



Knowledge Attitude and Practice of Ergonomics and Musculoskeletal Disorders as an Occupational Hazard among Periodontists in India – A Questionnaire Based Survey

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Authors' contributions

This work was carried out in collaboration between both authors. Author Gaurav Ketkar designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author Sankari M. managed the analyses and the literature searches of the study. Both authors read and approved the final manuscript.

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ABSTRACT

Ergonomics can be defined as a discipline that studies workers and their relationship to their occupational environment. To prevent musculoskeletal disorders which can develop over time and can lead to long-term disability proper ergonomic design is necessary. Periodontal work covers most of the areas in the oral cavity including distal aspects of posterior teeth which are difficult to approach. Hence preventing work related strain was of greater significance in ensuring long term successful practice as a periodontists. The purpose of this survey was to assess the knowledge attitude and practice of ergonomics and musculoskeletal disorders as an occupational hazard in periodontists in India .A survey was conducted among 150 periodontists in India in which 120 periodontists responded. The survey was distributed through questionnaire printouts and electronic media. The data was collected, analysed and interpreted. The results suggested that 85% of the periodontists had adequate knowledge and attitude towards ergonomics, however the practical

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application was not as satisfactory. This survey concludes that the knowledge and attitude of periodontists in India regarding ergonomics and musculoskeletal disorders as an occupational hazard is good overall, but the practice is needs some improvement.

Keywords: Ergonomics; musculoskeletal disorders; occupational hazards; periodontist.

1. INTRODUCTION

Dentistry is an occupation that requires good mental and physical health of the operator. A fit dentist is one of the most important factors in a successful dental practice also long term well being of the operator [1,2]. Ergonomics is not just a way of avoiding musculoskeletal issues that might occur due to improper practice it is the practice that ensures high productivity and success rate along with avoidance of illness and increased satisfaction amongst the practitioners as well as the workers. A study by Gorter et al in 2000 showed that out of every ten dentists, one dentist shows poor general health and three dentists show poor physical health [1] Such poor health can disrupt or impair a practice and overall health of the dentist. Although, according to a study done by Kupcinkas & Petrauskas et al in 2003, 88% of dentists report good or excellent health, Yet there is evidence that shows that dentists still do suffer from work related physical illnesses [3-5].

Dental practice may result in physical injuries such as pain and dysfunction, muscular imbalance, neuromuscular inhibition [6-8]. A combination of multiple risk factors seem to be the cause rather than a single risk factor. Prolonged static posture, repetitive movements, genetic predisposition, mental stress, mechanical stress, extrinsic stress, physical conditioning, age, non work activities, awkward positions, poor posture, poor postural muscle strength, poor flexibility, infrequent breaks, inappropriate selection and use of dental stools and magnification aids, vibration and cold temperature etc. can all be involved [9] The musculoskeletal health of dental professionals has been studied worldwide. A study by Branson et al in 1998 indicates that 81% of dental operators experience pain in their back, neck and shoulder or arm [1]

A study was done by Murphy DC et al 1997 to evaluate the common reasons of the dental practitioners to retire early out of which 29.5% of the dental practitioners had to retire early because of the musculoskeletal disorders.

The results clearly show the importance of the ergonomic perspective of the of the dental practice, hence this study carries immense importance to find out about the awareness of the dental practitioners specially periodontists about the knowledge about the subject.

Periodontists particularly work in all parts of the oral cavity. The work field also includes working in minute furcation areas of the teeth were approach and instrumentation is difficult and time consuming. Their specialty requires repetitive precise movements of long duration and the use of vibrating and ultrasonic instruments. Also periodontics is one of the the speciality that makes the use of indirect vision. All these factors are responsible for the poor posture of periodontists while working. Hence special attention should be made to make sure that this speciality has sufficient knowledge about how musculoskeletal disorders as an occupational hazard can be prevented [6,10].

Dental ergonomics is the adaptation of the working environment and methods to the dentist and his team, with respect to the physical and psychological capacity, for a healthy, safe and comfortable functioning in their professional activity. It takes into account the worker's capabilities and limitations to ensure that tasks, equipment, information and the environment suit each worker. It is the efficiency of persons in their working environment 3. The purpose of this survey was to assess the knowledge and attitude of periodontists towards ergonomics and musculoskeletal disorders (MSDs) and the efforts they make in their practise to reduce the risk of such an occupational hazard [5].

Previously we have done studies in the field of periodontics related to regeneration, effectiveness of mouthwash, PRF ect. and now we have planned to do a KAP study about awareness of ergonomics and musculoskeletal disorders as an occupational hazard for the periodontists working in India [11-25].

2. MATERIALS AND METHODS

A total of 150 periodontists in India were included in the survey in which 117 practitioners

responded. A structured closed questionnaire consisting of questions (Table 1) based on knowledge, attitude and clinical practice were distributed among the periodontists through means of communication such as questionnaire forms, electronic media and other means of communication such as personal emails etc. The questionnaire held a total of 20 questions of which 3 were knowledge based, 7 questions to check the attitude of the practitioners and 9 questions based on the clinical practice followed by them. The questionnaires were distributed randomly to periodontists in India. The survey data was then collected together and analysed.

3. RESULTS AND DISCUSSION

Hand & wrist problems and back problems are most commonly faced issues by all the dental practitioners which include tendinitis , trigger finger , carpal tunnel syndrome , Guyon's syndrome , upper and lower back pain , hence proper implementation of ergonomic principles is of utmost importance in ensuring a long, productive, healthy, and pain free career. Periodontics is a high risk profession for musculoskeletal disorders (MSDs) as it requires

high visual demands which result in the adoption of fixed postures. In this survey, periodontists were asked about the occurrence of pain due to MSDs and ergonomics. The investigation showed the frequency of pain among 29.3% occurring very frequently and 66.4% occurring occasionally (Fig. 5) .54.6% of them did not take any measures to reduce the occurrence of pain (Fig. 5). 54.3% periodontists are aware of the different stretching exercises that can be performed to relieve the physical stress (Fig. 5). Almost 64.4% of the periodontists are aware of safe neck tilting limits but only 36.9% frequently follow it while working (Fig. 5). Statistics show that the maximum number of periodontists complain of pain in the back and shoulder followed by the neck (Fig. 5). It also shows that only 35.7% of the periodontists stop working for a while when the pain or discomfort arises (Fig. 5). This indicates that although the knowledge of periodontists about this subject is good, their practice and attitude towards it is not satisfactory. This may be due to negligence towards personal health while working. Measures must be taken to educate dentists about the magnitude of the situation as the MSD's have a long term effect on an individual's life and methods to reduce the occurrence of such illnesses.

