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Basics of Musculoskeletal Health in Dentistry: An Overview

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This book is an overlook onto the basics of musculoskeletal health amongst dentists which is the most commonly targeted profession of musculoskeletal pain and its consequences. This book also covers the common areas of pain, aeitiolgy, the study stating specialty specific areas of pain due to repetitive work of dental specialties and also mentions the measures of prevention and consequences if being neglected, i.e. in general stating importance of musculoskeletal health.

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BASICS OF MUSCULOSKELETAL HEALTH IN DENTISTRY

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PREFACE

This book is a concise approach to bring into everybody's knowledge about what are musculoskeletal disorders and the basic science behind how our musculoskeletal system functions. Moreover it states the major musculoskeletal problems faced by dentists in their routine practise, cause behind it and what preventive measure a dentists could take to avoid or at least face minimal problems so that they can be effective and efficient in their practise to bestow best of their knowledge and skills to dental profession.

This book also highlights a short study done in Vadodara (Gujarat-India) and its nearby outskirts to throw an insight in reality of problems faced by dentists in that region, similarly by other dentists across the globe.

It also mentions the consequences of continuous musculoskeletal pain and its negligence leading into major musculoskeletal problems over a period of time, if proper ergonomics is not followed.

1. MUSCULOSKELETAL DISORDERS

Despite numerous technical advances in recent years, many occupational health problems still persist in modern dentistry. These include percutaneous exposure incidents (PEI); exposure to infectious diseases (including bio-aerosols), radiation, dental materials, and noise; **musculoskeletal disorders;** dermatitis and respiratory disorders; eye injuries; and psychological problems. PEI remains a particular concern, as there is an almost constant risk of exposure to serious infectious agents**.** Musculoskeletal disorders (MSDs) are injuries or pain in body's joints, ligaments, muscles, nerves, tendons, and structures that support limbs, neck and back.[1] MSDs are degenerative diseases and inflammatory conditions that cause pain and impair normal activities[2].They can affect many different parts of the body including upper and lower back, neck, shoulders and extremities (arms, legs, feet, and hands). MSDs can arise from a sudden exertion (e.g., lifting a heavy object), or they can arise from making the same motions repeatedly repetitive strain, or from repeated exposure to force, vibration, or awkward posture. Examples of specific MSD disorders are carpal tunnel syndrome, epicondylitis, and tendinitis.[3]Abrasions, contusions, and fractures that occur from sudden physical contact with objects that might occur in an accident are not considered MSDs.

MSDs are an increasing healthcare issue globally, being the second leading cause of disability. For example, in the U.S. there were more than 16 million strains and sprains treated in 2004, and the total cost for treating MSDs is estimated to be more than $125 billion per year. Neck pain is one of the most common complaints, with about one fifth of adults worldwide reporting pain annually.[4] Most workplace MSD episodes involve multiple parts of the body. MSDs are the most frequent health complaint by European, United States and Asian Pacific workers and the third leading reason for disability and early retirement in the U.S. MSDs are widespread in many occupations, including those with heavy biomechanical load like construction

and factory work, and those with lighter loads like office work. The frequency of injury and body parts affected vary by occupation.

Dentistry is known to be a demanding profession that requires concentration and precision. It is based on the social interaction between health care providers and their patients. Therefore, a healthy dentist is particularly important for a successful dental practice as well as the wellbeing of patients. It is well known that musculoskeletal diseases (MSDs) are very frequent in the present adult population and have an enormous and growing impact worldwide. As far as dentists are concerned, MSDs represent one of the greatest problems of dental professionals.

Musculoskeletal disorders, most common occupational health hazard that affect the physical, psychological and social aspects of dentists. The causes of MSDs include equipment that is poorly designed or improperly used; the use of various types of force by parts of the body; awkward posture; repetition; the use of vibrating tools; and other factors, including some that are not work related (such as obesity, arthritis, autoimmune disorders, and smoking). Although there are known risk factors for MSDs, it is difficult to attribute a given disorder to a specific risk factor. It is likely that these types of injuries result from multiple risk factors, degrees of exposure to risk, and other issues (such as hereditary factors) rather than from any one single cause. As most dentists work at their private clinic with regular patients, sick leave may incur a considerable impact on the economics and goodwill of some dental practitioners. This, in turn, has an impact on their productivity and ultimately reduces their quality of life. In fact, the most common complaint amongst dentists is how MSD is impacting their personal life, and the lack of time between working periods for recovery. Musculoskeletal disorders (MSD) are a costly health problem, leading to courier ending disability if not treated. That being said, there is a direct relationship between decreased fitness levels and MSD. Musculoskeletal disorders arise from a number of sources; however the primary cause in the dental practice is the prolonged static posture (PSP's). With PSP's, neuronal ailments, ischemia and trigger points, disc herniation/bulging, and spasticity will develop. These are all due

to the common dental posture; seated with a forward lean, lateral neck flexion with rotation and arm abducted. It is considered that these biomechanical risk factors combined with psychosocial stress contribute to the development and progression of MSD. Despite this knowledge amongst all dental professionals, MSD prevalence rates continue to be high especially among dentists and dental hygienists. As a dentist, the level of precision and control is quite high, having to look into someone's mouth, and to work with fine tools in a confined space for long periods of time. It is the required level of control and accuracy that requires the dental professional to maintain a rather controlled and static posture for these extended periods of time. Although we have muscles in our bodies that are meant to maintain postural positions, humans have yet to evolve to the point where the muscles can work effectively without some rest. Physiologically, a sustained tension on a muscle or any soft tissue for extended periods of time without rest causes ischemia and may lead to necrosis within the muscle. This can only be remedied with periods of rest, and that can be done in a number of ways, all to be discussed later in this article. What complicates and increases the risk of injury is the forward lean at the waist and head carriage commonly found in the dental posture. This position, when maintained for long periods of time will eventually lead to the muscles "shutting off" thereby relaxing the stabilizing muscle structures of the spine. To make sure we don't "fall apart," the ligamentous structures take the brunt of the load. This can only be sustained for so long before the ligamentous tissues tear, however before this happens, creep occurs.

Aside from biological hazards dentists continue to suffer from musculoskeletal disorders (MSDs). To understand the nature of these problems, further studies are needed to identify causative factors and other correlates to MSDs. Continuing the education and interventions to help to reduce the MSDs are needed. For these reasons, it is important that dentists constantly get informed regarding up-to date measures on how to deal with MSDs. Possible explanations were that many experienced dentists are probably better adjusting their work positions and techniques in order to avoid MSDs, when compared to less experienced dentists. A more likely

explanation will be that more experienced dentists suffering from severe musculoskeletal disorders would have ceased practise and have not been captured in cross sectional survey. This later hypothesis was supported by five year follow up study of dentists in Sweden. [5]

The gradual deformation of the intervertebral joint under constant load constitutes creep, and it affects the ligaments. In unsupported sitting, compressional loads in the lumbar spinal disks increases 40% above normal forces compared to those loads incurred during standing. During forward flexion and rotation, a position often assumed by dental operators, the pressure increases 400%, making the structure susceptible to injury.[6]When it is noticed, often neglected Once the ultimate bad news of a disc herniation does occur, it can be a big blow that can put someone out of commission for many months. The common neurological signs and symptoms seen and felt in the hips and legs and in particular down the arm into the hands should be a red alert signal that something needs to be looked at and taken care of. This is the worst case scenario. However, it is one that does occur, and occurs often. In fact approximately 5% of all Low back pain is from a herniated disc.

