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Assessment Of Motor Function Of Hand In Dental Professionals.

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Abstract:
Background*: Dentistry Is A Stimulating And Rewarding Occupation But Is Physically And Mentally Demanding. Manual Dexterity Is The Important Physical Attribute Required In This Profession. Hand Strength Has Been Identified As An Important Factor For Predicting Disability. Repeated Activities Of Upper Extremity Are An Essential Component Which Can Leads To Musculoskeletal Disorders In Dentists. Hence It Is Essential To Assess Motor Function In Dental Surgeons.*
Materials And Methods*: 300 Dental Surgeons From Institutional As Well As Private Sector Were Included In Study. Along With 300 Control Group Subjects. Hand Dexterity Was Assessed Using Purdue Peg Board Test For Hands, Hand Grip Strength By Jamar Hand Dynamometer And Pinch Strength Of Thumb By Using Pinch Gauge*
Results*: Unpaired T Test Was Applied To Compare The Two Groups. Statistically Significant Difference Of Grip Strength Found Between Dentists And Control Group Where Dentists Group Has Reduced Grip Strength (P < 0.0001). Also Grip Strength Of Dominant Hand (Right) Of Dentists Was Significantly Reduced As Compared To Non-Dominant Hand. Mean Pinch Strength Was Almost Similar In Dentists As Compared To Control Group (P = 0.9860) No Significant Difference Of Dexterity (P = 0.902, P = 0.9 For Male And Female Dentists Respectively) And Pinch Strength (P = 0.999, P = 0.57 For Male And Female Dentists Respectively) Between Dominant And Non-Dominant Hand In Dentists Group.*
Conclusion: *Repetitiveness Of Task Has Significantly Affected Hand Function In Dental Surgeons Whereas Some Of The Functions Like Dexterity Have Been Improved In Dentists For Dominant Hand.*
Key Word*: Dentists, Dexterity, Grip Strength, Pinch Strength.*

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I. Introduction

Dentistry is a stimulating and rewarding occupation but is physically and mentally demanding. Manual dexterity is an important physical attribute required in this profession. Hand strength has been identified as an important factor for predicting disability. In addition to its predictive value, grip strength and key pinch strength are considered to be "objective" outcome parameters and are used to quantify outcome after various interventions[1] Various hand disorders are prevalent in dental professionals. Different activities such as repeatedly bending the hand up, down, or from side to side at the wrist and continuously pinch gripping an instrument without resting the muscles are responsible for the same.[2]

Dental clinical training also has influence on manual dexterity component of the hand. A study done by Akram[1] and Ullah *et al.*,[3]2008 to assess manual dexterity in the BDS curriculum had given conclusive proof that manual dexterity improves with increased clinical exposure and training. Dentistry is a profession characterized by performing fine within the limited space of a small operatory using vibratory tools and instruments [4]

Connective tissue diseases (CTDs) may affect different tissues including muscles, tendons, and nerves. CTDs among dentists most commonly affect the upper body causing pain or other symptoms at the neck, shoulders, elbows, forearms, wrists, or hands[5] If the dentist's wrists are routinely positioned in extremes of wrist flexion or extension, the risk for carpal tunnel syndrome is increased[6] hence, this study aimed at the assessment of motor function of dentists.

II. Material And Methods

In this cross-sectional study design, convenient sampling method was used. Dental postgraduate students, faculty, and private practitioners were included in study along with Physiotherapy students as control group.

Dentists, practicing dentistry for a minimum period of 5 years working at least 15 h or more in a week, were included in study, whereas dentists with musculoskeletal deformity involve upper limbs. Dentists with any previous history of trauma to upper extremity were excluded. A total of 300 dentists were recruited from various dental colleges and private setups in Mumbai and Navi Mumbai. A total of 300 age-, body mass index (BMI)-, and gender-matched individuals were involved in control group [Table 1]. The study was approved by the Institutional Ethics Committee. Written informed consent was taken from all participants. General physical examination such as height, weight, and BMI was recorded, and details regarding work schedule and symptoms if any were obtained to fulfill the inclusion and exclusion criteria. Both the experimental and control group participants were right dominant, so all the tests were carried on the right hand followed by the left hand. There were 144males (48%) and 156 females (52%) who participated in the study. Same proportion was maintained in control group.