Table 1. Showing question-wise results of the survey

Questions	Options	% of respondents
1) Are you a	a) Full time practitioner b) Part time practitioner c) Full time academician	a) 50% b) 35.1% c) 14.9%
2) Are you aware of different correct operating positions for different surgical and non surgical procedures?	a) Yes b) Maybe c) No	a) 66.4% b) 23.3% c) 10.3%
3) Do you try to follow the correct operating positions while working?	a) Yes b) No c) Sometimes	a) 50% b) 15.5% c) 34.5%
4) How well do you rate your operating position while performing procedures?	a) Good b) Average c) Poor	a) 29.3% b) 60.3% c) 10.3%
5) How many clinical hours do you spend while working on a patient in a week?	a) Less than 20 hours b) 20-40 hours c) 40-60 hours d) More than 60 hours	a) 31% b) 42.2% c) 19.8% d) -
6) Do you work with an assistant when necessary?	a) Yes b) No c) Sometimes	a) 54.3% b) 22.4% c) 23.3%
7) How often do you experience pain in back, neck, shoulder or hands post procedure?	a) Always b) Sometimes c) Never	a) 29.3% b) 66.4% c) -%
8) Where the pain is experienced post	a) Neck	a) 17.5%

Questions	Options	% of respondents
procedure?	b) Shoulder	b) 19.3%
	c) Back	c) 21.9%
	d) Hands	d) –
	e) Combination of two or more	e) 40.4%
9) Are you aware of safe limits of tilting neck while performing the procedure?	a) Yes	a) 43.3%
	b) No	b) 36.3%
	c) Maybe	c) 20.4%
10) If yes; do you follow it while working?	a) Yes	a) 36.9%
	b) No	b) 36.9%
	c) Maybe	c) 26.2%
11) Do you feel numbness in your fingers while working?	a) Yes	a) 33.9%
	b) No	b) 51.3%
	c) Maybe	c) 14.8%
12) How often do you change position while working?	a) Always	a) 31.9%
	b) Never	b) 13.8%
	c) Sometimes	c) 54.3%
	d) 31.1%	d) 31.1%
13) Do you make it a point to rest your feet on ground while working?	a) Yes	a) 64.7%
	b) No	b) 13.8%
	c) Sometimes	c) 21.6%
14) Do you make it a point to rest your back while working?	a) Yes	a) 38.8%
	b) Never	b) 19.8%
	c) Sometimes	c) 41.4%
15) Do you take short breaks between procedures ?	a) Yes	a) 71.6%
	b) No	b) 28.4%
16) Do you stop working for a while when the pain/discomfort arises ?	a) Yes	a) 35.7%
	b) No	b) 23.5%
	c) Sometimes	c) 40.9%
17) Are you aware of stretching exercises that can be done in clinical hours ?	a) Yes	a) 54.3%
	b) No	b) 45.7%
18) How often do you consider ergonomic principles before purchasing work material tools or equipment?	a) Always	a) 31.9%
	b) Sometimes	b) 52.6%
	c) Never	c) 15.5%
19) Do you feel any difficulties or muscular strain while working in someone else's clinic (as consultant) ?	a) Yes	a) 38.6%
	b) No	b) 30.7%
	c) Sometimes	c) 30.7%
20) Do you think information and training about ergonomics will be useful?	a) Yes	a) 91.4%
	b) No	b) 8.6%

Table 2. Showing cross tabulated data of working hours and the type of the practice that individual follows

Type of participant * number of clinical hours		Number of clinical hours				Total
Count		less than 20 hours	20-40 hours	40-60 hours	more than 60 hours	
Type of participant	Full time Practitioner	14	23	15	7	59
	Part time Practitioner	12	22	5	1	40
	Full time Academician	10	4	3	0	17
Total		36	49	23	8	116

