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"Effectiveness of Physiotherapy Intervention Along With Ergonomics among Dentists with Carpal Tunnel Syndrome: A Randomized Controlled Trial"

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Abstract:
Background*: Carpal Tunnel Syndrome is a neuromuscular disorder, which commonly affects dentists. This syndrome represents the most common compressive mononeuropathy of the upper limb and leads to pain, significant disability, and reduction in strength. Physical therapy is widely used, relatively inexpensive, non-invasive, and easy to apply. Ergonomics is an applied science concerned with designing products and procedures for maximum efficiency and safety. The study aimed to find the effectiveness of physiotherapy intervention along with ergonomics among dentists with carpal tunnel syndrome and determine the better of these for benefit of patients.*
Materials and Methods: *In this prospective randomized controlled study, a 6-week intervention study, 30 Dentists with features of carpal tunnel syndrome were studied. They were divided into 2 groups by simple random sampling; Group A: Control group and Group B: Experimental group. Pre and post-treatment data were collected and analyzed using SPSS 26.0. Paired and unpaired t-test was used to find out the significance of the treatment.*
Results: *A statistically significant improvement in pain, improve hand function, grip-strength ($p<0.05$) after the treatment was found in Group B as compared to Group A.*
Conclusion: *The study concluded that physiotherapy intervention along with ergonomics more effective among dentists with carpal tunnel syndrome.*
Keywords-*Carpal Tunnel Syndrome, Grip Strength, Dentist, Ergonomics, Symptom severity scale, Functional Status scale*

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I. Introduction

The Wrist joint is formed by the articulation between a distal end of radio- & ulnar and carpal bone. [1] There are 8 carpal bones live Scaphoid, Lunate, Triquetral, Trapezium, Trapezoid, Pisiform, Capitate, Hamate.[2] Median nerve supplies carpel tunnel compression of median nerve at level called Carpel Tunnel Syndrome. Carpel tunnel syndrome is a compressive neuropathy that is defined as a mono-neuropathy or radiculopathy caused by compressive force. [3]Carpal Tunnel Syndrome, First studied by "James Paget" in 1854, is a common entrapment neuropathy, affecting about 3.8% of the population. [4]Carpal Tunnel Syndrome, or CTS, is one number of Muscle, Tendon-, Nerve related disorders that affects people performing intensive work and their hands. There has been a tremendous increase during the last 20 years in the number of reported cases of CTS. Both Dental and Dental hygienists have been reported to have a high prevalence of upper extremity musculoskeletal disorders, including CTS.[5]CTS is most often seen in patients between 25 and 74 years of age. [6] Its general prevalence in society is between 3.7% and 5.8%. [7] CTS is 10 times more frequent in women than men. [8] Over all, CTS is ranked sixth among recognized occupational diseases.[3] The Primary sign is pain in the wrist, tingling sensation, pain or numbness in the thumb, index finger, medial finger and radial side of the tiny finger, also there is a reduction of the grip strength and function of the affected hand. [9]Analysis of data from the population-based Occupational Supplement of the U.S. National Health Interview Survey indicated that repetitive bending/twisting of the hands/wrists and uses of vibratory tools are important risk factors for CTS. [10] Lalumandier JA et al conducted a study in 2001 and concluded that there are 71.4% of the cases diagnosed with CTS reported 17-23 years of work in dentistry and 85.7% more than 20 hours per week. The consistent finding revealed that the dental hygienist with more than 10 years of practice were 1.9 times more prone to CTS symptoms.[11]This illustrates that prolonged working periods may be associated with the increased risk of the CTS. Diagnostic methods of CTS include the electrophysiological study, Magnetic Resonance