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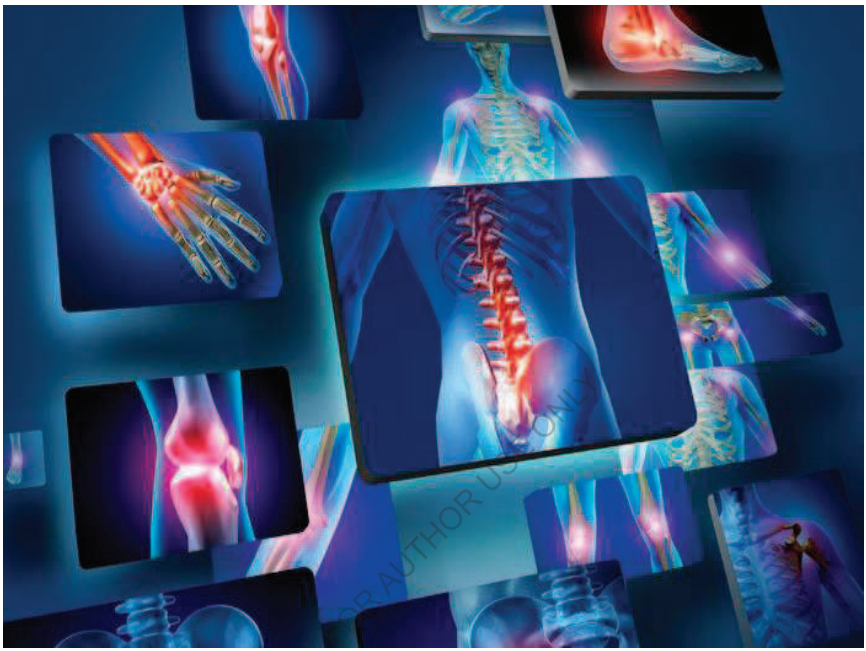
2. AREAS OF MUSCULOSKELETAL PAIN



This picture clearly states the, most prone sites of our musculoskeletal system.

According to one study of job postures and musculoskeletal illness among dentists it was found that in dentistry, due to the repetitive activities, long term working in static postures, inappropriate working conditions as well as usage of inappropriate tools musculoskeletal disorders are likely to occur – the prevalence of these disorders in different global studies is reported to occur in back, neck, shoulders and arms from 64% to 93% of the cases. [1]

Almost all work including dentistry requires the use of the arms and hands. Therefore, most MSDs affect the hands, wrists, elbows, neck, and shoulders. Work

using the legs can lead to MSDs of the legs, hips, ankles, and feet. Some back problems also result from repetitive activities.

A study has identified that it is not only work-related tasks that are risk factors for MSD among dental hygienists, but also psychosocial factors, such as a lack of involvement in practice decisions and work interference in home life.[1]

Dentists tend to hold one posture for a longer period of time than hygienists, meaning that dentists must have excellent endurance of the stabilizing muscles of the neck and shoulder in order to have optimal hand and arm function and to avoid musculoskeletal dysfunction. On average, women's muscles can exert only two-thirds the force of men's. What this means for
female dentists is that when the head moves forward, out of neutral position, there is generally less muscle to stabilize the neck.

List of areas mainly affected by musculoskeletal pain amongst dentists include:-

1) Lower Back: It is found to be one of the most affected areas among dentists, due to their continuous bending out of the neutral position (neutral position is one in which our head is in line with our body).
   Most commonly affects general dentists, dental students due to their wrong postures because of inexperience and unawareness about ergonomic position. Even in professionals practising any one speciality may be susceptible to any specific type of musculoskeletal pain, like periodontists, and endodontists may be more susceptible to lower back pain due to their erogonomically wrong and prolonged bending postures.

Basic Science:-The prolonged posture of continuous bending generally causes spasm of back muscles, which if continued to occur over prolonged period of time may lead to severe back pain and if neglected and not treated may lead to musculoskeletal disorders which if listed would commonly involve sciatica, lumbar spondylosis, disc compression and herniation

The muscles involved commonly include paraspinal muscles whose function is to extend and rotate the spine and maintain posture. It consists of splenius, semispinalis, multifidus, rotatores, interspinales, intertransversarii and sarcospinalis muscles. [2]

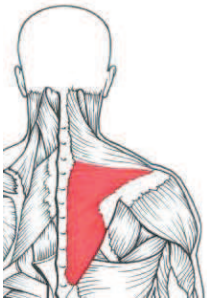
2) Upper Back: - Along with lower back, upper back is also affected due to prolonged and repetitive use, increased slipperiness of the objects handled (requiring increased grip force), the speeding up of movements which may ultimately result in fatigue of muscles involved along with the joints. This may occur due to continuous involvement of particular muscle or may be due to forceful exertions.

   The most common affected group of dentists includes endodontists, oral surgeons, pedodontists, along with general practitioners.

3) Shoulders: - The delivery of dentistry requires substantial endurance of the shoulder girdle stabilizing muscles, especially the middle and lower trapezius muscles. These shoulder-stabilizing muscles tend to fatigue quickly with forward head, rounded upper back, and elevated arm postures.

Basic Science: - Pain or discomfort of upper back and shoulder is mainly due to spasm of shoulder stabilising muscles i.e. trapezius and also involves rotator cuff muscles. The function of trapezius muscle is to stabilize shoulder muscles, rotator cuff muscles are helpful in promoting shoulder movements like rotation, arm abduction.

If this pain remains for prolonged period of time and continuous can lead to severe symptoms which can ultimately result in musculoskeletal disorders like Tension neck syndrome, thoracic outlet syndrome trapezius myalagia, rotator cuff tear or tendinitis.



The primary shoulder stabilizing muscles involved i.e. middle and lower trapezius fatigue with forward head postures and abducted arm postures.

3) Neck: - Among all musculoskeletal disorders, neck is the most common complaint amongst dental professionals mainly due to forward head postures. Optimal posture of the head is ears-over-shoulders when viewed from the side. Unfortunately, dentists do not achieve this neutral position during their long hours of dental practice, unless they are using a microscope. Even with telescopes, the best head posture that dentists can attain is about 25 degrees of forward head tilt; however, when compared with postures of their colleagues who do not wear scopes **(40 to 60 degrees forward head tilt)**, the ergonomic advantage of scopes becomes clear.[3]

Basic Science: - Dentistry being a demanding and precision based profession requires continuous neck tilting out of its neutral position to achieve accessibility and ease of operation; hence neck is considered to be most prone to musculoskeletal disorders amongst dentists.

Like all other MSDs if the pain or discomfort is neglected can lead to severe consequences like neck spasm, trapezitis, Tension Neck Syndrome, cervical spondylosis, cervical disc herniation and buldging.[3] [4]

4) Elbows: -Your elbow joint is made up of bone, cartilage, ligaments and fluid. Muscles and tendons help the elbow joint move. When any of these structures is hurt or diseased, you have elbow problems. Many things can

make your elbow hurt include sprains, strains, fractures, dislocations, bursitis and arthritis. In dentistry no arm rests while practising sitting dentistry can cause sprain and spasm of muscles and injury to underlying tendons attached to the elbow joint. Still a greater number of dentist use dental stool without arm rests in their dental setup which affects their hand and elbow while applying greater exertion of forces. Use of armrests even provides better stability for instrumentation

Basic Science: - Elbow pain not only specific to sports but also common complain amongst dental professionals when their arm lacks support while their practice. This mild to moderate pain on long run can lead to severe disability affecting professional and personal life and can ultimately turn into MSDs like bursitis, dislocations and even fractures when there is severe damage of the tendon supporting the elbow joint.

5) Wrists and 6) Hand: - Problems with the wrist, hand, and fingers are common. They can be caused by simple things, like carrying out repetitive tasks. As you get older, normal wear and tear can cause your problem to flare-up now and again, often for no reason i.e.it is also age related disorder along with an occupational hazard. While during procedures like root canal treatment, using vibratory tools and instruments all can affect nerves, muscles, tendons of hand.