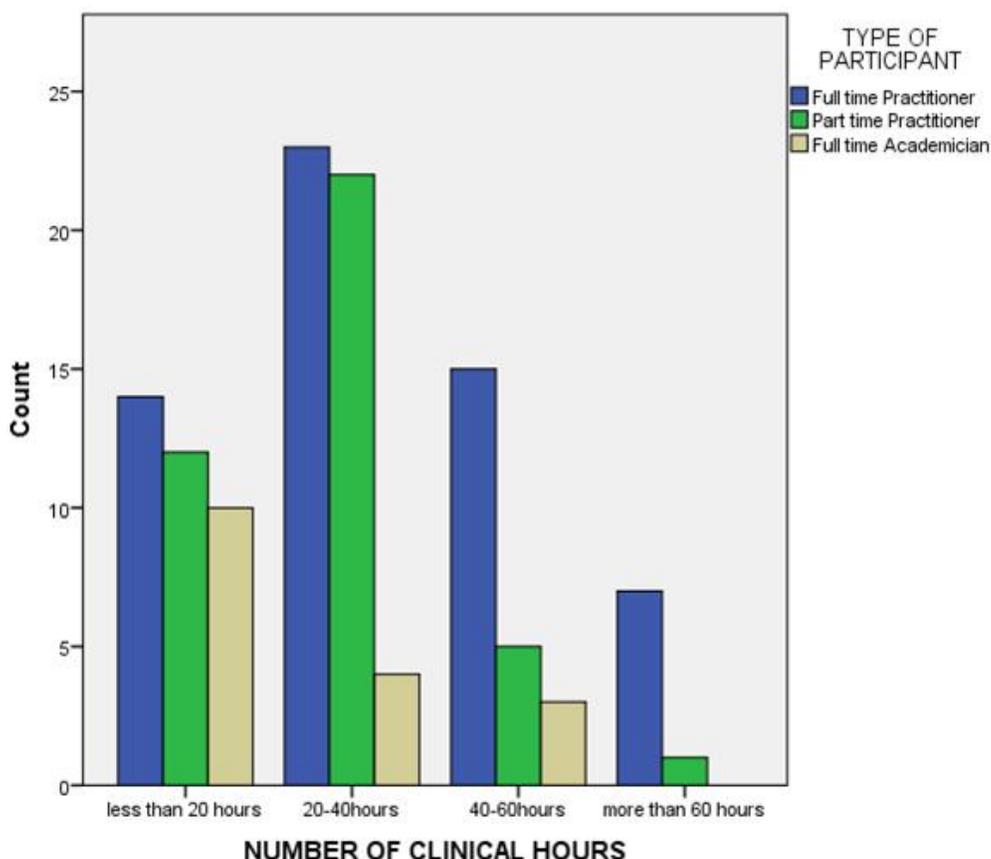


Fig. 1. Bar chart representing distribution of working hours amongst the 3 groups namely full time practitioner (blue colour bar) , part time practitioners (green colour bar) and full time academicians (yellow colour bar)

According to the results of this chart we can see that most of the full time and part time practitioners practice 20-40 hours in a week. Correlation calculated using chi-square test in SPSS ver. 20 (Table no. 2). Where x axis represents the number of working hours and y axis represents the count in each group

While the direct etiology of the development of MSDs is difficult to discern, we know that the practice of dentistry is associated with difficulties in visualization of the working area, and specific clinical tasks that demand concentration and precision [3] This may result in decreased range of motion, function and elasticity of tissue strength as a result of degenerative arthritic changes in the spine related to repetitive microtrauma [26]. MSDs consist of injuries that mainly affect soft tissues like muscles, tendons, ligaments, joints, cartilage and nervous system. These conditions are also known as cumulative trauma disorders, repeated trauma, repetitive stress injuries, and occupational overexertion syndrome. Lower back and neck injuries occur due to prolonged and static postures [27]. Repetition and force more commonly are related to hand and arm conditions. The risk for

trapezius pain may be increased by holding the arm elevated for long periods while holding the mirror. Historic trends to improve efficiency such as increased number of patient visits can also increase MSD risk. In addition, there may also be their factors such as body height, dominating arm and availability of specific chairs, high visual demands, workplace organization, and lack of recovery time, prolonged working hours which add to the risk of developing MSD's.

Neck and lower back were the common sites for MSDs as periodontists do large of their work with their head bent forward and rotated and with their arms, especially the right one, held out from the body [6]. This working posture leads to a considerable load on different structures in the neck, back and shoulders.

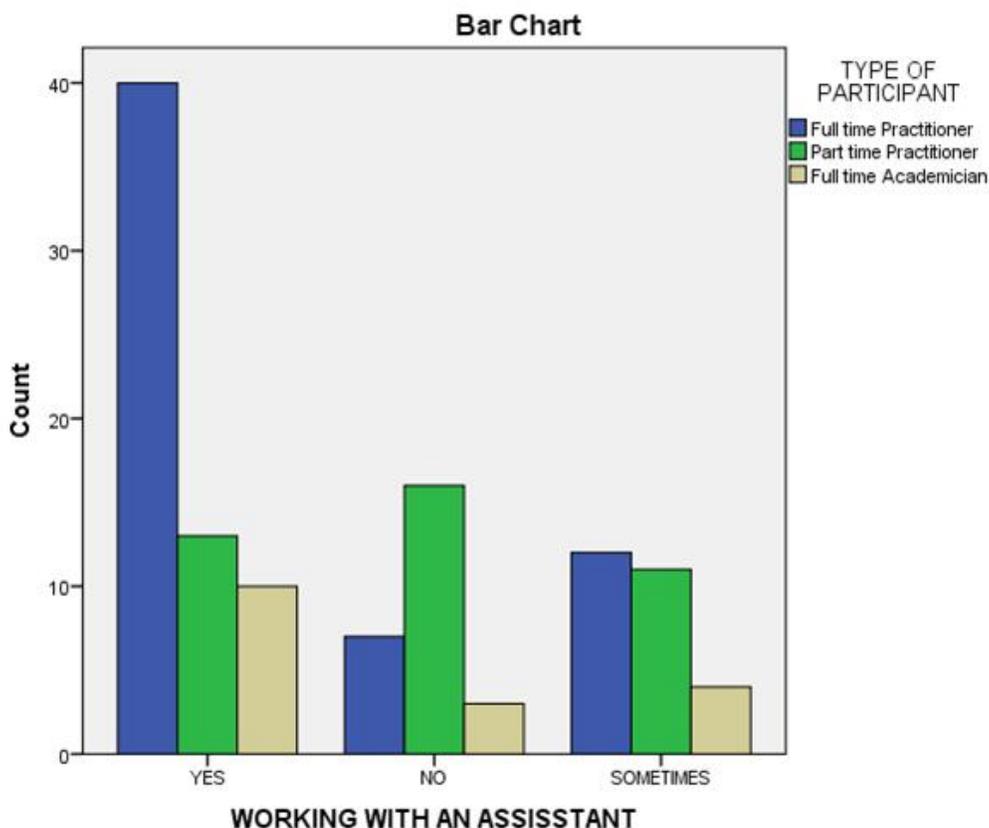


Fig. 2. Bar chart representing distribution of individuals working with assistants (four handed dentistry) amongst the 3 groups namely full time practitioner (blue colour bar) , part time practitioners (green colour bar) and full time academicians (yellow colour bar)

Based on the results in the chart we can see that most of the full time practitioners practice four handed dentistry whereas the number of part time practitioners working with assistants is fairly lower. It can be attributed to the simple fact of longer working hours of full time practitioners. Correlation calculated using chi-square test in SPSS ver. 20 (Table no. 3) .Where x axis represents the incidence of individuals working with an assistant and y axis represents the count in each group

Table 3. Showing cross tabulation between incidence of working with an assistant and the type of practice followed by the individual

Working with and assistant * Type of participant cross tabulation		Type of Participant			Total
		Full time Practitioner	Part time Practitioner	Full time Academician	
Working with and assistant	Yes	40	13	10	63
	No	7	16	3	26
	Sometimes	12	11	4	27
Total		59	40	17	116

Dentistry as a profession has showed a marked rise in females in the last 10 years this is a concern because , According to a survey done by Lindfors et al, Thiele et al and Lundstorm et

al; [2] females dentists are more prone to MSDs than males [28] This makes it all the more necessary to improve ergonomics and reduce the risk of occupational hazards [6,29,30].

