International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-2, February 2016
ISSN: 2395-3470
www.ijseas.com

STUDY OF PINCH STRENGTH INTER-RELATIONSHIP CORRELATING CTS AMONGST ASSEMBLY LINE WORKERS

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ABSTRACT

Carpal tunnel syndrome (CTS) is the most commonly reported work-related musculoskeletal disorder of the upper extremity. It has been found that the probability of having CTS symptoms is more while working with finger extremities dominated work in manual assembly line .While a causal relationship has been found between the pinch strength and CTS development, few studies have analysed the predictive outcome scores of pulp, lateral and chuck pinch. In this communication, effect of outcome score of pulp, chuck and lateral pinch has been studied. Carpal Tunnel Syndrome (CTS), amongst muffler manufacturing assembly line workers in actual industrial environment has been studied through questionnaire and physical tests. A sehan pinch gauge was used to check the outcome score of pinch strength for pulp, chuck and lateral pinches. Also comparisions of various digits in context to pulp pinch was also studied.

Relevance to industry

This research provides guidance on assessment of exposure to pinch strength prioritizing job tasks relative to risk of developing carpal tunnel syndrome.The awareness will lend a hand to the workers as well as management to take obligatory precautions at workstations as of jobs involving repetitive upper extremities. Following the outcomes of study, management can get rid of absenteeism and heavy compensations caused due to CTS.

Keywords: *CTS, WMSD, Pinch strength, Pulp pinch. Chuck pinch, lateral pinch. Assembly line, Finger extremities.*

I. INTRODUCTION

The attainment of elevated performance has been important in the production units. Workforce of the production units has to perform under extreme physical conditions to achieve higher yields thus involving greater efforts (Zetterberg & Ofverholm, Kumar et al., Silverstein and hughes]. In spite of the lack of reliable quantitative data, experience has made customary that the characteristics of small-scale industries results in likelihood of musculoskeletal injuries and accidents[Glass, Choobineh et al.]. Because of greater efforts, under extreme physical conditions Musculoskeletal disorders (MSDs) are developed in the work place which are commonly known as Work-Related Musculoskeletal Disorders (WMSDs). These WMSDs are common dilemma of medical

health in working population, causing pain, numbness, temporary or permanent disability, lost work time, and an evident increase in worker's compensation costs [Fagarasanu and Kumar, Cheng et al.]. Most common sufferers are those workers involved in tasks necessitate of forceful and repetitive motion of the neck, shoulders, elbows, wrists, hands, and finger extremities leading to work related upper extremity disorder(WRUED) [Spies et al., Coury, Ajimotokan, Heiden et al.].WMSDs problems are widespread in many countries and various occupations especially among industrial workers [Wenzhou et al.]. One of the prime MSD, Carpal Tunnel Syndrome (CTS) is a symptomatic compression neuropathy of the median nerve at the level of the wrist/hand characterized physiologically by evidence of increased pressure within the carpal tunnel and decreased function of the nerve at that level. (Figure1) It is characterized by patients reporting numbness, tingling, hand and arm pain and muscle dysfunction [Yao et. al. 2010; Kumar et. al.2010; Simon et. al. 2011].

In the present study an attempt has been made to monitor the impact of finger extremities. The study is conducted on 123 male workers of a muffler manufacturing industry exposed to repetitive work. A total of 246 hands (both hands) have been used for data collection (Table 1). The study was conducted by questionnaire designed and physical examination of individual workers. Health questionnaire form was designed according to the information required like age, height, weight, various types of pinch strength, levels of potential CTS symptoms etc.