Basic Science: -The wrists flexors and extensors along with hand muscles like flexor digitorium responsible for precise dental work involving repetitive movements and prolonged working hours may affect the hand causing pain which can lead to disorders like tendinitis, carpel tunnel syndrome i.e. due to ulnar nerve entrapment, hand vibration syndrome, etc.[5].

Taking breaks in between long appointments and doing basic exercises can help to reduce the rate of progression towards severity.

6) Knees/Thighs/Ankles: - Long unfavourable standing hours while practice and doing procedures such as extraction, long hours surgeries common

among oral surgeons and periodontists can affect knees/ankles/thighs i.e. in general whole lower limb.

Basic Science: - Long standing hours affect the calf muscles, heel of foot, tendons of ankle joint and underlying neurovascular structures. In future can lead to knee problems, varicose veins which are common among surgeons.

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3. AETIOLOGY

Musculoskeletal health plays an important role for being efficient in our day to day life. Work place, job postures, working period along with other predisposing factors like age, gender, obesity or any other systemic illness may worsen the condition. [1]

Among the job postures, dentists have to acquire continuous bending of neck and back out of the neutral position of their body to gain better access, ease of operation and precision in their work. This intentional bending to obtain better vision if continued for long time may affect the muscles involved like back extensors, rotators, paraspinal muscles whose main function is to maintain postures and facilitate bending and twisting movements. Long and continuous posture can cause sprain may further lead to spinal problems like lumbar spondylosis, disc herniation, sciatica. Being an occupational hazard, there are many factors which will affect musculoskeletal health; of which common factors leading to pain and discomfort amongst dentists includes:

1. Muscle imbalances

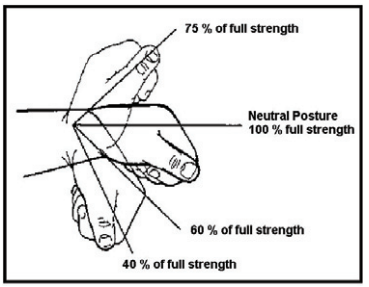
Prolonged bending of neck out of neutral position, rounding of upper back and elevated arm requires substantial endurance of the shoulder girdle stabilizing muscles, especially the middle and lower trapezius muscles and triceps and biceps of the upper limb. These shoulder-stabilizing muscles and muscles of upper limb tend to fatigue quickly with forward head, rounded upper back, and elevated arm postures. When these muscles get fatigue, other accessory muscles try to compensate the load which will cause pain and discomfort due to ischemia. [2]

This muscle imbalance in neck may result in a “tension neck syndrome,” and is one of the most frequently diagnosed musculoskeletal disorders (MSDs). Symptoms include pain, tenderness, and stiffness in the neck and shoulder muscles, often with muscle spasms. Pain developed radiates to shoulder blades and occiput region of head, thus Headache being the most common symptom. Two major contributing

factors to tension neck syndrome in dentistry are forward head and elevated arm postures. [2]

Researchers have suggested that excessive use of a pinch gripping is the greatest contributing risk factor in the development of MSDs among dental hygienists. [3] Repetitive motions are extremely prevalent in clinical practice, particularly when performing scaling, root planning and polishing.

The following diagram shows the reduction in strength which occurs as the wrist deviates further away from its neutral posture.



Too much bending and elevated shoulders can lead to muscle spasm and chronic disorders

2. Forward head posture

In order to achieve proper vision, most common position dentists tend to tilt their neck forward. Generally optimal posture of the head is ears-over-shoulders when viewed from the side. Unfortunately, dentists do not achieve this neutral position while working in the operatory unless they are using a microscope. Even with telescopes, the best head posture that dentists can attain is about 25 degrees of forward head tilt; however, when compared with postures of their colleagues who do not wear scopes (40 to 60 degrees forward head tilt), the ergonomic advantage of scopes becomes clear. [3]

This figure clearly shows neck out of its neutral position which can build tension in shoulder girdle and upper back muscles.

Foe dentist's first line of defence against neck and shoulder pain is to learn how to attain optimal head posture and shift the muscle workload throughout the workday. Next, they should incorporate in their schedule 2 min regimen of stretching and strengthening exercises to increase their muscular resistance towards pain.

3. Magnification

In modern dentistry use of properly adjusted scopes is found to reduce muscle strain in the neck and upper back by promoting proper neck and shoulder posture.[4] According to one literature two of the most critical factors to consider when purchasing scopes are working distance and declination angle. Working Distance is an important term meaning the distance from the operator's eye to the working area.

From an ergonomic and musculoskeletal point of view, the declination angle of the scopes is your most important consideration. The Declination Angle is the steepness of the downward viewing angle the scopes allow. A good declination angle will allow you to work with a more upright, neutral neck posture, about 25 to 30 degrees of neck flexion (head tilt).Even then, working in postures with greater than 20 degrees of neck flexion has been associated with increased neck pain. This means dentists must not only address the ergonomic magnification component but the muscular level as well, by strengthening the shoulder girdle stabilizing muscles. [4]

Placing the operators head to close to patient mouth's places the operator in awkward position as shown in this figure

4. Correct height

Position of patient and dentists are considered to be major contributing factors for musculoskeletal pain and discomfort while dental practise; most common of which is neck pain, shoulder pain and back pain. This is mainly due abduction of arm when patient is not positioned at elbow level which tend to develop muscular tension in

neck, shoulder and arms. Dentists should position the patient at elbow level so that muscles involved while working can stay relaxed and reduces sprain and muscle spasm.

According to rules of ergonomics patient should be at elbow level of dentists along with legs of dentist's perpendicular to the floor and feet flat to the floor.

Above figure shows correct height and position of the operator and correct height at which patient should be placed i.e. at elbow level.

5. Open the hip angle

To maintain optimal head posture, you must be able to get close to the patient. A common problem among shorter dentists is the inability to get their legs under the patient chair without lifting the arms away from the sides. A tilting seat may enable closer positioning to the patient by opening the hip angle. Now you can position the patient slightly lower to decrease "chicken-winging." Additionally, tilting the seat pan 10 to 15 degrees forward has been shown to help maintain the low back curve

and reduce low back disc pressures,[5][6] which can, in turn, help reduce low back pain as it will have to stabilize the paraspinal muscles and back extensors.

Many dental stools are being design like saddle-style stool will allow the closest positioning to the patient by placing the operator in a position in between standing and sitting. This opens up the hip angle to about 140 degrees, helps promote the spine's natural curves, and shifts the workload to different muscles than those used with traditional seating. Along with these we should also prevent overwork on muscles to prevent its sprains, spasms and chronic damage.

6. Armrests

Among dentists who already experience neck pain, the simple weight of the arms hanging unsupported at the sides may often perpetuate that pain. [7] Armrests can reduce such strain by providing an operating fulcrum at the elbow, which also improves instrument stability. Dentists with neck pain who have short arms should consider support under the elbows at home as well as in the operatory, when driving, sitting on a couch, or at the computer. Armrests can stabilize the elbow and hand muscles which will prevent muscle spasm, ligament damage which may lead to musculoskeletal damage like tennis elbow, epicondylitis, bursitis.

7. Strengthening

All strengthening exercise may not be necessarily to be done daily, as it may time consuming in busy schedule. Due to their susceptibility to the muscle imbalance described earlier, most dentists should focus on specific strengthening of the shoulder-stabilizing muscles and do away from exercises that strengthen the upper trapezius, levator, and upper rhomboids, muscles that are already prone to tightness, ischemia and pain.