Jebsen hand function test

Hand dexterity was assessed using Jebsen hand function test (JHFT). It was performed using both the hands. The seven components of the test were explained verbally and demonstrated by the investigator to the participant. START and STOP commands were given by the investigator. The score of the JHFT was recorded in seconds at the end of the test[7] Test is conducted with the right hand first and later repeated with the left hand. One practice trial (per arm) was provided before timing the test. Test period was recorded with a stopwatch in seconds. Scores were based on the amount of time it takes to complete.

Handgrip strength

The standard, adjustable handle Baseline hydraulic hand dynamometer (standard 12-0240) was used to measure grip strength. A review [8] of the reliability and validity of the Jamar in comparison with other grip strength measurement devices concluded that excellent interinstrument reliability exists between the Jamar, Dexter, and Baseline dynamometers, which all measure grip strength in pounds and kilograms and could be used interchangeably. For standardization, it was set at the second handle position for all participants. The dynamometer was lightly held around the readout dial by the examiner to prevent inadvertent dropping[9] The participants were positioned as per the guidelines of "The American Society of Hand Therapists." For each of the tests of hand strength, the participants were seated on a chair with a straight back, without armrest with the feet flat on the floor with their shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in neutral position, and wrist between 0° and 30° dorsiflexion and between 0° and 15° ulnar deviation[10-13] The participant was asked to squeeze the dynamometer with maximum isometric effort and maintain it for 3 s. No other body movement was allowed. Three attempts for each participant were conducted, alternating the right and left hands with 1-min rest between two attempts to overcome the fatigue. Best of three attempts was considered. All the participants were evaluated in the same position and under the same protocol. The dynamometer was reset to zero before each reading of grip strength, and it was read to the nearest increment of two[13] This same protocol was followed. The results were compared between the right and left hands[14-17]

Pinch strength

Pinch strength was assessed using pinch gauge.[18] Thumb pulp was placed over the lateral aspect of proximal interphalangeal joint of the index finger, other fingers flexed, and the gauge was placed with dial facing up[16] The participants were instructed to squeeze maximally three times, and the mean of the three readings was obtained. The same was repeated with the left hand.

GraphPad InStat (LLC, USA) was used for analysis.

III. Result

Table I: Demography of study population

	VARIABLES	ALL SUBJECTS	MALE	FEMALE
DENTISTS	Age(yrs)	32±1.17	31±1.16	30±1.18
	Bmi(kg/m^2)	28.48±1.87	27.88±1.25	25.21±1.85
	Practicing years	5.45±1.46	5.6±1.23	4.89±1.5
	Practicing hours/day	8.36±1.86	8.23±1.45	7.51±1.52
	Gender		48%	52%
CONTROL	Age(yrs)	34.73 ± 4.14	32.73 ± 1.18	31.74 ± 3.14
	Bmi(kg/m^2)	29.97±1.77	27.85±1.25	24.10±1.97
	Gender		48%	52%

Table II Comparison of Dexterity, Hand Grip and Pinch strength between Dentists and controls

Hand	Group	Dexterity (sec)		Grip (kg)		Pinch (Kgs)	
Right	Control	47.43±4.41	P=0.0002	53.23±9.77**	P<0.0001	20.52 ±5.43	P=0.9860
	Dentist	44.93±4.59**		48.27 ±2.36		20.55±5.58	
Left	Control	46.94±4.32	P=0.0.0207	53.15±9.8#	P=0.912#2	20.40±5.61	P=0.9865
	Dentist	44.94±4.5		53.13±9.8		20.39±5.46	

**very significant, P<0.0001considered very significant, # not significant

Table 3: Comparison of Hand function between dominant & non-dominant hand

parameter	Hand	Control Male		Control Female		Dentist Male		Dentist Female	
Dexterity (seconds)	Rt	45.25 ±4.43	P =0.901 t = 0.127	45.42±4.07 *	P=0.0360 t=2.107	44.25±4.34	P =0.902 t = 0.122	44.19±4.84	P =0.900 t = 0.125
	Lt	45.52 ±4.15		46.49±4.13		44.31±4.86		44.26±4.84	
Grip (kgs)	Rt	57.75 ±9.9	P=0.999 #	49.19±7.6	P=0.986#	53.02±11.26	P=0.0001 **	44.075±11.79	P<0.0001 **
	Lt	57.75 ±9.9		49.06±7.8		57.76±9.97		49.075±7.6	
Pinch (kgs)	Rt	23.73 ±5.4	0.965#	17.74±4.97	P=0.565#	23.81±5.07	P=0.999#	17.60±3.8	P=0.5712#
	Lt	23.71 ±5.4		17.45±4.84		23.83±5.09		17.36±3.7	

