



CORRELATION BETWEEN THE SHOULDER PAIN UPPER LIMB MUSCULOSKELETAL DISORDER AND HANDGRIP STRENGTH AMONG DENTAL PROFESSIONALS

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ABSTRACT:

BACKGROUND: Musculoskeletal disorders (MSDs), particularly in the neck and shoulder, are common occupational issues among dental professionals due to prolonged static postures and repetitive movements. Shoulder pain is frequently reported and may impact both performance and well-being. Handgrip strength serves as a reliable indicator of upper limb function and musculoskeletal health.

AIM: The aim of the study was to observe the correlation between the shoulder pain upper limb musculoskeletal disorder and handgrip strength among dental professionals.

METHOD: An observational study was conducted involving 100 dental professionals (50 males and 50 females) with an average age of 35 years. Participants completed a structured questionnaire to assess the presence of shoulder pain and upper limb MSDs, followed by handgrip strength testing using a dynamometer. Descriptive statistics and correlation analysis were used for data evaluation.

RESULTS: Improving grip strength may help workers adopt better postures, reducing musculoskeletal injury risk, and also alleviate shoulder pain and disability. Strengthening hand and forearm muscles can enhance overall upper body function, reducing strain on the shoulder joint and leading to improved outcomes.

CONCLUSION: This study found that dental professionals with weaker grip strength tend to experience more shoulder pain and disability due to postural instability. Therefore, exercises that strengthen the hand, forearm, and upper body muscles may help improve functional capacity and reduce discomfort.

KEYWORDS: Shoulder Pain, Upper Limb Musculoskeletal Disorder, Handgrip Strength, Dental Professionals, Observational Study, Musculoskeletal Disorders (MSDs), Occupational H

INTRODUCTION

Musculoskeletal disorders (MSD) and pain are a common health burden among dental professionals in Western countries. Work-related musculoskeletal disorders (MSDs) are one of the most common occupational health problems worldwide and develop as a result of injury to the bones, muscles, tendons, joints, and supporting structures.⁽¹⁾ Musculoskeletal disorders (MSDs) are highly prevalent among dental professionals due to the repetitive, precise, and often awkward postures required during clinical procedures. One of the most commonly reported complaints is shoulder pain, which can significantly affect a dentist's productivity, quality of life, and overall career longevity. Upper limb musculoskeletal disorders, particularly those affecting the shoulder, are often associated with ergonomic challenges in dental practice, such as prolonged static postures and repetitive arm and hand movements.⁽²⁾

Handgrip strength, a widely recognized indicator of overall upper limb muscle function, is essential for dentists to perform fine motor skills and maintain effective control of dental instruments. Decreased handgrip strength may be reflective of underlying musculoskeletal issues and functional impairments. Conversely, chronic shoulder pain and associated upper limb dysfunction could negatively impact grip strength, leading to compromised clinical performance.⁽³⁾ Understanding the correlation between shoulder pain, upper limb musculoskeletal disorders, and handgrip strength among dental professionals is crucial for early intervention, prevention strategies, and ergonomic modifications. This project aims to explore this relationship to enhance occupational health awareness and improve clinical ergonomics in dentistry.⁽⁴⁾

Grip strength is the force applied by the hand to pull on or suspend from objects and is a specific part of hand strength in application of grip strength wrist should be in neutral position. Grip strength is a general term.⁽⁵⁾ any professional worker referring to muscular power and force that they can generate with their hands for a proper grip the thumb, the fingers and the lumbricals (flexor digitorum profundus, MCP) the interossei (three palmar interossei, four dorsal interossei) the hypothenar (carpal ligaments, abductor digiti minimi muscle, flexor carpi ulnaris tendon) in order to perform power grip stable wrist is needed biomechanically a stable wrist prevents the dissipation of finger flexion and extensor forces as tendon moves. The human hand is the most complex structure in the body.⁽⁶⁾

Dentists are at higher risk of MSDs than other medical professionals due to their improper repetitive movements in static positions, awkward postures, and long working hours without rest periods.⁽⁷⁾ Many postural faults among dentists are caused by craning and/or excessive bending and twisting of the neck, bending forward from the waist, elevation of shoulders, and general bending or twisting of the back and neck.⁽⁸⁾ The prevalence of MSDs among dentists ranges between 63% and 92% and affects mostly the lower back (36.3–60.1%) and the neck (19.8–85.0%) Similarly, dentistry students also experience muscular pain and fatigue in their educational lives due to inappropriate working postures, inadequate ergonomic factors, and lack of awareness about proper working postures.⁽⁹⁾

