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Prevalence of finger dexterity proficiency using nine-hole peg test among surgeons

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Abstract

Objectives: This study examined the prevalence of finger dexterity proficiency using Nine-hole peg test among surgeons.

Methods: The purpose & procedure of the study was explained to participants. Subjects were screened according to inclusion & exclusion criteria, a written consent was obtained, & the procedure was explained to them. Participant performed Nine-hole peg test according to the norms; proficiency of finger dexterity was concluded on the basis of age, sex, and dominance.

Results: The result indicates a significant decrease in average finger dexterity proficiency ($p < 0.003$), particularly in dominant hand($p<0.001$) among surgeons.

Conclusions: The study concludes with a prevalence of reduced finger dexterity proficiency among surgeons, particularly in the dominant hand.

Keywords: Finger dexterity; Surgeons; Nine-hole peg test; Coordinated control movement

1. Introduction

Dexterity is ability to find a motor solution for external situation which adequately solve an emerging motor problem accurately, quickly, rationally, and resourcefully [1]. It is one of the unique characteristic of human beings which is essential for accomplishing various activities of daily life and occupations[2].It shows the relationship between the nervous system and skills and how successfully a person can develop certain motor skill and also the level of perfection he or she is able to require .It requires both gross and fine hand motions and coordination for its performance [3].The effect of dexterity on hand-object interactions has been identified by three main limitations, which includes cognition, strength and dexterity[1,2].Dexterity is also important to minimize surgical damage as it is proposed to be a cause for many injuries and other errors.[4,5] Though it is helpful throughout medicine, and especially important in surgical branches[5].

The conditions which may cause issues on one's finger dexterity that prevent them from fulfilling their occupations and work tasks include repetitive movements of fingers for long hours, poorly designed equipment which does not fit to the individual's physical needs [6]. It is also influenced by various factors such as age, gender, dominance, etc. [4]

Surgery is an art and acquiring dexterity is advantageous to a surgeon and they should acquire the art of using the instruments with neatness, rapidity and certainty. Dexterity should not be mistaken for technical skill and there appears

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to be a very thin line of demarcation between dexterity and technical skills. The use of both the hands during surgery determines the overall quality of the surgical procedure and confidence in using both hands with equal precision increases the efficiency of a surgeons [7]. The surgeons work involves precise, coordinated, fine motor activities along with the use of many delicate instruments and cognitive skills [5]. A Great hand grip strength (HGS) and excellent dexterity are two of the major skills required for the surgeons to perform complex surgical procedures, but it might be argued that surgical differentiation has led to differences in both skills among surgeons of various surgical specialities[8].

As orthopedic trauma surgeons regularly perform surgical procedures on fractured bony structures using their strength and relatively heavy surgical tools, on the other hand during vascular, oncological and gastro-intestinal surgeries, precisely coordinated movements of the hands are essential for performing on the small structures [6]. Basically, Surgeons across different specialties face unique challenges based on the nature of their work and the specific skills required.

The 9-Hole Peg Test (9-HPT) is a brief, simple, standardized and timed measure test of upper extremity function and dexterity which use to assess the main aspects in every participants like fine skill, coordination and speed[9,2]. The advantages of the NHPT include - it is simple, cheap and easily portable equipment which is easy to administer and time-efficient, it also requires a precise and coordinated finger movements, and do not rely heavily on more proximal or axial movements that could be used to compensate for deficits in fine motor dexterity[10,11]. The test required a coordinated control of the muscles of fingers and thumb[2].

2. Materials and Methodology

2.1. Methodology

- **Study design**: Cross sectional study.
- **Study setting**: Dr. Ulhas Patil Medical Hospital, Jalgaon
- **Study Duration:** 6 months
- **Type of sampling**: Convenient sampling
- **Study population**: Surgeons
- **Sample size**: minimum sample size is 51.
- **Place of study**: Dr. Ulhas Patil Medical Hospital, Jalgaon.

2.2. Inclusion criteria

- Surgeons (General surgeon, Orthopedic surgeon, Neurosurgeon, gynecologist, ophthalmologist, ENT surgeon, Nephrologist)
- Involve in surgery more than 6 months (minimum 50 surgeries done)
- Age 27year & above.
- Participants willing to participate.

2.3. Exclusion criteria

- Not involve in surgery less than 6months (less than 50 surgeries done)
- Age below 27 years.
- Participants undergone upper extremity surgery.
- Participants having pathological upper extremity conditions and disorder.
- Participants any severe ophthalmic disorder.
- Participants not having adequate sleep in last 24 hours.
- Participants with CNS impairments.
- Participants not willing to perform.

Materials: Nine-hole peg board, Chair, Table, paper, pen, Stopwatch, Calculator.