not significant, *significant, **very significant

Statistically significant difference of grip strength found between dentists and control group where Dentists group has reduced grip strength ($P < 0.0001$). Also grip strength of dominant hand (right) of dentists was significantly reduced as compared to non-dominant hand. Mean pinch strength was almost similar in dentists as compared to control group ($P = 0.9860$) No significant difference of dexterity ($P = 0.902$, $P = 0.9$ for male and female dentists respectively) and pinch strength ($P = 0.999$, $P = 0.57$ for male and female dentists respectively) between dominant and non-dominant hand in dentists' group.

IV. Discussion

The hand dexterity test can independently assess component tasks such as the time it takes to grasp, move, position, and reach while transferring objects. The hand dexterity of both the hands was found to be lower in control group compared to dentist group, and the difference between them was found to be statistically Significant [Table 2]. No significant difference of dexterity was observed between the right and left hand of dentists (males and females) [Table 3]. Surgery and dentistry are two professions that are generally assumed to require a high degree of manual dexterity or psychomotor skill19 The Crawford Small Parts Dexterity Test was administered to 71 freshman dental students at Fairleigh Dickinson University in New Jersey. This test previously had been used to evaluate potential applicants who wanted to work in engraving, etching, or watching assembly. This study showed that students improved on this test over 4 years when tested at the beginning and end of dental school, suggesting that dental instruction improved on skills involving perception and dexterity20

A study done by Akesson et al. on the dominant hand of dentists, dental hygienist, and dental assistants has concluded that dentists' assistants have better manual dexterity than controls, and our results are similar to this21

A study by Luck et al22 demonstrated that dental students improve their levels of manual dexterity as they proceed through the degree program, probably due to years of practice,the hand dexterity is improved over time. As both the hands are commonly used in dental procedures, we might have found no significant difference of dexterity between the right and left hands of both male and female dentists.

Comparison of handgrip

In our study, statistically significant difference of grip strength found between dentists and control groups where dentists group has reduced grip strength. Furthermore, grip strength of dominant hand (right) of dentists was significantly reduced as compared to nondominant hand. This observation was consistent for female as well as male dentists. (Table 2)

This could be attributed to dentists mostly using high speed and low speed hand pieces, and it has been noted that in workers exposed to vibrations like people working in mining and forestry often complain of decreased muscular force23 and it seems that this is a constant phenomenon, present not only during work but also at rest. The impaired muscle function in the full handgrip, which also engages the local muscles of the hand, may be based on an injury to muscle tissue, nerve tissue, or a combination of both induced by vibration24 Another study done by Akesson et al. on female dental personnel has stated that dentists were more affected primarily due to grip force, increased exposure time, and use of high and low speed hand pieces that run at frequency levels most likely to cause impairments. Mean handgrip strength between the right and left hands in controls was statistically significant for females where dominant hand has better grip strength as compared to nondominant hand, which is attributed to their daily work activity only.

Comparison of pinch strength

In our study, we found that mean pinch strength was almost similar in dentists as compared to control group [Table 2]. Furthermore, no difference of pinch strength was observed between the right and left hands for dentists. Similar results were found for control group also [Table 3]. Dentists use both the hands for all dental procedure; this could be a reason to have no difference between the right and left hands of pinch strength. Selection of lateral pinch strength for assessment and comparison between dentists and control group may have given us statistically not significant difference as this pinch is common type used by normal population for various activities of daily living. Comparison of other types of pinches is suggested for future studies.

V. Conclusion

It was observed that dental group was found to have better dexterity as compared to control group. It was also observed that grip strength was less in dental as compared to control group. However, there was no significant difference in pinch strength between the two groups. It was found that there was no significant difference of dexterity and pinch strength between dominant and non-dominant hands in dentists group, whereas grip strength of the dominant hand was less in dentist .There was no significant difference of pinch strength for control and dentists between the dominant and non-dominant hands.

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