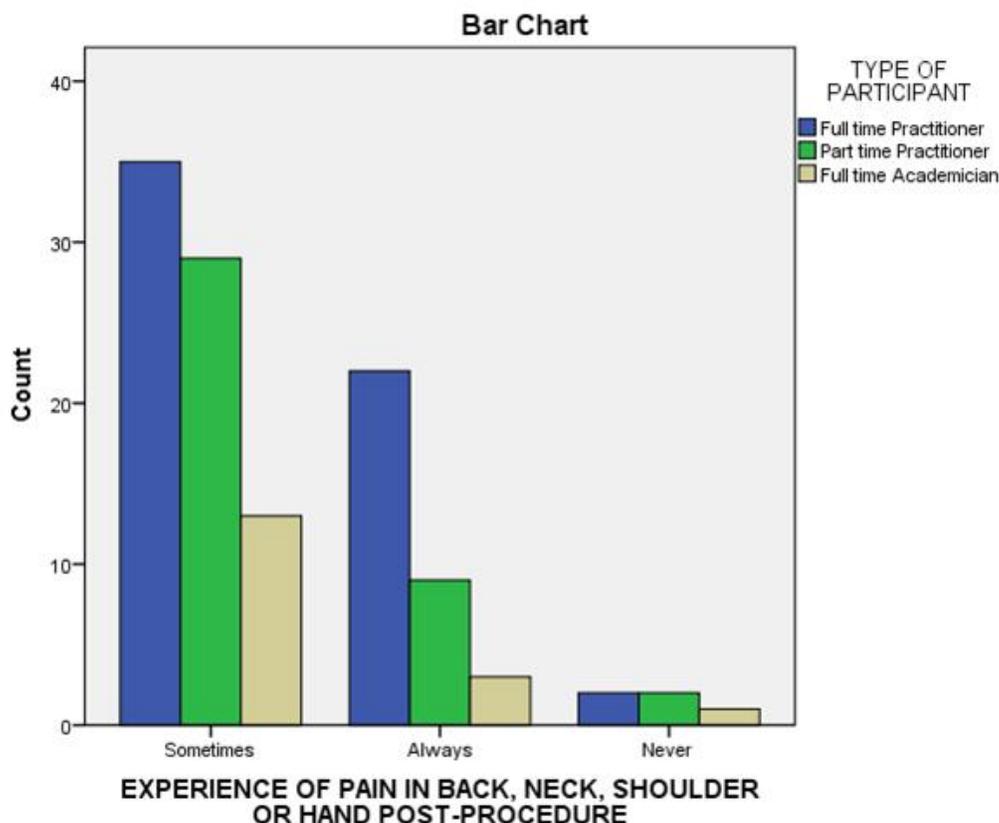


Fig. 3. Bar chart representing distribution of incidence of experiencing pain post procedure amongst the 3 groups namely full time practitioner (blue colour bar), part time practitioners (green colour bar) and full time academicians (yellow colour bar)

Based on the results of this bar chart we can see that incidence of experiencing pain by full time practitioners post procedures is higher than that of part time practitioners followed by academicians. It can be attributed to the simple fact that working are much more in case of a full time practitioner. Correlation calculated using chi-square test in SPSS ver. 20(Table no. 4) .Where x axis represents the incidence of pain in back ,neck ,shoulder or hand and y axis represents the count in each group

Table 4. Showing cross tabulation between incidence of pain while working and the type of practice followed by the individual

Pain While Working * Type of Participant Cross Tabulation		Type of Participant			Total
		Full time Practitioner	Part time Practitioner	Full time Academician	
Pain While Working	Sometimes	35	29	13	77
	Always	22	9	3	34
	Never	2	2	1	5
Total		59	40	17	116

The number of patients treated per day is a significant predictor for the incidence of MSDs. A study done by Forouzan Rafie et al in 2004, stated that MSDs were positively associated with

work hours. Prolonged static contractions lead to accumulation of lactic acid, that lead to reduction of oxygen levels causing fatigue and pain [2].

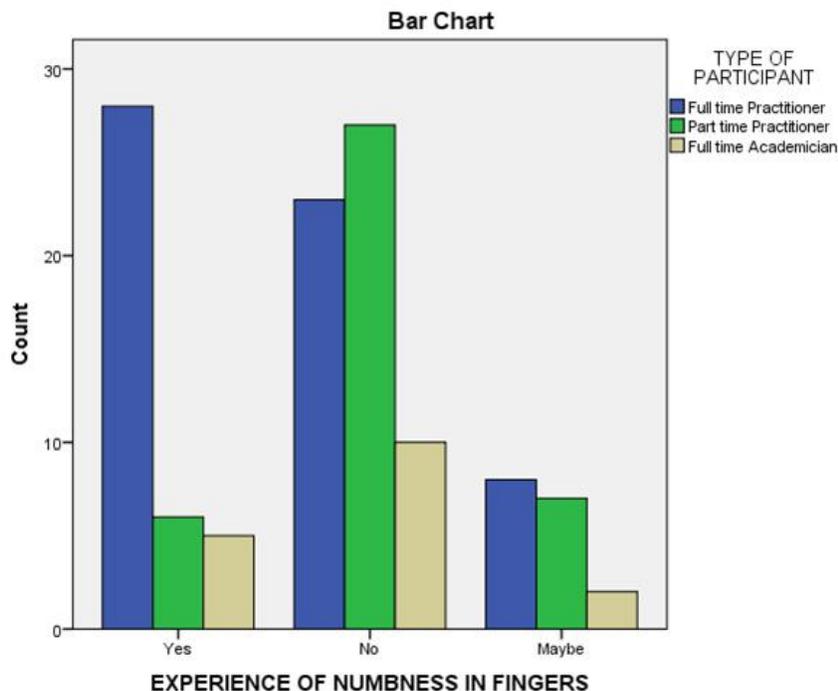


Fig. 4. Bar chart representing distribution of incidence of pain and numbness in fingers during or post procedures amongst the 3 groups namely full time practitioner (blue colour bar) , part time practitioners (green colour bar) and full time academicians (yellow colour bar) Correlation calculated using chi-square test in SPSS ver. 20(Table no. 5) . Where x axis represents the incidence of pain or numbness in fingers and y axis represents the count in each group