Caballero et al. reported that 80% of a sample of 41 dentistry students suffered from muscular pains.⁹ Another study showed that 33% of a sample of 82 dentistry students had lower back pain, 28% had neck pain, and 10% had both. Whereas hand is the functional unit of dentist and is used for firm holding of instruments and tools.⁽¹⁰⁾ The amount of static force that hand can squeeze around dynamometer is referred as handgrip.⁽¹¹⁾ Grip strength may be affected by gender (male > female), age. Handgrip strength used to assess functional activity. Measurement of handgrip strength used to detect whole upper arm strength.⁽¹²⁾ Many studies that show reduction of handgrip, 20-30% less on painful side. In addition to that, unilateral musculoskeletal pain Cause delay in initiation of grip and getting relaxed.⁽¹³⁾

So the purpose of the study was to define correlation between neck pain intensity and handgrip strength in male and female dentists. High rates of occurrence of upper extremity musculoskeletal disorders (MSDs) in dental professionals (dentist, dental hygienist, and dental assistant) are well documented, including regional neck and shoulder pain, shoulder tendonitis, neuropathy, tension neck syndrome, and trapezius myalgia, with more recent attention given to students either as a control group or as a newly exposed group. Much of the focus has centered on dentists and dental hygienists, while fewer studies attempt to estimate the prevalence of MSDs among dental assistants and dental hygiene students.⁽¹⁴⁾ The few studies that have examined MSD prevalence in dental assistants and dental hygiene students have found mixed evidence for appearance of early symptoms.⁽¹⁵⁾

Shoulder pain is the second most frequently reported acute musculoskeletal complaint general practice. The shoulder is the third most common site of musculoskeletal pain in the general population. There is a paucity of information regarding the impact of shoulder disorder on general population and as such, there is increased interest in defining disability associated with shoulder disease.⁽¹⁶⁾ As with other observational methods for a quick ergonomic risk assessment application in occupational health, the original version of the RULA was created as a form to be filled-in by the participant. By applying this scoring method, experienced occupational health staff can rapidly decide whether their working procedures are ergonomically risky. The worksheet consists of 15 steps (figure 4) in which the position of the limbs, neck, and the trunk are assessed and evaluated according to the risk potential. In the RULA, the static or dynamic natures of postures are considered; this is especially interesting for dentistry since the static postures are considered a major health hazard.⁽¹⁷⁾ **T. Francis TG, S. Anandhi (2016)**¹⁸ concluded that thumb length is positively correlated with handgrip strength, and the musculoskeletal disorders among dental professionals. The thumb length is poorly correlated with dominant hand dexterity.

METHODOLOGY

The study is an observational study. The sample size is about the 50 dental professionals including the males and females. Dental professionals (Interns), Age group 21 – 25 years, Subject willing to participate in the study, Poor posture person, Who are all having the shoulder pain, are included. Subject with any kind of wrist or hand injuries in the past 1 year, subject not willing to participate in the study, subject with previous history of fracture on upper limb, subject with any kind of musculoskeletal, Subject with any kind of neurological deformity in the upper limb are excluded in this study.

HAND GRIP STRENGTH:

Hand grip strength is measured using a hand – held dynamometer. Participant is asked to sit in a chair with the elbow flexed to 90 degrees and the forearm in mid prone on an armrest. Participant are then squeezes the dynamometer.

RULA:

RULA consists of three sections. The first is to recording the working posture, the second is scoring system, and the third is action level of risk and need for action to be conducted to gather assessment that is more detailed. A coding system, categorized into four levels indicates the level of intervention required to reduce the risk of injury. Activities using this ergonomic evaluation approach result in a risk score between

one and seven where higher score signifies greater level of apparent risk. RULA is a tool used without the need of any special equipment or investigator. It just requires a clipboard and pen and done in a simple workplace, without hindrance to the force.

THE SHOULDER PAIN AND DISABILITY INDEX (SPADI): The SPADI is a self-report questionnaire that measures pain and disability in the shoulder. It consists of 13 items in 2 subscales: pain (5 items) and disability (8 items). The items of both subscales are measured with visual analog scales from 0 (no pain or difficulty) to 10 (worst pain imaginable or so difficult it required help). Each item is scored by measuring the distance from the left anchor to the mark made by the person. Subscales are scored in a 3-part process: First, item scores within the subscale are summed. Second, this sum is divided by the summed distance possible across all items of the subscale to which the person responded. And third, this ratio is



FIGURE 1: HAND DYNAMOMETER



FIGURE 2: HANDGRIP STRENGTH



FIGURE 3: RULA ASSESSMENT

DATA ANALYSIS AND INTERPRETATION

In the study, 50 samples were taken for both male and female with Age, Grip strength, RULA score and SPADI score.