Imaging (MRI), and Ultrasonography. The diagnostic Physical examinations for the CTS are the Phalen test (PT), hand elevation test (HET), and Tinel sign (TS). Among these physical examinations, PT and HET have been reported in the literature to be highly correlated with the electrophysiological diagnosis of CTS. [12]For CTS diagnostics, the Boston Questionnaire (BCTQ - Boston Carpal Tunnel Questionnaire) is also used. It consists of two parts. The first concerns the severity of the patient's symptoms (SSS). The second one examines the functional state of the hand and the level of its dysfunction (FSS). [13]Treatment options in the management of CTS involve a multidisciplinary approach that includes medical, surgical, physical, and occupational therapy. The physical therapy treatment approaches according to the stages includes rest, splinting, therapeutic ultrasound, neuromuscular electrical stimulation, grip and pinch strengthening exercises, joint mobilization, and nerve and tendon gliding exercises and ergonomic advice. [14]Ergonomics- "ergon" means work and "omics" means law. It is the science of fitting the job settings conducive to the worker. Thus, ergonomics is a science concerned with how to fit a job to man's anatomical, physiological and psychological character in such a way that it enhances human efficiency and well-being. [15] In recent times ergonomics has become a popular term. The term has been used with most professions but increasingly in the dental profession. [16]Efforts to reduce CTS risk factors through improved job design, less stressful work methods, better training, and stringent job placements are being introduced in an attempt to manage the problem (Armstrong,1986)[17]Carpal tunnel syndrome is a serious diagnosis for dental professionals because of repetitive motion & hand.

So, the need of the study found out the Effectiveness of physiotherapy intervention along with ergonomics among dentists with carpal tunnel syndrome and to determine the better of these to get the best results & greater benefits for the population.

The aim of the study was to find out the effectiveness of Physiotherapy intervention along with ergonomics among dentists with carpal tunnel Syndrome.

The objectives of the study were to investigate the effect of the Physiotherapy intervention along with ergonomics in increasing the grip strength, reducing pain and improvement of hand function among dentists with Carpal Tunnel Syndrome, and to compare experimental group with control group by using Grip strength, NPRS, Functional Scale (Boston Questionnaire).

II. Material And Methods

The prospective, parallel group Randomized control trial study was carried out on the dentists at Nootan College of Physiotherapy, Orthopedic department OPD, Visnagar, Gujarat from September 2020 to March 2021. A total 30 participants (both male and female) of age between 25 to 45 years were included in this study.

Study Design:-Randomized Controlled Trial
Study Location:-Nootan Collage of Physiotherapy, Orthopedic Department OPD, Visnagar, Gujarat
Study Population:-Dentists with Carpal Tunnel Syndrome
Study Duration:-6 Months (September 2020 to February 2021)
Treatment Duration:-6 Weeks
Sample Design:-Simple Random Sampling (Lottery Method)
Sample Size:-30 Patients
Group A 15 Subjects (Control group)
Group B 15 Subjects (Experimental group)

Inclusion criteria:-
1. Age between 25 to 45 years. [6]
2. Both male and female dentists.
3. Dentists who work more than 20 hours in a week. [18]
4. Unilateral involvement only.
5. Involvement of Right or Left side of the wrist can be included.
6. Dentists who are willing to participate in the study.

Exclusion criteria:
1. Cervical Spondylosis. [19]
2. Trauma to the wrist. [19]
3. Pregnancy. [19]
4. Rheumatoid Arthritis. [19]
5. Carpo-metacarpal arthritis of Thumb. [20]
6. Cervical Radiculopathy. (C6) [20]
7. Flexor Carpi radialistenosynovitis. [20]
8. Median Nerve compression at elbow. [20]
9. Presence of Reynaud phenomenon. [20]