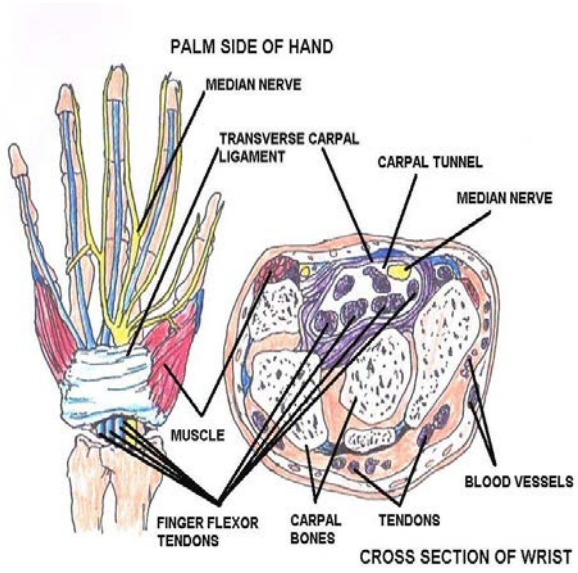
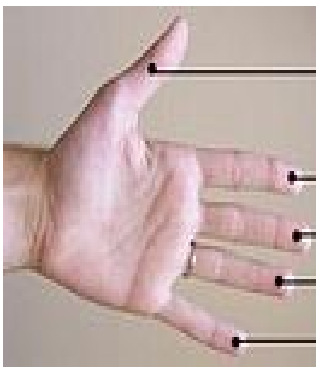


Figure 1: Anatomy of human hand

(Carpal tunnel syndrome, Technical Learning College, 2008)

A **finger** is a limb of the human body and a type of digit. Normally humans have five digits, termed phalanges, on each hand. The first digit is the thumb, followed by index finger, middle finger, ring finger, and little finger . From the thumb on the radial side to the ulnar side of the hand, the fingers are in the order as shown in figure 2.



Thumb,
Index finger
Middle finger
Ring finger
Little finger.

Figure 2: Human Hand Fingers Representing Each Digit

Dominant hand is the hand by which worker do his activities of daily life work, ADL'S (usually right hand). Pinch grip which is measured either as lateral (or key) pinch, tip (or pulp) pinch or chuck (or palmar or tripod) pinch precisely targets the thenar musculature and therefore is more specific to median nerve pathology. [Geere et al., 2007; Mosby's pocket Dictionary, Mosbey Elsevier,Missouri, 2009. ISBN: 978-0-323-05291-7]. Pulp pinch (Figure3) is the grasp in which the tip of the thumb is pressed against any or each of the tip of the other fingers. In lateral pinch (Fig. 4), the force of thumb flexion is opposed by the stability of the lateral aspect of middle phalanx of index finger while partially clenched fist . In chuck pinch (Fig. 5), thumb flexion is opposed by flexion of the index and middle fingers, combined [Imrhan,1991]. In chuck pinch, grip strength is measured between the pulp of the thumb in opposition to the combined pulps of the index and middle fingers. Repetitive chuck pinch, carried out while the wrist is in some degree of flexion may contribute significantly to CTS in some patients [Smith et al., 1977].

Figure 3: Pulp Pinch

Figure 4: Lateral Pinch

Figure 5:- Chuck Pinch

II. TOOLS FOR PINCH STRENGTH ANALYSIS.

Following tool have been used for pinch strength analysis

2.1 Gauge- SAEHAN Pinch SI 5005

SAEHAN pinch gauge – SI 5005 was used for pinch strength analysis. This pinch gauge has been made for many decades with JAMAR trade name. Many of improvements has been made and the design is internationally accepted as a standard features. Dual scale shows both pounds and kilograms(Saehan catalog_2010_12_11.pdf). The output of the pinch gauge is quantitative. It is held by the therapist, not the patient. The patient should apply pressure to the pinch block with the finger pads or finger tips. Pressing the pinch button with the thumb causes the force reading to appear on the gauge. (Instruction manual, SAEHAN hydraulic pinch gauge, SH5005).

The American Society of Hand Therapists recommends the following testing position:

- Patient should be seated
- Shoulders should be adducted and neutrally rotated.
- Elbow should be flexed at 90 degrees.
- Wrist should be in neutral position.

2.1.1 Instrument Calibration

Calibration with the materials testing machine is performed by applying pressure on the bridge of the pinch meter. Certificate of calibration was endow with.

III. DATA ANALYSIS ANRESULTS

Factors of finger extremities of the assembly line workers are described in the following sub points.