ABOUT THE VARIABLES CONSIDERED IN THE STUDY

- Grip strength refers to the force exerted by the hand and forearm muscles when gripping an object. It is commonly measured using a hand dynamometer and is an important indicator of muscle strength, endurance, and overall health.
- The RULA score (Rapid Upper Limb Assessment) is used to evaluate the risk of musculoskeletal disorders

(MSDs) in the upper body (arms, wrists, neck, shoulders, and back). It is specifically designed to assess the ergonomic risks associated with posture, movement, and force exertion during tasks in the workplace or in other environments where physical strain is involved.

- The SPADI (Shoulder Pain and Disability Index) score measures shoulder pain and disability index (higher scores indicate more pain and dysfunction).

Correlation:

Correlation is used to measure the association between the two quantitative variables. The two main types of correlation are positive and negative. Correlation ranges from -1 to +1. Variables with correlation values closer to +1 indicate a strong positive relationship, while values closer to -1 indicate a negative relationship. Weak or no correlation is observed when values are near 0.

OUTPUT

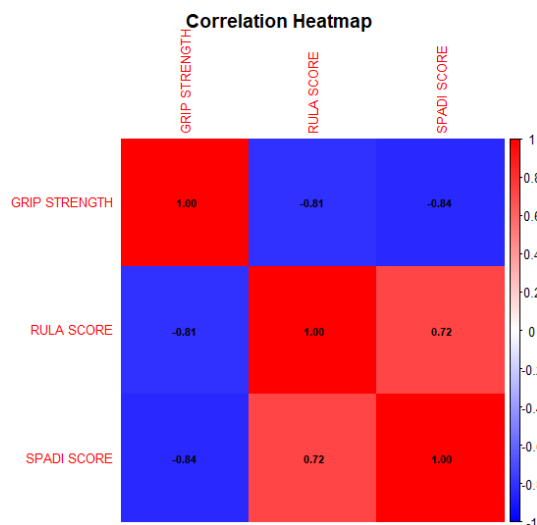
```
> correlation
      GRIP STRENGTH RULA SCORE SPADI SCORE
GRIP STRENGTH      1.0000   -0.8088   -0.8368
RULA SCORE         -0.8088    1.0000    0.7201
SPADI SCORE        -0.8368    0.7201    1.0000
```

From the above output, it is observed that

- A correlation coefficient of -0.8088 between Grip Strength and Rula score indicates that there is a strong negative correlation between the two variables.
- In this study, as grip strength decreases Rula score increases, which shows that the individuals with weaker grip strength tend to have poorer postures (higher Rula scores). They are at higher risk of developing musculoskeletal disorders or injuries.
- The correlation between Grip Strength and SPADI Score is -0.8368, indicating a strong negative correlation between the two variables. As Grip Strength decreases, the SPADI score tends to increase.
- In this study, the individuals with weaker grip strength tend to experience more shoulder pain and disability, since they have higher SPADI scores.

Heatmaps

Heatmaps is used to visualize feature importance, where each column represents a feature, and the colours represent their importance scores. The goal of a heatmap is often to identify patterns and correlations between variables. Areas of high intensity (red colour) with values close to +1 indicate a strong positive correlation, while areas with low intensity (blue colour) having values near -1 indicate a strong negative correlation and the values near 0 with no colour indicates no significant pattern or no correlation between the variables.



Interpretation

From the above correlation heatmap, it is observed that the correlation between Grip strength with both the Rula score and SPADI score there occurs a strong negative correlation. This shows that the individuals with weaker grip strength tend to have higher RULA and SPADI scores, indicating greater musculoskeletal discomfort, disability, or risk of musculoskeletal disorders. This finding suggests that interventions aimed at improving grip strength might help reduce disability and pain, as reflected by lower RULA and SPADI scores. The correlation coefficients were found to be statistically significant, further supporting the robustness of this relationship.

Suggestions:

Physiotherapy for Grip strength

From the above analysis, it might be beneficial to provide targeted physiotherapy interventions aimed at improving grip strength. Physiotherapists can design exercises that strengthen the muscles in the hand, forearm, and upper body to improve functional capacity and reduce discomfort.

Focus on progressive resistance training

Exercises that involve strengthening the muscles responsible for grip (such as wrist flexors, extensors, and hand muscles) could help enhance overall strength, reduce the RULA score (indicating less upper limb strain), and decrease SPADI scores (indicating reduced shoulder pain and disability).

RESULT

1. The strong negative correlation between grip strength and Rula score suggests that improving grip strength might help workers adopt better postures and reduce the risk of musculoskeletal injuries.
2. The strong negative correlation between grip strength and SPADI score shows that improving grip strength may have a positive impact on reducing shoulder pain and disability. Strengthening the hand and forearm muscles could potentially help in improving overall upper body function and reduce the strain on the shoulder.

joint, leading to lower SPADI scores (less pain and disability).