The middle and lower trapezius muscles may be strengthened by utilizing an elastic exercise band and pulling diagonally downward, squeezing the shoulder blades downward and together. Always use a very light resistance when strengthening

postural stabilizing muscles and seek professional guidance from a health-care professional to ensure good technique. Use of exercise bands in reverse manner can over strengthen the muscles.

Additional target areas for dentists to strengthen include the shoulder external rotators, transverse and oblique abdominals, multifidus, and deep postural neck muscles. Strengthening exercises should only be performed when there is no musculoskeletal pain and full range of motion is present.

8. Self-therapy

Tightness, ischemia, and trigger points in the upper back and neck muscles should also be addressed daily with specific chair side stretching and trigger point self-therapy.

The possible aetiologies' of neck and shoulder pain among dentists are numerous, including neurological, spinal disc, joint, ligamentous, and other pain mechanisms. Most frequently, however, neck and shoulder problems originate from postural problems that lead to muscle imbalances. If these imbalances are not addressed, they can eventually compress nerves and discs and cause joint dysfunction.

Education of this type in dental schools may help dentists develop healthy postural habits and maintain balanced musculoskeletal health before they sustain a permanent musculoskeletal injury. Addressing muscular pain early on can make the difference between a satisfying, lengthy career or painful early retirement.

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4. EPIDEMIOLOGICAL STUDY

A cross-sectional study was conducted amongst 358 general and speciality dentists of Vadodara city and its periphery in Gujarat, India. The main and objective of this study is to understand the prevalence and level of awareness of MSDs amongst dentists and even to explore the differences of musculoskeletal pain amongst speciality dentists. The questions were designed including Demographic Proforma and other questions in reference to Standard Nordic Questionnaire. [1]The questionnaire was designed taking into consideration the physical health related to musculoskeletal pain or discomfort or disorders. The initial part of questionnaire involves the demographic Proforma and any past or present medical history; the dentists having past or present medical history of musculoskeletal disorder or surgery were excluded from the survey analysis. Next portion of the questionnaire involves the 10 most common areas were dentists might experience pain which includes eyes, neck, shoulder, upper back, elbows, lower back, wrists, hands, hips/thighs, and ankles/feet along with type of pain experienced. The severity of pain was graded as mild, moderate and severe. Dentists were also asked about onset and duration of pain. Further questions like activity responsible for pain, do they take breaks or practice any sport or yoga or taking physiotherapy treatment or have routine of stretching and strengthening exercise to prevent or counter the pain. They were even asked whether they consumed analgesics or have taken leaves due to musculoskeletal pain and whether they thought postures during their practice were correct always or not. Dentists were also asked whether they were aware of that faulty posture during dental practice can lead to musculoskeletal disorders to check the awareness level. The purpose for the study was explained and also instructions on how to fill in the questionnaire were given while its distribution. Many of them returned the questionnaire during the course of event, few responded through emails and others answered through phone.

Statistical analysis was performed and data was analysed using descriptive statistics, chi-square test and independent T test.

Descriptive Statistics

		Years of ex.	Dur of pain (min)	Yes then How long (Months)	Age (Years)	Working Hours	Working Days	Ht	Wt
N	Total Observations	258	161	54	258	258	258	161	158
	Missing	0	97	204	0	0	0	97	100
Mean		7.24	34.16	29.85	32.86	7.54	5.88	5.14	65.07
Median		5.00	25.00	12.00	30.00	8.00	6.00	5.06	65.00
Std. Deviation		6.574	28.216	42.784	8.091	1.844	.622	0.37	11.121
Quartile	Q1	3.00	15.00	5.75	27.00	6.00	6.00	5.03	57.00
	Q2 (Median)	5.00	25.00	12.00	30.00	8.00	6.00	5.06	65.00
	Q3	10.00	45.00	36.00	37.00	8.00	6.00	5.09	72.25

Frequency Table

A survey of 358 dentists was conducted of which 258 dentists answered the questionnaire with an equal frequency of male (50%) and female (50%).

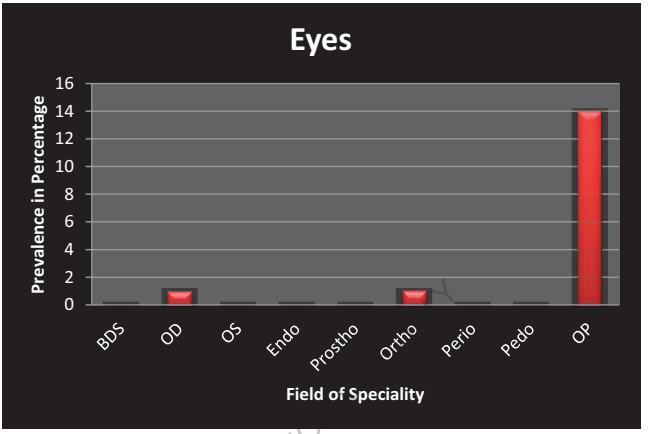
Gender	Frequency	Percent
F	129	50.0
M	129	50.0
Total	258	100.0

To know the speciality specific areas of pain approximately 59% of speciality dentists were included. Among these dentists 41% of BDS dentists were included to compare the severity pain

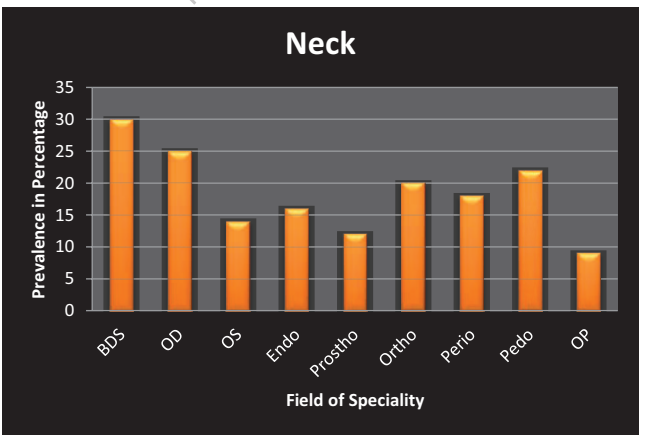
Speciality	Frequency	Percentage
BDS	41	15.9
Endo	37	14.3
O.P.	17	6.6
O.S.	28	10.9
OD	9	3.5
Ortho	50	19.4
Pedo	15	5.8
Perio	30	11.6
Prostho	31	12.0
Total	258	100.0

This study also classifies which area different speciality dentists were prone to according to their daily work postures. From this study it was evaluated that 51.6% experience moderate pain and 24.6% had mild type of pain. Amongst different speciality dentists- Oral pathologist were more prone to eye strain (87.5%) [Graph 1]and neck pain whereas Oral surgeons were more prone to shoulders (25%)[Graph 3], upper back pain(13.7%)[Graph 4] and knee pain (58%)[Graph 10]; Oral radiologist and BDSs are more prone to neck and back problems; Periodontists were found to be more prone to elbow pain(43.8%) [Graph 5] and lower back pain(19.2%)[Graph 7];Endodontists were found to be more prone to lower back pain(16.9%)[Graph 7], wrists pain(31.9%)[Graph 6] and pain in hands(23.1%)[Graph

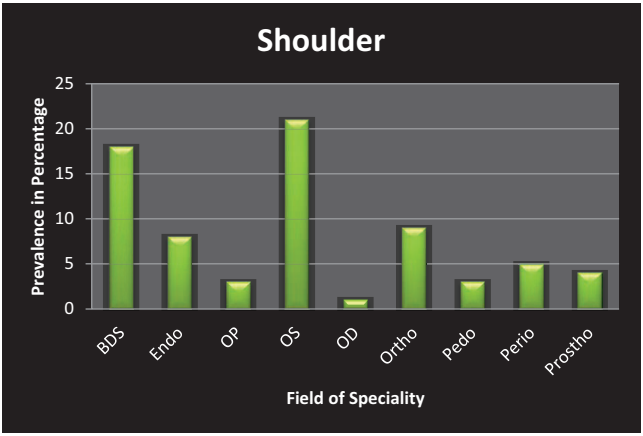
8]; Orthodontists suffering from musculoskeletal pain were reported higher in number than other specialities with major complain of wrists(40.6%)[Graph 6] and hand pain(37.2%)[Graph 8] [specifically in fingers]; Pedododntists reported of higher lower back pain and pain in thighs(12.5%)[Graph 9] and ankles(14.3%)[Graph 11] and Prosthodontists were found to have more pain in thighs(62.5%)[Graph 9], hands(17.9%)[Graph 8] and upper back(12.7%)[Graph 4].