2.4. Outcome measures

- **Nine-hole peg test**: The Nine Hole Peg Test (NHPT) is an instrument that was developed to measure finger dexterity (fine manual dexterity). The NHPT consists of a square board composed of a small container with nine holes and nine pegs arranged in a 3×3 square pattern. NHPT is widely considered a gold standard metric for finger dexterity because of its simplicity, low cost, and short time to administer. Different versions of the NHPT

apparatus are available varying in the type of material, dimension of the surrounding surface and the shape of the container, but not the size of the holes or pegs, nor the distances between the holes(Figure1) Instruments that offers information on motor aspects and levels of strategy that affect the functionality of the subjects' hands.

- **Assessment procedure**: We assured applicants during the consent process that the results of the testing would not have an impact on their practice. The participant is asked to sit comfortably on a chair with feet completely in touch with the floor. The pegboard is centered in front of the subject, with the pegs placed in the container next to the board on the same side as the hand being tested. The dominant hand was tested first. The following instructions are given to subjects as the examiner briefly demonstrates the test: The subject is asked to pick up the pegs one at a time, using the testing hand, and put them into holes at the maximum possible speed until all holes are filled. Then pegs should be removed from the holes, one by one, and replaced back in the container. The stopwatch is started by the examiner as soon as the subject touches the first peg and stops when the last peg hits the container. The container is then placed on the opposite side of the pegboard. Registers the time that the subject takes to complete the task. This process must be done with both hands independently. The dominant hand is tested first, followed by the non-dominant hand. The time duration of each hand are averaged, and the results are interpreted based on gender, age, and dominance, using standard norms.

3. Results and discussion

Table 1 Dominance wise

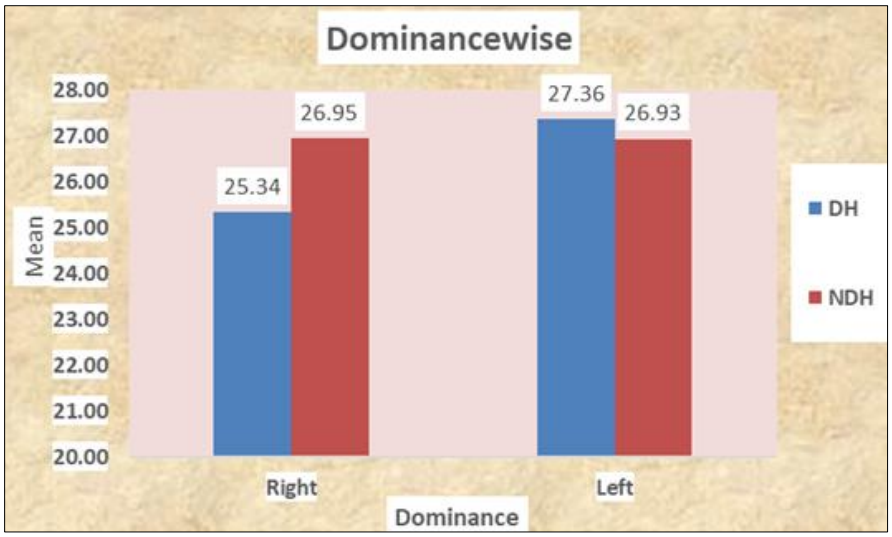
Dominance wise										
			Normal		**Abnormal**					
Variable	**Groups**	**N**	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Mean**	**SD**	**t value**	**p value**
Dominance	Right	48	2	3.92	46	90.20	25.34	3.22	3.87	0.001
	Left	3	0	0.00	3	5.88	27.36	0.41		

Comment- Unpaired t test was used to compare means. Test statistics value of test was 3.87 with p value 0.001. Here p value less than 0.05, shows significant difference in means.

In this study, a total number of 51 surgeons were included. The result indicates a significant decrease in average finger dexterity ($p< 0.003$), particularly in dominant hand($p<0.001$) among surgeons.

Table 2 Non dominance wise

Non-Dominance wise										
			Normal		**Abnormal**					
Variable	**Groups**	**N**	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Mean**	**SD**	**t value**	**p value**
Dominance	Right	48	3	5.88	45	88.24	26.95	3.89	0.01	0.990
	Left	3	0	0.00	3	5.88	26.93	0.01		