Data Collection Procedure

Graph No.1 shows the sampling flow diagram, Total 36 Dentists who came to Nootan College of Physiotherapy and that complains of pain, tingling, and numbness in the palm were assessed and Diagnosis of Carpal tunnel syndrome was done by Special Tests (Positive Phalen Test &Tinel's Sign).Among 36 04 dentist didn't met the inclusion criteria and 02 dentists decline to participate in the study due to their personal reason. So, 30 dentists who are diagnosed with carpal tunnel syndrome were selected, and informed about the study along with procedure, and were requested

to sign written informed consent forms. All the subjects completed a detailed orthopaedic assessment. The assessment obtained information about demographic details, medical history, analysis of pain, ROM, Special test, investigation reports & functional test of the participants. Randomization into groups was achieved through Lottery Method. Only Participants were blinded. After that pre-intervention that includes Grip strength, NPRS, and Functional scale (Boston) will be taken. The treatment will be given to the subjects of Group-B (Experimental Group).After that post-intervention evaluation is done. Each patient was evaluated before the First session and after the last session. The Data will be collected and then will be further used for Statistical Analysis.

Graph No: 1 Sampling Flow Chart

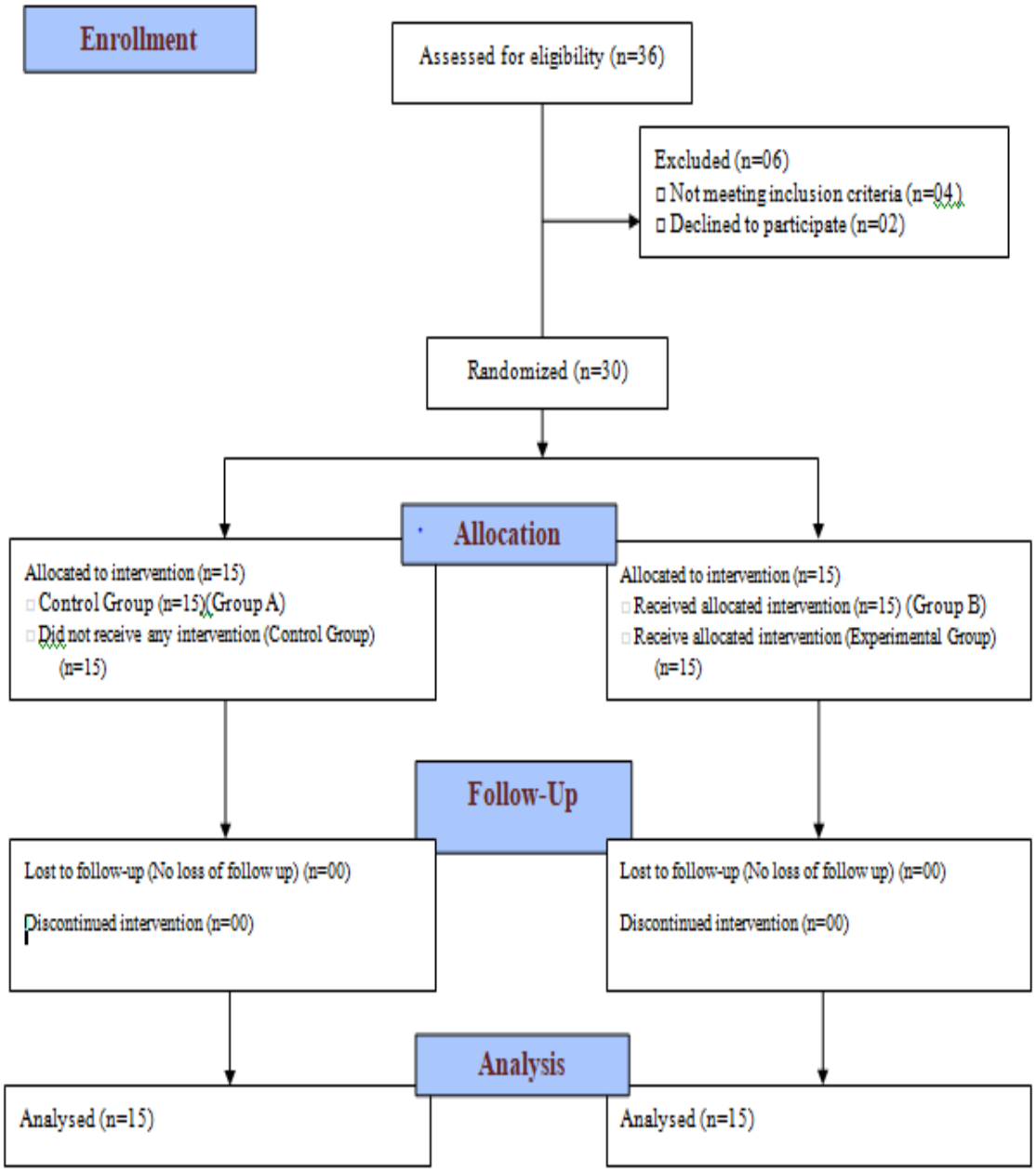


Table No. 1 and Phtograph No. 1 to 6 shows the Physiotherapy treatmenent Protocoal from 1st week to 6th week with appropriate dosage**.**

Table No.1 Physiotherapy Treatment Protocol [26, 27, 28, 29, 30, 31]

Week 1	Week 2	Week 3