Table 5. Showing cross tabulation between incidence of numbness in fingers and the type of practice followed by the individual

Numbness In Fingers * Type of Participant Cross Tabulation					
Count		Type of Participant			Total
		Full time Practitioner	Part time Practitioner	Full time Academician	
Numbness in Fingers	Yes	28	6	5	39
	No	23	27	10	60
	Maybe	8	7	2	17
Total		59	40	17	116

While MSDs are multifactorial in nature, so too should be the approach to correcting or preventing them. The increased use of magnification systems have been associated with decreased neck and low back pain, as they allow operators to maintain healthier postures. Placing the feet flat on the floor and adjusting the seat height up until thighs gently slope downward while the feet remain flat on floor helps maintain the low back curve and enables one to position their knees under the patient. Static positions lead to more fatigue. Literature supports the idea

that workers should vary their work positions as often as possible to shift the workload from one group of muscles to another [31,32]. Alternating between standing and sitting can also help relieve stress build up. Positioning the patient too high causes the shoulders to elevate and necessitates bringing the arms closer to the torso, leading to prolonged static muscular tension in the neck and shoulders. The working area must be positioned at the elbow level in order to maintain the shoulders and arms in a relaxed state [33].

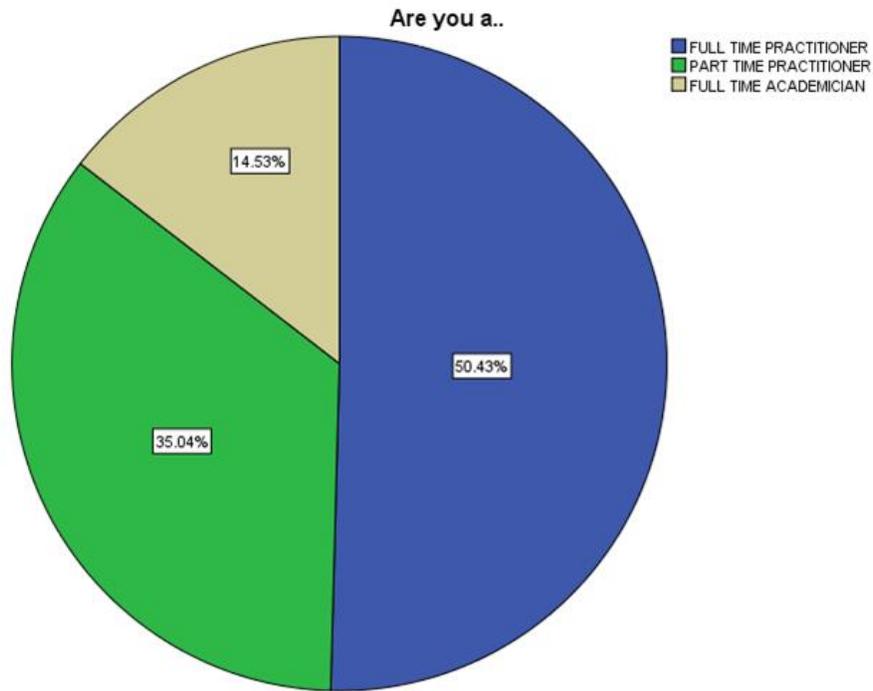


Fig. 5.1

Are you aware of different correct operating positions for different surgical and 2n surgical procedures?