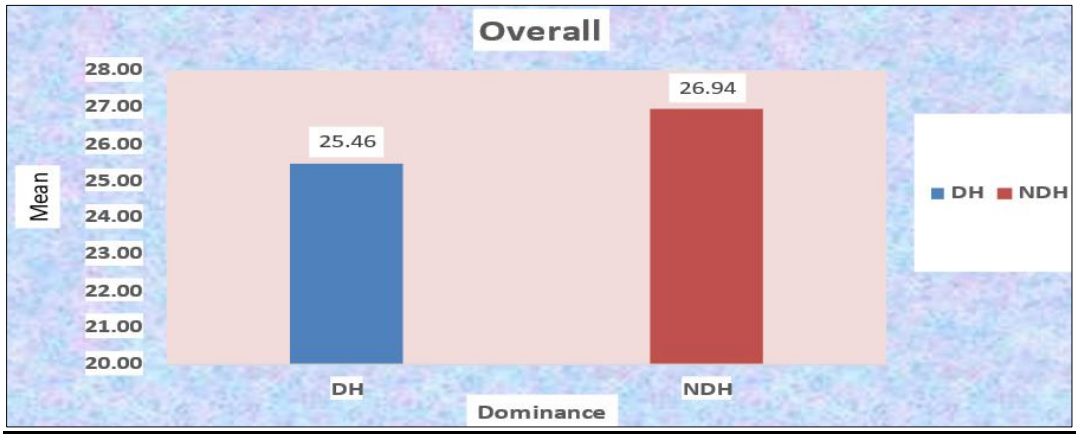


Comment- Unpaired t test was used to compare means. Test statistics value of test was 0.01 with p value 0.99. Here p value more than 0.05, shows no significant difference in means.

Figure 1 Statistical analysis of dominant & non dominant hand

Table 3 Overall

Overall										
			Normal		**Abnormal**					
Variable	**Groups**	**N**	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Mean**	**SD**	**t value**	**p value**
Gender	Male	30	1	1.96	29	56.86	26.77	4.03	0.41	0.684
	Female	21	2	3.92	19	37.25	27.21	3.57		



Comment- Paired t test was used to compare means. Test statistics value of test was 3.15 with p value 0.003. Here p value less than 0.05, shows significant difference in means

Figure 2 Statistical analysis of overall presentation

The purpose of our study aimed to investigate finger dexterity among surgeons, focusing on factors such as repetitive movements, poorly designed equipment, and age, which highlighted the importance of finger dexterity in surgery. The present study used a wooden nine-hole peg test to measure finger dexterity and to understand better sensory integration by using a wooden set. As previous studies have used devices like the Perdue Pegboard, the Minnesota Small Parts Test, and the Imperial College Surgical Assessment Device (ICSAD), which are all steel-based sets.

This research is valuable for understanding that dexterity declines with age due to changes in the nervous, vascular, and musculoskeletal systems, muscle mass reduction, sensory loss, and cold exposure. These physiological changes can impact hand function, grip strength, and proprioception, as well as sleep deprivation and addictions among surgeons, which have led to reduced finger dexterity.

According to the observation of Munira Abbas Hirkani and Jeetendra Yogi, they found the effect of sleep deprivation (SD) on finger dexterity during the residents' on-call period and found that SD significantly decreased finger dexterity at the end of the 24-hour duty period. The changes in finger dexterity correlated negatively with subjective sleepiness assessment which significantly decreases finger dexterity in resident doctors, potentially causing medical errors.

Our analysis highlights a significant decrease in average finger dexterity($p<0.003$) among surgeons, particularly in the dominant hand($p<0.001$), but no significant difference in local mean scores across age groups or sexes. A surgeon has 75% decision-making and 25% dexterity, which increases efficiency. A study has found that experienced surgeons can perform tasks in a better way with their dominant hand as compared to the non- dominant hand. The study also found a thin line between dexterity and technical skills and that ambidexterity is not limited to knot-tying or suturing. Motor practice induces plastic changes in the primary motor cortex, promoting motor learning and performance improvements bilaterally by improving basic daily life changes.

The wear and tear theory, which focuses on aging and joint health, is applied to surgeons due to their repetitive movements during surgery. This can lead to joint strain, muscle fatigue, cumulative injury, and decreased performance. Overuse of certain muscle groups can weaken others, causing potential injuries and decreased efficiency. Chronic conditions like carpal tunnel syndrome or osteoarthritis can also impact surgeons' ability to perform procedures effectively. As wear and tear accumulate lipofuscin, surgeons may experience decreased dexterity, increased pain, and reduced stamina, ultimately affecting surgical outcomes.

Surgeons need outstanding finger dexterity for precision in their operations, honed through extensive training and repetitive tasks. However, overuse or strain can diminish this dexterity, highlighting the physical demands of their role.

The study highlights that maintaining finger dexterity is crucial for surgeons to ensure optimal surgical performance. Encouraging surgeons to engage in activities that enhance their dexterity can lead to significant improvements in their practice, ultimately benefiting patient.

4. Conclusion

The study concludes with a prevalence of reduced finger dexterity proficiency among surgeons, particularly in the dominant hand.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

The research work obtained ethical clearance from the institutional ethical committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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