1.Active Range of Motion (AROM)[43] [3 Repetition ; 2 set ; Twice a day] **2.Ultrasound[44]** Area :- Carpal Tunnel Frequency:-1MHz Mode:-Pulsed Mode1:4 Intensity:-1.0W/Cm2 Duration:-15min Motion:-Circular motion No of session-2 times/week for 4 week	**1. Active Range of Motion (AROM)** [5 Repetition ; 2 set ; Twice a day] **2.Ultrasound[44]** Area :- Carpal Tunnel Frequency:-1MHz Mode:-Pulsed Mode1:4 Intensity:-1.0W/Cm2 Duration:-15min Motion:-Circular motion No of session-2 times/week for 4 week	**1. Active Range of Motion (AROM)** [7 Repetition ; 2 set ; Twice a day] **2.Ultrasound[44]** Area :- Carpal Tunnel Frequency:-1MHz Mode:-Pulsed Mode1:4 Intensity:-1.0W/Cm2 Duration:-15min Motion:-Circular motion No of session-2 times/week for 4 week **3.Nerve Gliding Exercise** [3 Repetition each movement/session; 5 session/week for 4 week]
Week 4	**Week 5**	**Week 6**
1. Active Range of Motion (AROM) [7 Repetition ; 2 set ; Twice a day] **2.Ultrasound[44]** Area :- Carpal Tunnel Frequency:-1MHz Mode:-Pulsed Mode1:4 Intensity:-1.0W/Cm2 Duration:-15min Motion:-Circular motion No of session-2 times/week for 4 week **3.Nerve Gliding Exercise** [5 Repetition each movement/session; 5 session/week for 4 week] **4.Decompression Exercise** [5 Repetition with 5 sec hold; 2 sets ; 3 times a day]	**1. Active Range of Motion (AROM)** [10 Repetition ; 2 set ; Twice a day] **2.Nerve Gliding Exercise** [7 Repetition each movement/session; 5 session/week for 4 week] **3.Decompression Exercise** [7 Repetition with 5 sec hold; 2 sets ; 3 times a day] **4.Hand Squeeze Exercise:** [3 sec hold; Repeat for 1 min a day] **5.Strengthening Exercise:** [7 Repetition with 5 sec hold; 2 sets ; 3 times a day]	**1. Active Range of Motion (AROM)** [10 Repetition ; 2 set ; Twice a day] **2.Nerve Gliding Exercise** [10 Repetition each movement/session; 5 session/week for 4 week] **3.Decompression Exercise** [10 Repetition with 5 sec hold; 2 sets ; 3 times a day] **4.Hand Squeeze Exercise:** [5 sec hold; Repeat for 1 min a day] **5.Strengthening Exercise:** [10 Repetition with 5 sec hold; 2 sets ; 3 times a day]

All the Participants who are included in the experimental group were instructed to follow the below ergonomic advice during and after the study.