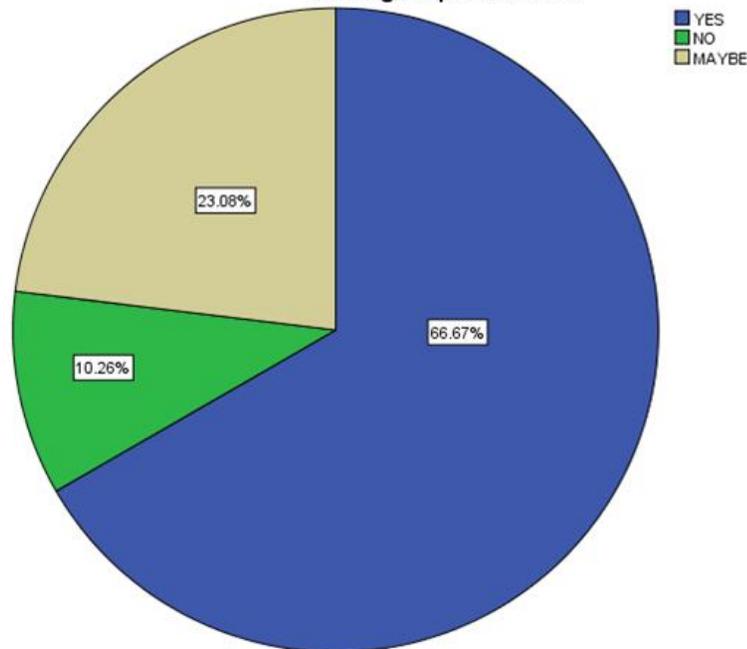


Fig. 5.2

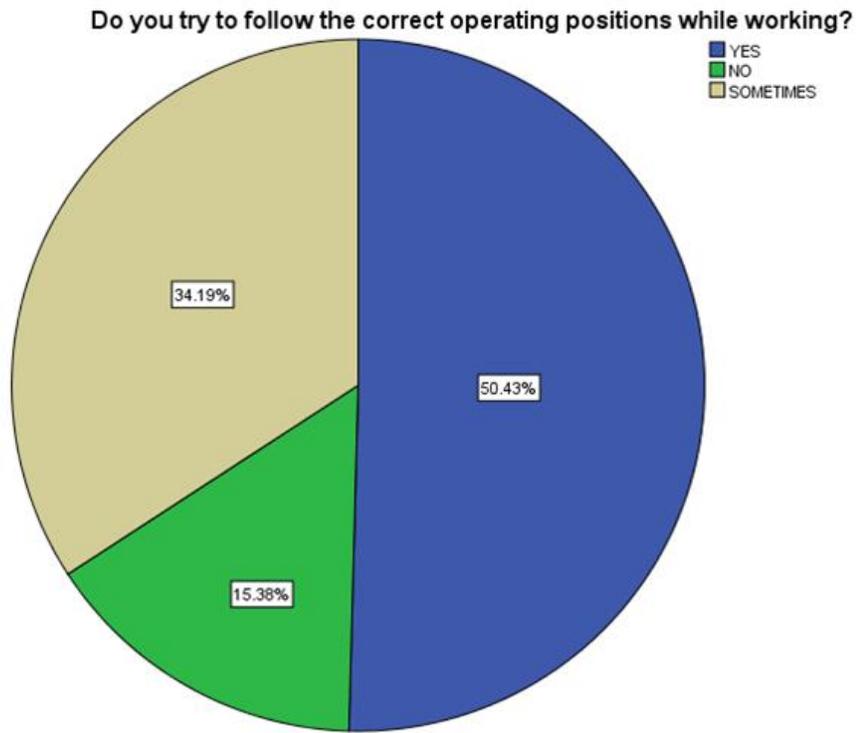


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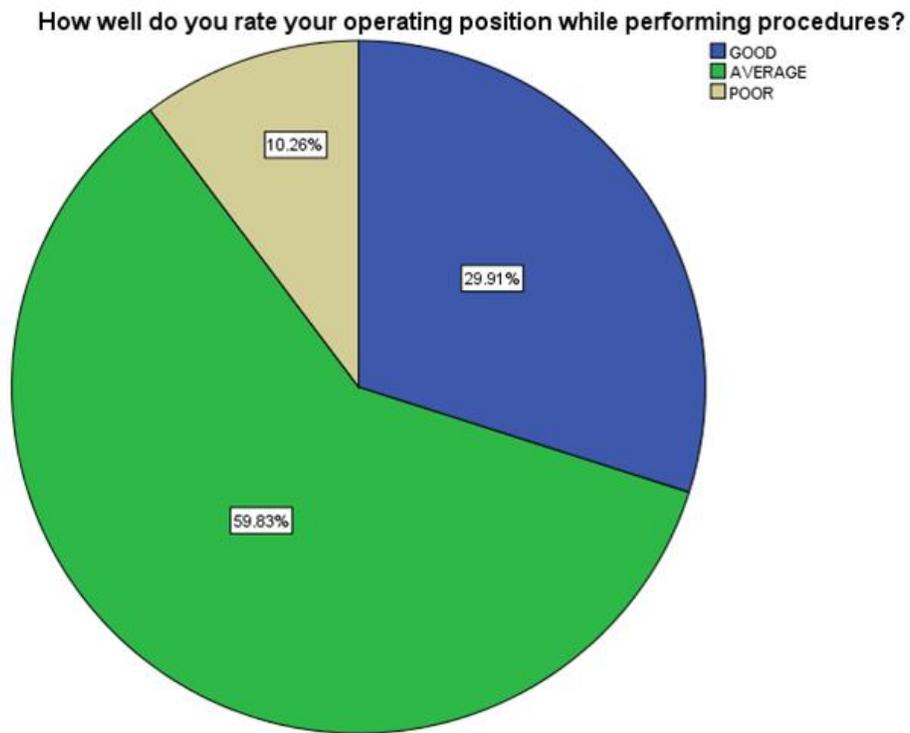