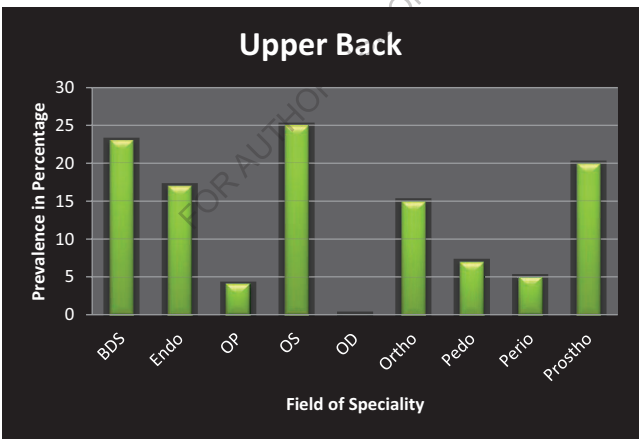
Graph 1



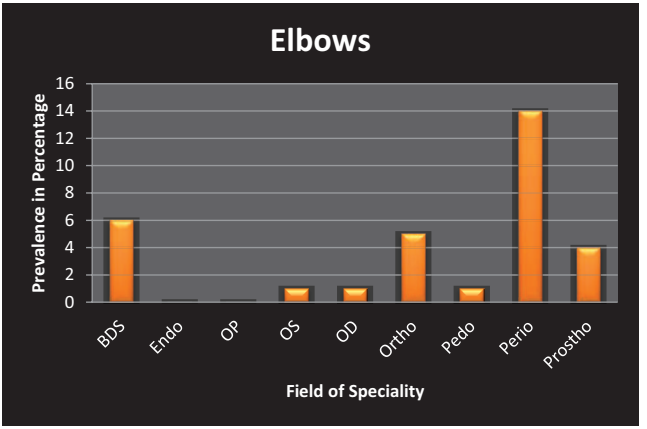
Graph 2



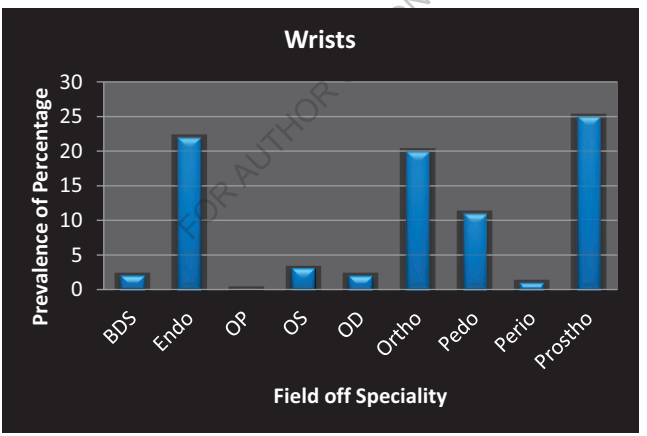
Graph 3



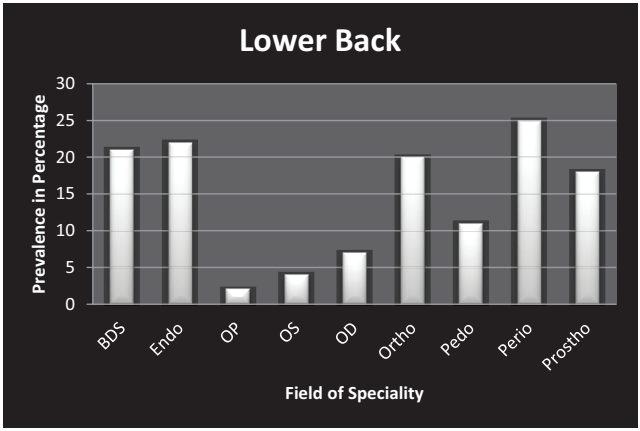
Graph 4



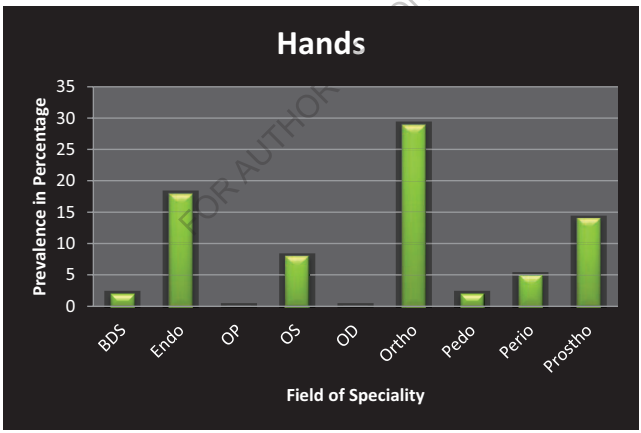
Graph 5



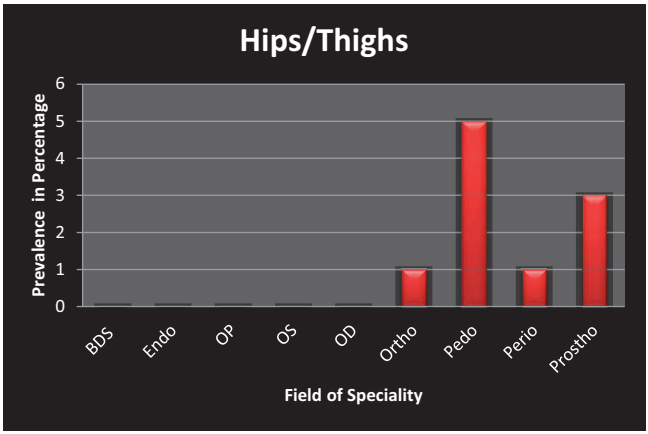
Graph 6



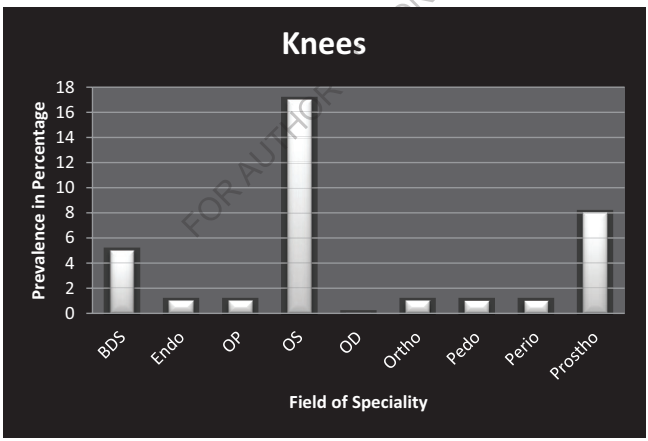
Graph 7



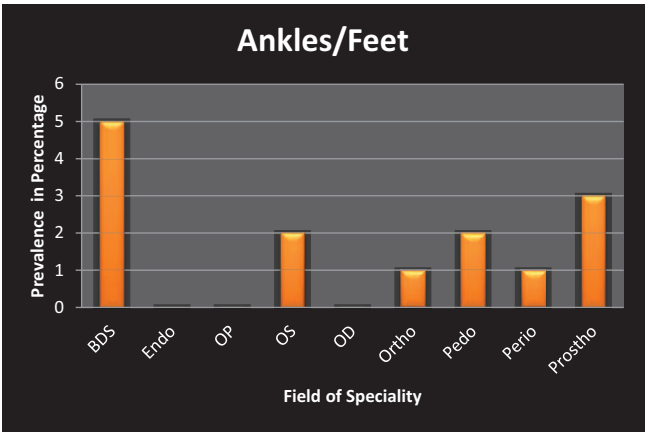
Graph 8



Graph 9



Graph 10



Graph 11

Detailed analysis concerning descriptive data and statistically significant correlation between the occurrence of musculoskeletal complaints of mild and moderate pain is done for thorough understanding of musculoskeletal disorders. Amongst all these 258 dentists those who were involved in any kind of sports or yoga or physiotherapy or stretching to relive their pain symptoms were found to have less severe pain or no pain while their dental practice when compared to those who are not involved in any kind of activity.

Reports showing dentists involved in any kind of activity:-

Eyes:-

			Eyes		
			Pain	No Pain	Total
Activity	Yes	Count	6	78	84
		% within Eyes	37.5%	32.2%	32.6%
	No	Count	10	164	174
		% within Eyes	62.5%	67.8%	67.4%
Total		Count	16	242	258
		% within Eyes	100.0%	100.0%	100.0%

Neck:-

			Neck		Total
			Pain	No Pain	
Activity	Yes	Count	50	34	84
		% within Neck	34.0%	30.6%	32.6%
	No	Count	97	77	174
		% within Neck	66.0%	69.4%	67.4%
Total		Count	147	111	258
		% within Neck	100.0%	100.0%	100.0%

Shoulder

			Shoulders		
			Pain	No Pain	Total
Activity	Yes	Count	24	60	84
		% within Shoulders	33.3%	32.3%	32.6%
	No	Count	48	126	174
		% within Shoulders	66.7%	67.7%	67.4%
Total		Count	72	186	258
		% within Shoulders	100.0%	100.0%	100.0%

Upper Back

			Upper Back		
			Pain	No Pain	Total
Activity	Yes	Count	30	54	84
		% within Upper Back	29.4%	34.6%	32.6%
	No	Count	72	102	174
		% within Upper Back	70.6%	65.4%	67.4%
Total		Count	102	156	258
		% within Upper Back	100.0%	100.0%	100.0%

Elbows

			Elbows		
			Pain	No Pain	Total
Activity	Yes	Count	8	76	84
		% within Elbows	25.0%	33.6%	32.6%
	No	Count	24	150	174
		% within Elbows	75.0%	66.4%	67.4%
Total		Count	32	226	258
		% within Elbows	100.0%	100.0%	100.0%

Lower Back

			Lower Back		
			Pain	No Pain	Total
Activity	Yes	Count	39	45	84
		% within Lower Back	30.0%	35.2%	32.6%
	No	Count	91	83	174
		% within Lower Back	70.0%	64.8%	67.4%
Total		Count	130	128	258
		% within Lower Back	100.0%	100.0%	100.0%

Wrists

			Wrists		
			Pain	No Pain	Total
Activity	Yes	Count	25	59	84
		% within Wrists	36.2%	31.2%	32.6%
	No	Count	44	130	174
		% within Wrists	63.8%	68.8%	67.4%
Total		Count	69	189	258
		% within Wrists	100.0%	100.0%	100.0%

Hands

			Hands		
			Pain	No Pain	Total
Activity	Yes	Count	25	59	84
		% within Hands	32.1%	32.8%	32.6%
	No	Count	53	121	174
		% within Hands	67.9%	67.2%	67.4%
Total		Count	78	180	258