- Try to minimize the repetition movement of the wrist.
- Avoid or minimize the pinch position of the Finger and wrist.
- Minimize Excessive Wrist movement.
- Use a Round handles rather than hexagonal handle, because round handle decreased muscular Stress and Digital Nerve Compression.
- 5 min of rest for every 30 min of continues work and use of device.

Photograph No.1 : Grip Strength

Photograph No.2 : Ultrasound

Photograph No.3: Hand Squeeze Exercises

Photograph No.4 : C exercise

Photograph No.5: Abductor pollicis Longus isometric strengthening

Photograph No.6 : 1st Dorsal interossei strengthening

III. Result

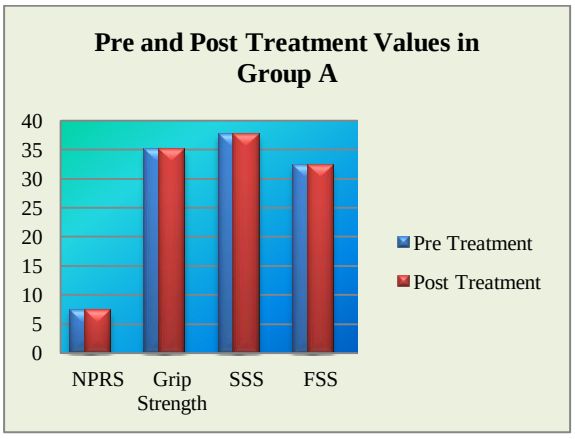
Pre and post-treatment data of the participants of both groups were noted. All statistical analysis was done using SPSS 26 software for windows. Descriptive analysis was obtained by using mean & standard deviation. Table No, 2, 3 and graph No. 2, 3shows the intergroup comparison between Group A and B of pre-treatment and post-treatment of NPRS, Grip Strength and symptom severity scale and functional status scale was done by paired t-test and intra-group comparison of pre-treatment and post-treatment of NPRS, Grip strength and symptom severity scale and functional status scale within Group A and Group B was done by unpaired t-test.

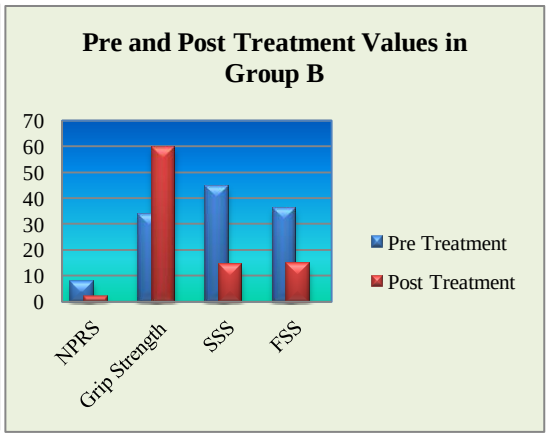
Table No. 2: Pre and Post treatment values of Group A

GROUP A	**Pre-Treatment Mean ± SD**	**Post-Treatment Mean ± SD**	**F- value**	**p value**
NPRS	7.40± 1.05	7.40 ± 1.05	0.01	0.02
Grip Strength(Kg)	35.06 ± 10.53	35.06± 10.53	0.73	0.72
Symptom severity Scale (SSS)	37.60 ± 11.47	37.60± 11.47	3.39	0.07
Functional Status Scale (FSS)	32.40± 5.82	32.40± 5.82	1.17	0.08

Table No. 3: Pre and Post treatment values of Group B

GROUP B	Pre-Treatment Mean ± SD	Post-Treatment Mean ± SD	t- value	p value
NPRS	7.93 ± 1.27	2.26 ± 0.59	24.393	0.00
Grip Strength(Kg)	33.67± 11.37	59.60± 3.31	-8.629	0.00
Symptom Severity Scale (SSS)	44.93 ± 9.85	14.46 ± 3.94	13.689	0.00
Functional Status Scale (FSS)	36.20± 5.90	14.73 ± 5.65	12.11	0.00