3.1 Effect of type of Outcome Score for pulp pinch: - The non-dominant hand was found to be 89 per cent as strong in pulp pinch as compared to dominant hand. Also, Rank order of pulp pinch strength for individual digits was found as Digit III > Digit II > Digit IV> Digit V for both dominant and non-dominant hand.(Fig. 6,7)

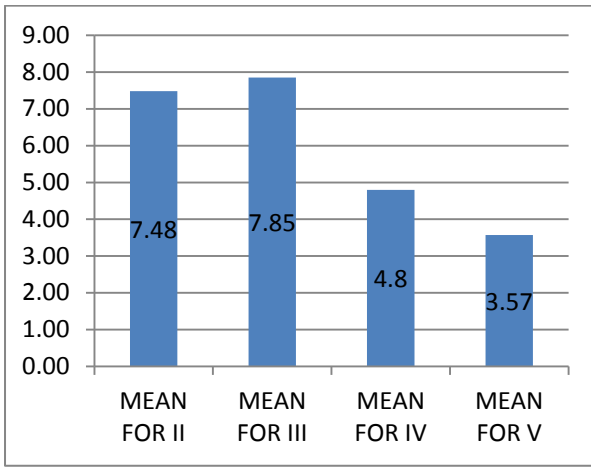


Figure 6:- Pulp Pinch (Dominated Hand), Kgs.

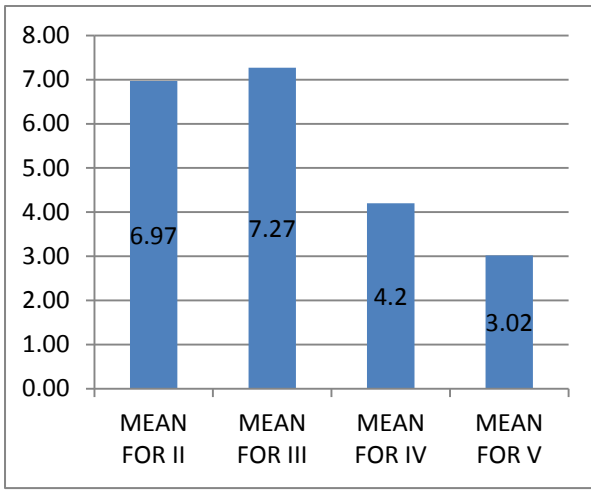


Figure 7:- Pulp Pinch (Non-Dominated Hand), Kgs.

3.2 Effect of Type of Outcome Score for lateral pinch: - The non-dominant hand was found to be 93 per cent as strong in lateral pinch as compared to dominant hand. (Fig. 8)

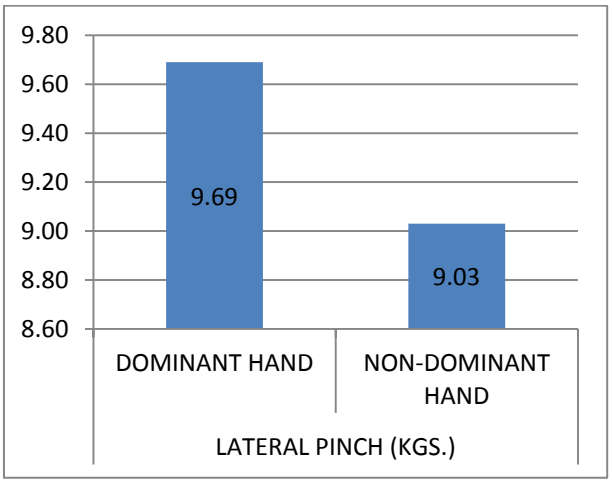


Figure 8:- Lateral Pinch, Kgs.