		% within Hands	100.0%	100.0%	100.0%

Hips/thighs

			Hips/thighs		
			Pain	No Pain	Total
Activity	Yes	Count	4	80	84
		% within Hips/thighs	50.0%	32.0%	32.6%
	No	Count	4	170	174
		% within Hips/thighs	50.0%	68.0%	67.4%
Total		Count	8	250	258
		% within Hips/thighs	100.0%	100.0%	100.0%

Knees

			Knees		
			Pain	No Pain	Total
Activity	Yes	Count	5	79	84
		% within knees	17.2%	34.5%	32.6%
	No	Count	24	150	174
		% within knees	82.8%	65.5%	67.4%
Total		Count	29	229	258
		% within knees	100.0%	100.0%	100.0%

Ankles/Feet

			Ankles/Feet		
			Pain	No Pain	Total
Activity	Yes	Count	3	81	84
		% within Ankles/Feet	21.4%	33.2%	32.6%
	No	Count	11	163	174
		% within Ankles/Feet	78.6%	66.8%	67.4%
Total		Count	14	244	258
		% within Ankles/Feet	100.0%	100.0%	100.0%

From this survey it was also found that 71.7% of dentists thought that their positions while their practise were correct.

Correct posture	Frequency	Percent
-	5	1.9
No	68	26.4
Yes	185	71.7
Total	258	100.0

It was also found that 65% of dentists were involved in either of preventive activities lke yoga, sports, stretching, physiotherapy or massage, etc and 53% of them followed taking breaks and stretching in between long appointments. From this study it was found that specific speciality dentists were more susceptible to specific areas of musculoskeletal pain.

From the above study it is clear that every speciality is more prone to specific areas due to their repetitive movements and sustained position. It was concluded from this study that all dentists had complaint about neck and lower back pain, but areas of severity of pain of were of different for various speciality practitioners as shown above.

Reference

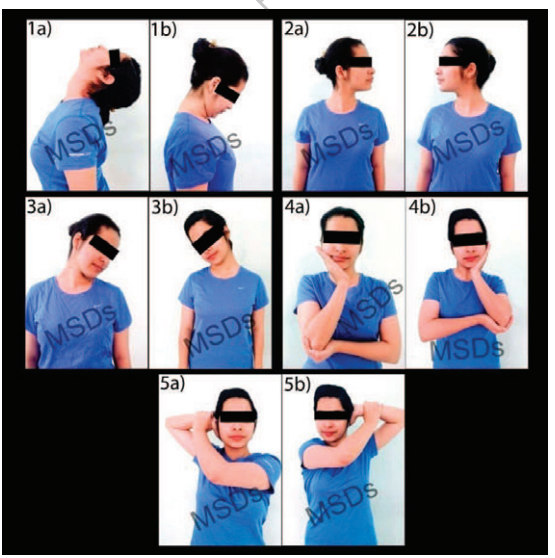
[1]I Kuorinka, B Jonsson, A. Kilborn, H. Vinterberg, F. Biering, G. Andersson and K. Jorgensen; Standard Nordic questionnaires for analysis musculoskeletal symptom (1987) 233-237

5. PREVENTIVE MEASURES

We all know 100 ounces of prevention is better than 1000 ounces of cure. Negligence being the major cause in increasing the incidence of musculoskeletal pain which if not treated can turn into chronic condition ultimately leading to career ending disability. Despite of very high awareness level (as found in our study) the major cause of negligence being is lack of time. Various factors including operator's postures, repetitive movement and prolonged working hours play major role in aggravating the musculoskeletal pain. Different treatment modalities are available to treat MSDs when condition become chronic and affects the routine lifestyle of the dentists. Thus, it is of prime most importance to pay attention towards musculoskeletal health in order to make dental practice less-stressful, will also increase efficiency of the dentists and in turn increases the quality of life.