Fig. 5.4

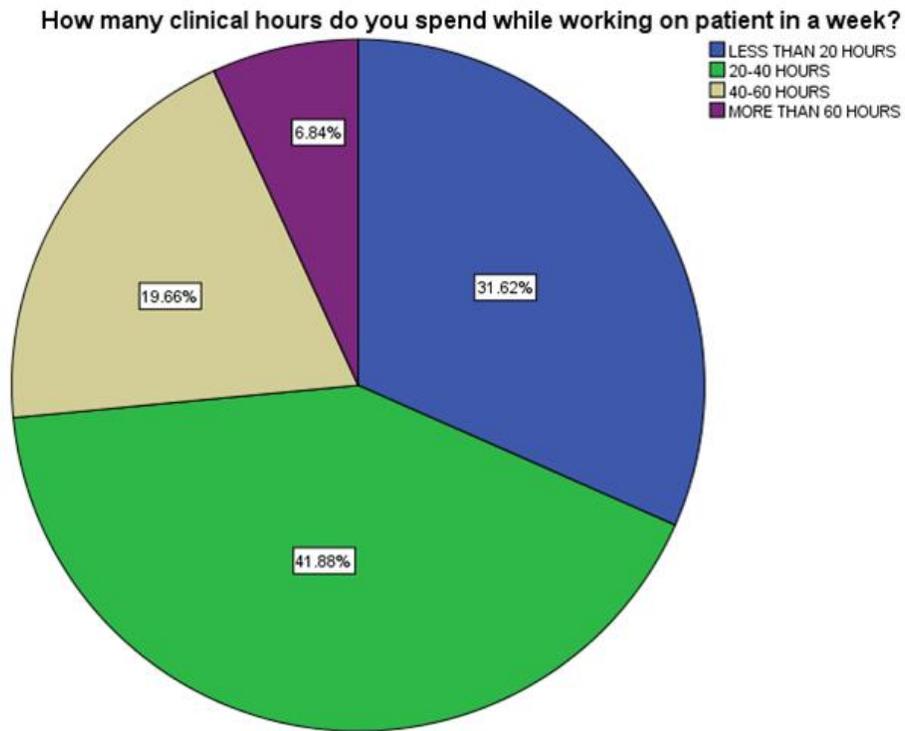


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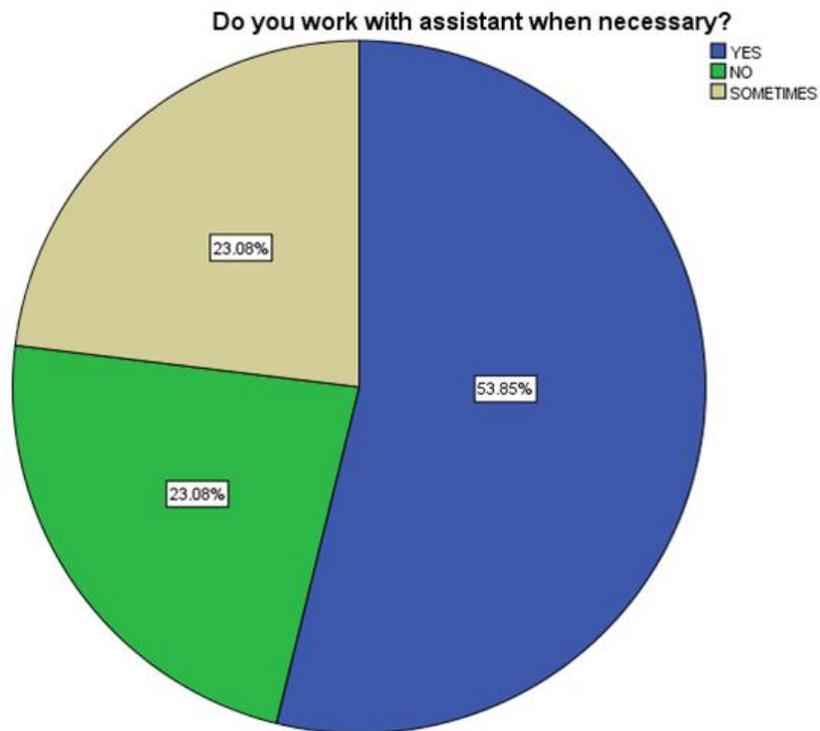


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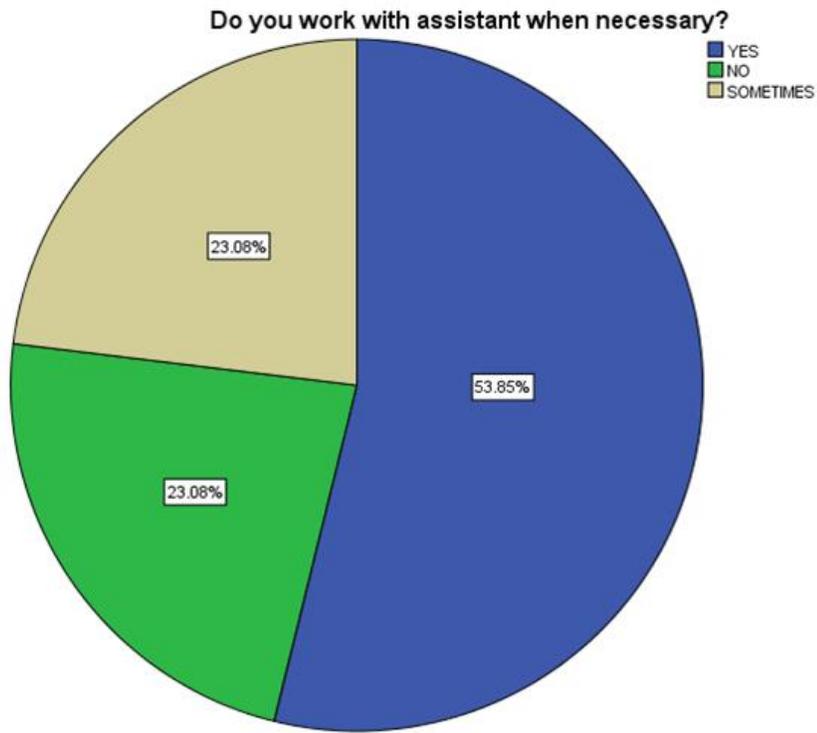