3.3 Effect of Type of Outcome Score for chuck pinch: - The non-dominant hand was found to be 92 per cent as strong in chuck pinch as compared to dominant hand.(Fig. 9)

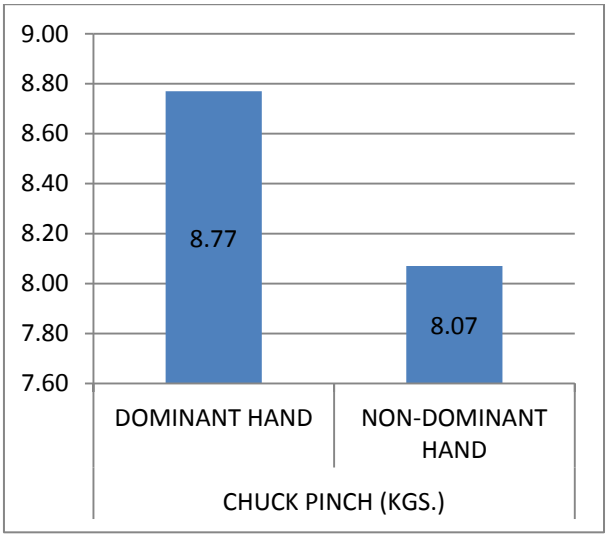


Figure 9:- Chuck Pinch, Kgs.

IV. CONCLUSION

It was analysed that CTS symptoms was reported more among those who are having low value of pinch strength. It is suggested that workstations should be such designed which are focussed on use of those finger extremities which attain more value of pinch strength in order to attain effective work and

in order to have lesser probability of attaining CTS Symptoms

This study is for spreading awareness amongst industrial workers and management regarding CTS.

V. FUTURE SCOPE

The work done in the present study on workers exposed to repetitive work in a manufacturing industry can be extended to industries of similar working environment to further generalise the results. And in the Current study involves a small sample of subjects (123 Workers) which may limit the generalisation of the results. Future studies may use larger sample sizes. The Saehan pinch meter is used in the present study. There may some question whether data from use of the newer pinch meters can be validly compared to their norms. Some other available pinch gauges may be used to validate results. Also, Longer-term follow up data is also needed to evaluate the responsiveness of these tools. Also, Some researchers have examined the effect of using hand gloves on hand grip strength and pinch strength which is not been considered in the present study. Such can be considered for further study.

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FIGURE CAPTION

Figure 1: Anatomy of human hand

Figure 2: Human Hand Fingers Representing Each Digits

Figure 3: Pulp Pinch

Figure 4: Lateral Pinch

Figure 5: Chuck Pinch

Figure 6 : Pulp Pinch (Dominated Hand), Kgs.

Figure 7 : Pulp Pinch (Non-Dominated Hand), Kgs.

Figure 8 :Lateral Pinch, Kgs

Figure 9 :Chuck Pinch, Kgs**.**

TABLE CAPTION

Table 1: Statistics of Assembly Line Workers under Study- Mean and Standard Deviation

Table 1: Statistics of Assembly Line Workers underStudy- Mean and Standard Deviation

	Factor of concern	Statistics (Mean ± S.D)
	Number of Workers	123
	Age (years)	26.902 ± 4.128
	Weight (kg)	66.39 ± 7.312
	Height (Meter)	1.65 ± 0.037
	BMI (Kg/m2)	24.16 ± 2.47
Pinch Strength	Dominant hand Pulp pinch Digit II	7.47 ± 1.19
	Dominant hand Pulp pinch Digit III	7.85 ± 1.35
	Dominant hand Pulp pinch Digit IV	4.80 ± 1.11
	Dominant hand Pulp pinch Digit V	3.56 ± 0.85
	Non-Dominant hand Pulp pinch Digit II	6.97 ± 1.20
	Non-Dominant hand Pulp pinch Digit III	7.26 ± 1.27
	Non-Dominant hand Pulp pinch Digit IV	4.19 ± 0.86
	Non-Dominant hand Pulp pinch Digit V	3.02 ± 0.68
	Dominant hand lateral pinch	9.68 ± 1.63
	Non-Dominant hand lateral pinch	9.03± 1.44
	Dominant hand chuck pinch	8.76 ± 1.48
	Non-Dominant hand chuck pinch	8.06 ± 1.26

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