Graph No. 2: Pre and Post-Treatment values in Group A **Graph No. 3:** Pre and Post-Treatment values in Group B

IV. Discussion

This study disclosed that after a six -week treatment program, among Two groups, Group-A (control group), Who do not receive any treatment, didn't found any significant change, whereas in Group-B (Experimental group), who receive Physiotherapy Intervention along with ergonomic advice, attained a significant improvement in the Grip strength, reduction in pain and improvement in hand function.

Currently, several conservative interventions are used to treat CTS, Evidence on the effectiveness of Physiotherapy intervention along with Ergonomic advice is lacking, however, this study evaluate the effectiveness of a nerve gliding exercise, ultrasound, decompression exercise and active range of motion along with Ergonomic advise to treat CTS among Dentists.

Dental professionals are amongst the most target group for MSD because of their long procedural working hours and awkward postures. Development of disorders ranging from a simple sprain to CTS can be seen amongst clinicians. [21]

The majority of the nerve gliding exercises is suggested by Totten and hunter involving extension of the wrist and fingers. [22]

Rozmaryn et al found that subjects who received tendon and nerve gliding exercises under-went surgery 28% less often than those who received traditional treatment.[23]

The recommendations of the American Association of Orthopaedic Surgeons have only dealt with ultrasound for a wide variety of physical therapy modalities in the treatment of mild and moderate CTS (recommendation 4b; Grade C, Level II).[24]

Similarly, in the European Hand guide Study methods such as ultrasound and nerve gliding exercises might be added to conservative management in CTS. [25]

Apart from the usual Physical therapy Intervention, Physiotherapists should focus on modifications of activities and the workplace (Ergonomic modifications). Ergonomics intervention can be considered as one method to reduce the hazard and risk of CTS through several methods and approaches. Work Conditions should be improved through the redesign process. Re-design can be applied into work-station, work posture, time schedule, works process, layout and others. Short break every time and scheduled is better than one break after a long time works. Ergonomics application can increase productivity through reduce of accidents and work-related diseases, increase work time. All these condition can enhance the quality of life.

In the current study, although the functional status scale showed improved results in both groups but this improvement was noted more in group-B as compared to group-A, with obvious differences in the values of the means of both groups showing higher improvement in group-B.

This study was conducted on thirty subjects with mean age of 29.40 ±3.18 (mean ± SD). The subjects were divided into two groups; Group-A (control group), who do not receive any treatment, didn't found any significant change, whereas in Group-B (Experimental group), who receive Physiotherapy Intervention along with ergonomic advise for 6 weeks.

The subjects were also advised about the ergonomics. In this study, Numerical Pain Rating Scale (NPRS), Grip Strength (Kg), Symptom severity scale (SSS); Functional Status Scale (FSS) were used as Primary outcome measures. The results showed a significant improvement in the outcome measures in the post-treatment stage as compared to the pre-treatment stage.

Though, Post-treatment statistical significant improvement was found in Group B which showed greater improvement in the Grip Strength, NPRS Score, SSS and FSS. (p value < 0.05).
The limitation the Randomized controlled trial was that the study had small sample size.

V. Conclusion

In the Randomized controlled trial (RCT) used in this study, the use of physiotherapy intervention along with ergonomics in Dentist with carpal tunnel syndrome, a significant improvement in grip strength, Symptom severity scale, and, Functional status scale evidenced a significantly improvement in experimental group (Group B) when compared to control group (Group-A).

Future Scope:-
1. The study can be done with long-term follow-up.
2. The study can be revised involving a large sample size.
3. The study can be done with other outcomes.

Conflict of Interest: None
Ethical Approval: Study was approved by the Institutional Ethical Committee.
CTRI Reg. No: CTRI/2021/01/030686

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