Through this literature it is tried to put some efforts to suggest basic exercises after consultation of few physiotherapists who have done specialisation in orthopaedics which can serve to be helpful if practised daily.

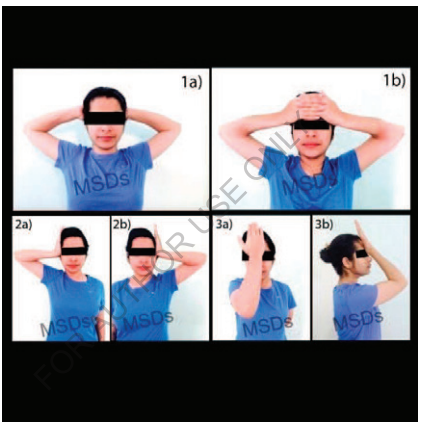
1. Neck Exercises



These figure shows normal stretching exercises which dentists can do in between long appointments. 1a) neck flexion, 1b) neck extension, 2a) and 2b) side to side movement

- ✓ This stretching of neck can be done for10 to 15 seconds and then relax.
- ✓ Deep breathing while doing exercise can serve to be helpful as it increases oxygen supply to body.

Note: These exercises should not be done in case of any kind of pain



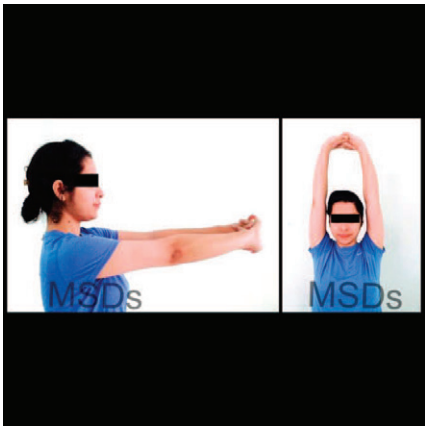
This figure shows neck strengthening exercises which helps to strengthen neck muscles in order to increase their resistance towards pain.

- ✓ For strengthening exercises, one should hold for 10-15 seconds and then relax.
- ✓ Deep breathing while doing exercise can serve to be helpful as it increases oxygen supply to body.

Note: These exercises should not be done in case of any kind of pain.

2. Shoulder Exercises

Shoulder girdle movements serve to be beneficial for shoulder stabilizing muscles.



After stretching your arms, hold for 10-15 seconds and then relax

x

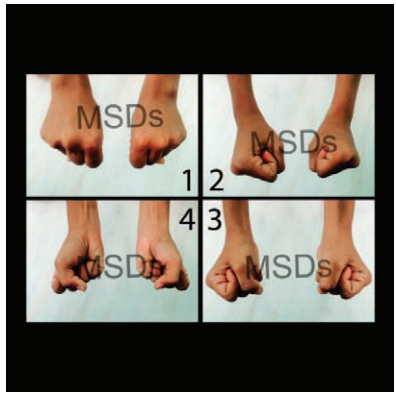
The above figure shows basic shoulder stretching movements and 2nd figure shoulder rotation in a sequence that should be done for 3-5 minutes

3. Upper Back Exercises

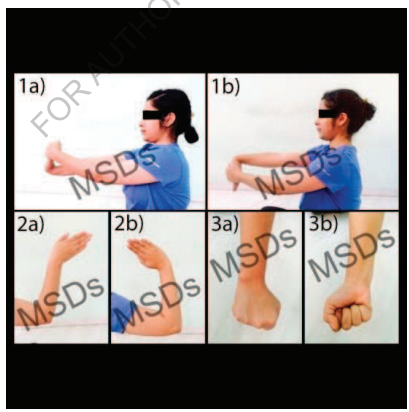
This position is known as opposite limb stretching in crawl position.

4. Lower Back Exercises

5. Wrists Exercises



This figure shows the simple wrist rotation in clockwise direction and can also be repeated in anti-clockwise direction.



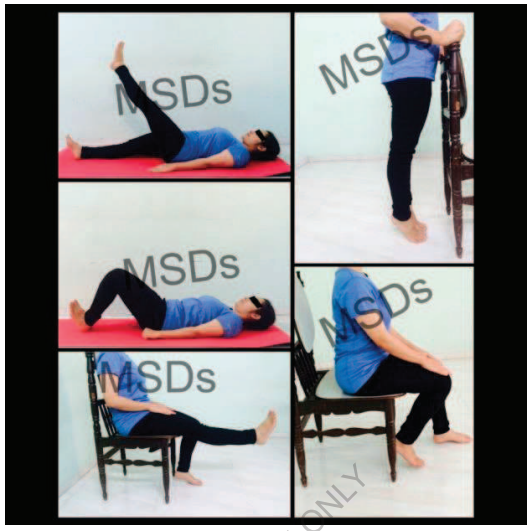
This figure shows wrist flexion (1a) extension (1b), adduction (2a), abduction (2b), pronation (3a) and supination (3b).

6. Elbow Exercises

This figure shows sequence of exercises. Hold the arm for 10-15 seconds and then relax in 1a) and 1b).

7. Hand exercises

8. Knee Exercises



9. Ankle Exercises

The above figure shows ankle extension, flexion, abduction and adduction in clockwise direction.

6. CONSEQUENCES OF MUSCULOSKELETAL PAIN

Dental professionals are normally the group of people at risk of suffering from MSDs due to their prolonged awkward or forced postures, repetitive movement and failure to adopt preventive measures. Repetitive movements and prolonged body postures can be expected to cause muscle damage as well as ligament and joint injuries. From the study conducted it was found that all dentists who were included in survey suffered from mild or moderate or severe kind of musculoskeletal pain, in spite of the high awareness rate as per the survey results.

The major being negligence and lack of time, dental professionals try to compromise their musculoskeletal health.

Awareness	Frequency	Percentage
-	1	0.4
Yes	257	99.6
Total	258	100.0

Karwaski *et al*. [1] reported that the symptoms are a product of many risk factors including prolonged static postures, repetitive movements, and poor positioning. Ratzen, [2] on the other hand, linked musculoskeletal pain occurrence in the dentists to the frequent assumption of static postures, which usually requires more than 50% of the body's muscles to contract to hold the body motion less, while resisting gravity. The static forces resulting from these postures have been shown to be much more tasking than dynamic forces. Repeated prolonged static postures are thought to initiate a series of events that could account for pain, injuries, or career-ending problems seen in MSDs.

The modern dentistry, four-handed dentistry that is presently being practised more commonly has also resulted in dramatic rise in musculoskeletal disorders as more if its work is sedentary in nature. [3]

Most of musculoskeletal injuries result only when there is repetitive demand and lack of rests period which in turn exceed tissue tolerance level. Once occurred, musculoskeletal injury lowers the tissue tolerance of that area before complete rehabilitation. Injuries before rehabilitation can result into more severe and permanent damage leading to career ending disability. [4]

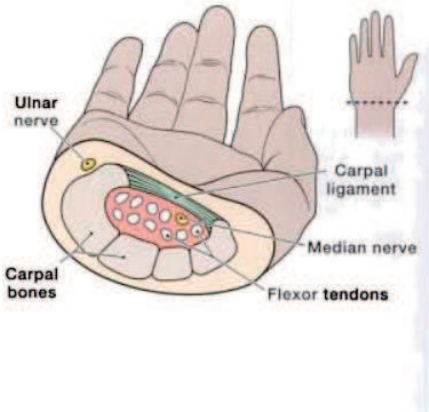
Amongst all areas most common affected includes neck, wrists, upper back and lower back pain followed by every other area of pain shoulders, hips/thighs, knees, ankles, elbows, etc. There are list of disorders that can occur as severe consequence of musculoskeletal pain, of which most common are listed below:

1. **Carpel tunnel syndrome(CTS) -** The risk factors associated with dental work that most commonly affect the wrists are chronic repetitive movements, awkward and static positions, mechanical stresses to digital nerves such as sustained grasps on instrument handles, extended use of vibratory instruments and inadequate work breaks. The wrist is in constant demand, often sustaining excessive and repeated stresses and strains. The safest position for the wrist is a straight or neutral position. This repeated injury can lead to disorder known as carpel tunnel syndrome.

