neuromuscular adaptation associated with an improved recruitment of motor units in skeletal muscle. Higher threshold motor units are recruited first and thus there is an increase in the maximal force generated in the muscle. Although changes in cross sectional area of hypertrophied muscle begins in the initial stage of strength training. It only begins to contribute meaningfully to improve strength as muscle hypertrophy becomes more visible. There is a direct correlation between the increase in muscle circumference and the increase in force generated by the muscle [7]. Following resistance exercise there is a brief increase in protein synthesis within muscle. Performing exercise with increased resistance caused more protein synthesis in the muscles and increased the total volume of muscles [5].

The findings of the study revealed that in group a exercises done with the theraputty showed significant increase in grip strength post 4 weeks of performing the given exercises. The

mean of the pre intervention grip of right hand in this group was 13.32, whereas the mean of the post intervention grip of right hand was 15.68. The mean of the pre intervention grip of left hand in this group was 11.61 & the post intervention grip of left hand was 13.70. This shows that there was a significant increase in the post grip strength of both the right as well as the left hand in group A since p value <0.0001.

In group B exercises done with the pulley table showed significant increase in grip strength post 4 weeks of performing the given exercises. The mean of the pre grip of right hand in this group was 13.12, whereas the mean of the post grip of right hand was 14.08. The mean of the pre grip of left hand in this group was 11.66 & the post grip of left hand was 12.46. This shows that there was a significant increase in the post grip strength of both the right as well as the left hand in group B since p value <0.0001. When comparison was made among the two groups i.e. theraputty exercise group (Group A) & pulley table exercise group (Group B) no significant difference between the two groups could be demonstrated since p values were 0.1425 and 0.2548 respectively. According to the study done by Dr. P. Sathya *et al.*, on effect of resisted exercises and free weight exercises on improvement of grip strength of cricket players. It concludes that both the Resistance (which included Theraputty) as well as the Free Weight Exercises were equally effective for improving the hand grip strength in cricket players. Hence, either of the exercises or a combination of the two mentioned exercises can be helpful while training the cricket players for improvement of hand grip strength [5]. Whereas, the study conducted by Dahan da Cunha Nascimento, *et al.*, evaluated the sustained effect of resistance exercise on blood pressure and hand grip strength following a non-training period in elderly hypertensive women. The study concluded that Resistance exercise may be a valuable method to increase muscular strength and blood pressure in elderly people with benefits being sustained up to 14 weeks following training cessation [8]

The results of present study showed that there was significant improvement in hand grip strength in dentists after four weeks of intervention with theraputty exercises and pulley table exercises. But when the post results of both the group were compared, it revealed that there was no significant difference between the interventions. Therefore, both the exercises were beneficial for improving the hand grip strength in dentists.

5. Conclusion

The current study concludes that both the groups had significant improvement in hand grip strength. Hence, the Theraputty exercises or pulley table exercises or a combination of the two mentioned exercises can be helpful while training the dentists for improvement of hand grip strength. If implemented in the daily clinical practice it would be beneficial to maintain a good strength of the hand muscles and avoid weakness of the same, which would enhance the performance of the dentists.

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