DISCUSSION

Prevalence of MSD and pain in our study is high with overall 92.6% of dentists suffering from musculoskeletal complaints in at least one body region. These findings are associated with higher workloads and existing comorbidities.

The incidence of musculoskeletal problems, especially work-related is increasing. One of the occupations that are encountering with these problems are dentists. In current study, it was found that most of the dental students had symptoms of MSDs. Similar studies conducted by different researchers have shown similar results. It was found that 86.6% of all students surveyed suffered from MSD associated with clinical requirements of their training. reported that 82% of undergraduate students and 90% of postgraduate students reported pain in at least one body region. Site of MSD in the current study was mostly neck, followed by lower back and shoulders and this is supported by other study. Study conducted by Rehman et al. also reported that lower back (57.8%), neck (37.5%) and shoulders (29.6%) were the three commonly affected sites of dental practitioners.

RULA was used by to assess dentists' working posture. The RULA method was used to watch, question, and assess 50 dentists and dental assistants. The dentists' working posture was found to be abnormal, with static and prolonged sitting, lifted shoulders, bent and twisted necks, and a bowed trunk that needed immediate attention used RULA to look at how dentists' working posture changed when they used alternative work concepts like proprioceptive derivation (Pd) vs the standard approach. The Pd concept is a strategy that helps dentists to keep a good posture while performing dental tasks, hence decreasing musculoskeletal pain. The primary reasons for employing Pd were that it increased comfort, improved treatment satisfaction, improved communication with assistants, increased instrument availability throughout treatment time, and reduced contact with chair/support components, according to the findings. This study provided optimal access and visibility, comfort, and control during clinical practise, which is an important component of dental ergonomics. The use of ergonomic stools with lumbar support in conjunction with proprioceptive-derived supports has grown over time, demonstrating comfort in the workplace for dentists and lowering work-related musculoskeletal problems (MSDs).

This study is about the prevalence of poor hand grip strength in dentists. This study was conducted to find prevalence of poor hand grip strength in dentists. Dentistry is a profession who suffers maximum musculoskeletal problems due to their poor posture, inappropriate working patters and faulty mechanics. maximum work is done by their wrist joint. All the major surgeries, minute procedures, scaling, etc requires there wrist and fist. There are variations in the diameter of their instruments .and due to long procedures their grip strength may alter. For this purpose study about grip strength in dentists was carried out.

The objective of this study was to find out prevalence of upper limb musculoskeletal disorder, shoulder pain and poor hand grip strength in dentists.

The study was conducted with 50 dentist. Ethical concerns and permissions were taken in prior. outcome measures used were hand dynamometer reliability. Grip strengths were taken in neutral, flexion and extension positions. This study investigated out of which 88% were of 20-30 age group 10% were of age group. Both male and female dentists participated in the study. in which male population included 35% of dentists and female population included 65% of dentists.

The reliability of SPADI measurements was evaluated by Roach and associates who calculated internal consistency values. They obtained Cronbach alpha values of 0.86 and 0.93 for the pain and disability subscales. The results of our study are similar to theirs in our study. Roach and associates used factor analysis

to evaluate the construct validity of the SPADI in 50 patients. They reported a 2-factor solution to a factor analysis when a varimax rotation was used. In our study, we also reviewed internal domain-item consistency using a confirmatory factor analysis. The factor analysis results indicated that except for 5 items, the other items loaded on factor 1 and **Tilak francis TG, Siva Anandhi (2016)¹⁸**: In the above summary, based on statistical analysis it was found that thumb length is positively correlated with handgrip strength, and the musculoskeletal disorders among dental professionals. The thumb length is poorly correlated with dominant hand dexterity **Belibei feng et al., (2014)**: This study has identified an alarmingly high prevalence of neck and upper extremity WMSDs among dentists in China, much higher than that in the western countries

CONCLUSION

In this study, it is concluded that the grip strength decreases and RULA Score increases among dental professionals. Hence it is concluded that individuals with weaker grip strength tend to experience more shoulder pain and disability due to postural instability. Therefore designing exercises that strengthening the muscles in the hand, forearm, and upper body to improve functional capacity and reduce discomfort.

LIMITATION AND RECOMMENDATIONS:

LIMITATION

- Sample size is small
- Duration of the study is short
- Gender differences are not considered
- Long term follow up was not taken

RECOMMENDATIONS

- Large sample can be taken for further study
- Long term follow up can be performed to understand about long term effect of exercise
- Further research can be done with other out come

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