   Definition: A painful disorder of wrist and hand caused by compression of median nerve within the carpel tunnel of wrist.

   Cause: The nerve fibres of median nerve originate from spinal cord in neck, thus poor posture can cause symptoms of CTS. Other causes include repetitive movements, continuous bending the hand up, pinching or gripping the instrument without resting the muscles. [5]

   Symptoms: Numbness, tingling and pain in thumb, index and middle fingers.



2. Tendonitis of the Wrist

Tendonitis is an inflammation of tendons. Tendons are the structures that attaches muscle to bone. Tendonitis of the wrist is accompanied by pain, swelling and inflammation on the thumb side of the wrist, and is made worse with grasping and twisting activities (e.g. polishing and scaling). People with this disorder have often noted an occasional sharp cracking sound when moving their thumb.

3. DeQuervain's Tenosynovitis

It is painful stenosing tenosynovitis of dorsal compartment of hand. It is usually caused by overuse or an increase in repetitive activity, resulting in shear trauma from repetitive gliding of dorsal compartment tendons. Beneath the styloid of radius leading to thickening of extensor retinaculum of wrist.[6]This disorder is characterized by pain and swelling in the thumb and wrist areawhen grasping, pinching, twisting, and a decreased range of motion of thumb with pain. Possible causes include synovial sheath swelling, thickening of tendons at base of thumb, and repeated trauma or twisting hand/wrist motions.

4. Trigger Finger

Trigger Finger often occurs as result of sustained forceful grips and repetitive motion which irritates the tendon and tendon sheath (tenosynovium). Nodules form in tendon causing warmth, swelling, and tenderness of the tendon. Pain occurs during movement that place tendons in tension. The fingers lock in the "Trigger Position".

5. Epicondylitis

The elbow should generally be held at a right angle or ninety degrees. Because blood vessels and nerves supplying the forearm and hand travel along the elbow joint, repeated or prolonged bending can cause compression, leading to forearm and hand symptoms.

Injuries at the elbow typically occur at either the inside of the elbow, referred to as Medial Epicondylitis (golfer's elbow), or outside of the elbow, known as Lateral Epicondylitis (tennis elbow). The forearm flexors, used to make a fist, attach at the inside portion of the elbow. Whereas the forearm extensors used to open the hand, attach at the outside of the elbow.

6. Cubital Tunnel Syndrome

Cubital Tunnel Syndrome is often caused by prolonged use of the elbow while flexed, resting the elbow on an armrest, or trauma from overuse can compress the ulnar nerve. It is characterized by pain, numbness, tingling and impaired sensation in the little and ring fingers, side and back of hand, loss of fine control, and reduced grip strength.

7. Bursitis

Rounding the shoulders can compress nerves, arteries, and veins that supply the arm and hand, leading to upper extremity symptoms. Poor thoracic alignment also limits oxygen intake. Slouching forward compresses the chest cavity, preventing the diaphragm muscle from completely filling the lungs with air. When oxygen is diminished, the body experiences fatigue and loss of concentration. The term bursitis means that the part of the shoulder called the bursa is inflamed.

There are many different problems that can lead to symptoms from inflammation of the bursa, one of those being impingement.

8. Thoracic Outlet Syndrome (TOS)

TOS is a condition resulting from compression of the nerves, arteries, and veins as they pass through from the neck to the arm (thoracic outlet). Possible causes include tight scalenes and pectoralis muscles, extra cervical rib, and prolonged durations of working with elevated elbows. This disorder is characterized by pain in the neck, shoulder, arm or hand, numbness and tingling of fingers, muscle weakness/fatigue, and cold sensation in the arm, hand or fingers.

9. Rotator Cuff Tear

The rotator cuff (RC) is a group of 4 muscles; supraspinatus, infraspinatus, teres minor and subscapularis. The RC assists with both gross and fine motor control of the arm. RC injury tends to occur where the muscle's tendon attaches to the bone.

10. Rotator Cuff Tendonitis

This disorder is characterized with pain and stiffness in the shoulder associate with backward and upward arm movements, and weakness of rotator cuff muscles. Possible causes include swelling or tearing of rotator cuff soft tissue, shoulder joint bone spurs/abnormalities, and poor shoulder posture.

11. Neck Disorders

Pain and discomfort are the most common complaints reported in the neck/shoulder region amongst dental professionals. Studies have also shown that female dentists reported neck symptoms 1.4 times more often than male dentists (Mangharam, 1998). It is common for pain in the arm and hand to stem from problems in the neck.

Neck and arm strain can be prevented by keeping the head and neck in proper alignment. The slight inward curve of the neck balances the head on the spine.

Holding the head forward disturbs this balance, straining the joints and the muscles of the neck and upper back. This posture also causes compression of the nerves and blood vessels as they exit the neck, leading to symptoms in the arm and hand.

Neck problems generally arise from prolonged static neck flexion and shoulder abduction or flexion, lack of upper-extremity support, and inadequate work breaks. Awkward postures are often adopted to obtain better views of the intraoral cavity,

provide a more comfortable position for the patient and to coordinate their position relative to the dentist or assistant.

✓ Myofascial Pain Disorder (MPD)

MPD is characterized by pain and tenderness in the neck, shoulder, arm muscles, and a restricted range of motion. Possible causes include overloaded neck/shoulder muscles.

✓ Cervical Spondylosis

This disorder is characterized by intermittent/chronic neck and shoulder pain or stiffness, headaches, hand and arm pain, numbness, tingling, and clumsiness.

Possible causes include age-related spinal disc degeneration leading to nerve compression and spinal cord damage, arthritis, and time spent with the neck in sustained awkward postures.

12. Back

✓ General Pain

The main risk factors associated with dental work are the sustained awkward postures and poor seating. Most individuals with low back pain do not simply injure their back in one incident but rather gradually over time. Repeated stresses from over the years begin to add up and slowly cause degeneration of various parts of the spine, resulting in low back pain.

✓ Disc Problems

In a seated posture the pressure in the lumbar discs increases by 50**%** as compared to standing. Additionally, sitting in an unsupported posture can cause twice the amount of stress as compared to standing. During bending (forward flexion) and twisting (rotation) motions of the spine, the pressure on the lumbar discs increases by 200%

(Fisk, 1987). This type of pressure on the disc can lead to a bulge or herniation, causing compression on a spinal nerve.

- ✓ **Sciatica**

Sciatica is characterized by pain in the lower back or hip radiating to the buttocks and legs, causing leg weakness, numbness, or tingling. It is commonly caused by bulging, prolapsed or herniated discs compressing a spinal nerve root and is worsened with prolonged sitting or excessive bending and lifting.

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CONCLUSION

Through this study and literature it is very clear that even though the awareness regarding musculoskeletal disorders is high, continuous negligence with a common reason being lack of time and lack of speciality specific measures can in turn contribute to ill musculoskeletal health. Long periods of mild (24.6%) and moderate (51.6%) pain in future can lead to musculoskeletal injury leading to career ending disability, if neglected.

Thus it is high time dental practitioners take the next step and start working towards fighting this hidden evil. This can be achieved by incorporating preventive measures along with ergonomically correct postures and speciality specific measures that can help to reduce the rise in prevalence rate of musculoskeletal disorders in dentistry.