Fig. 5.7

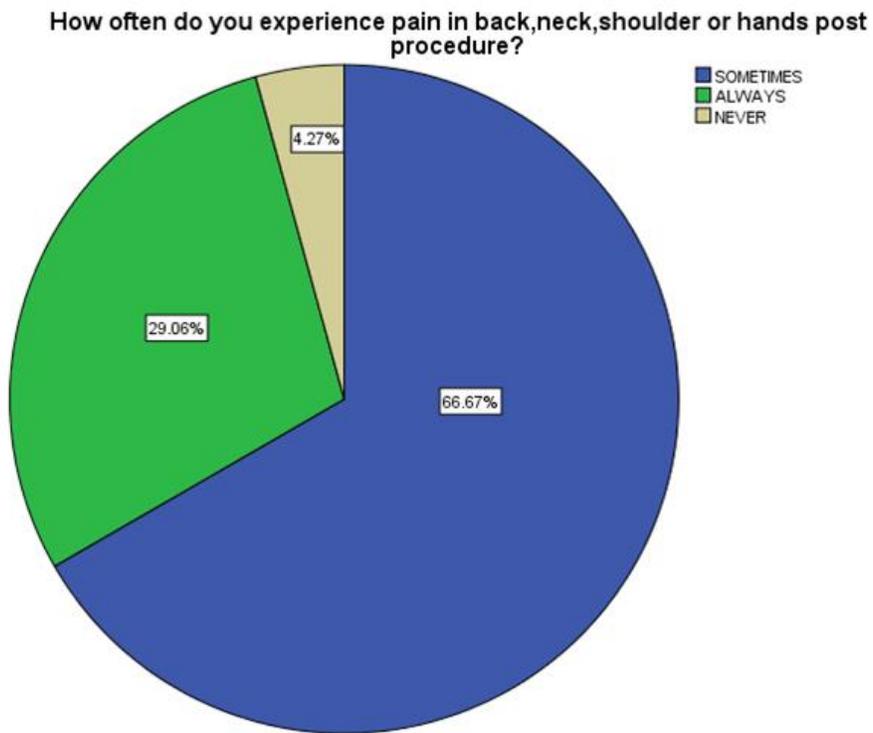


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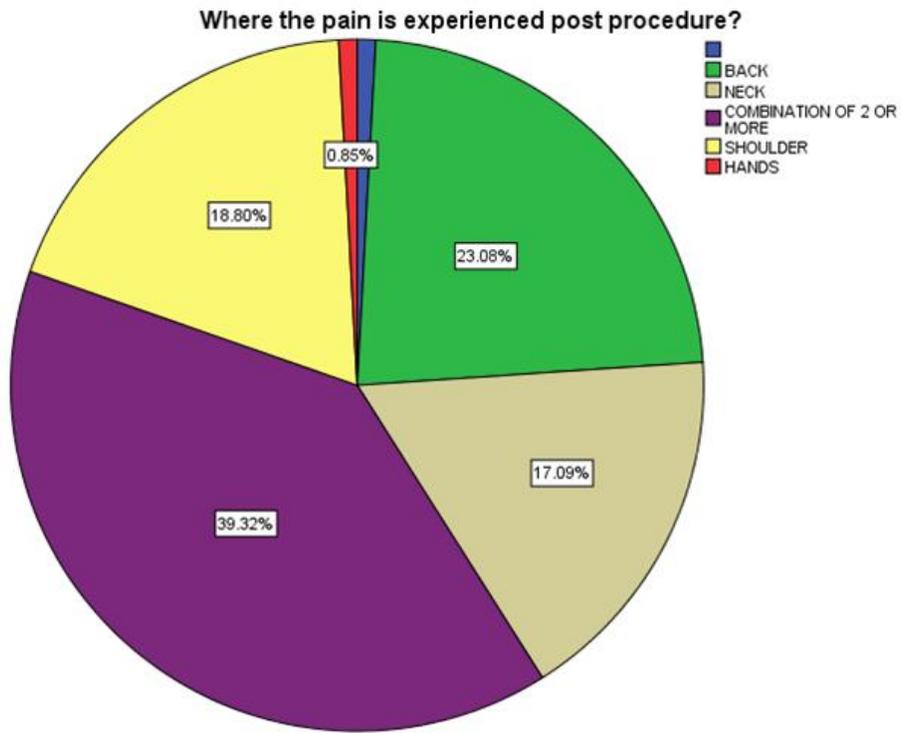


Fig. 5.9

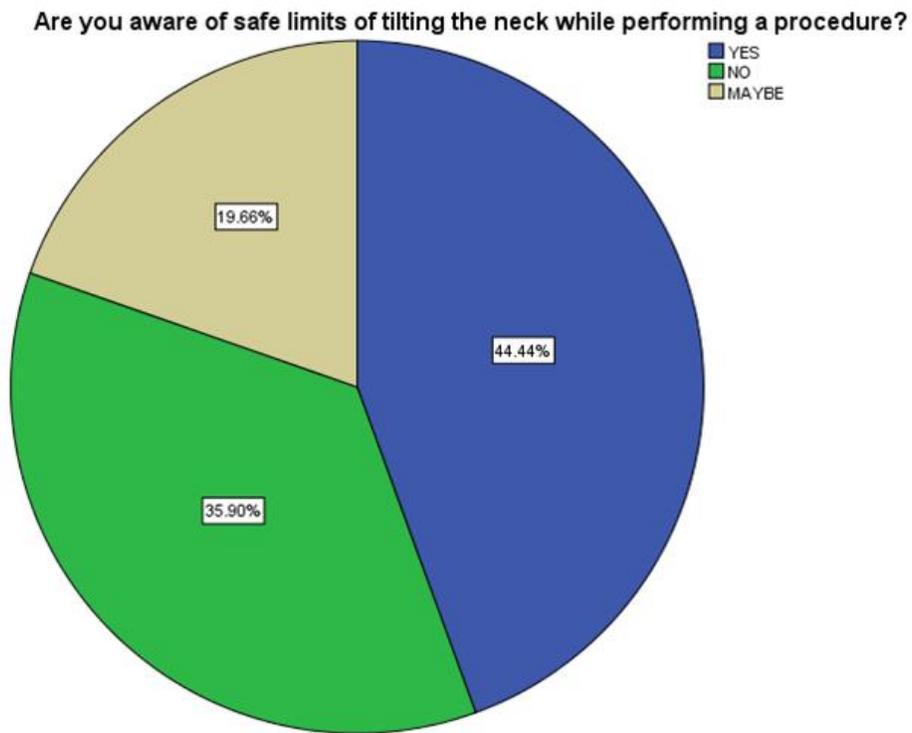


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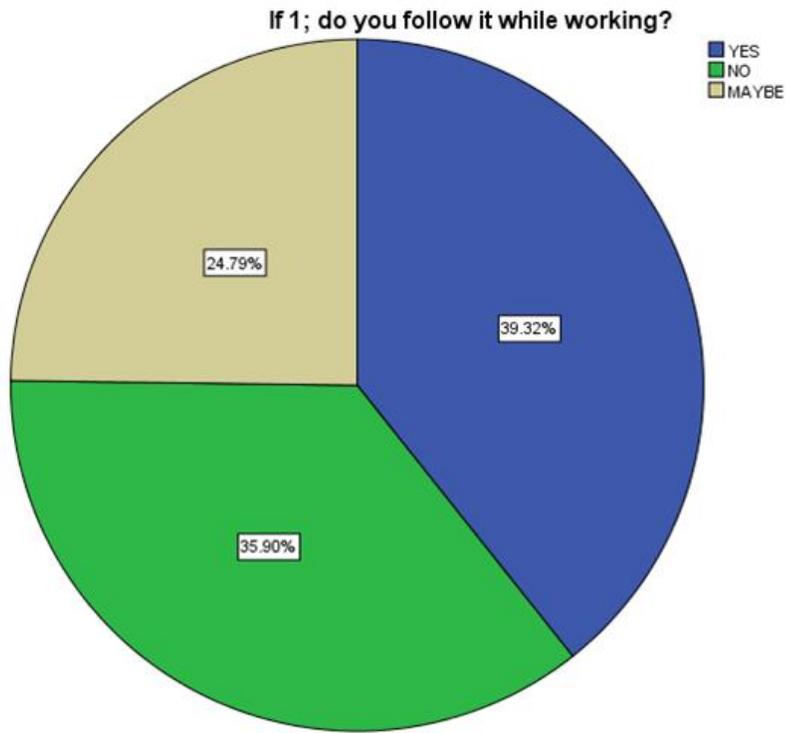


Fig. 5.11

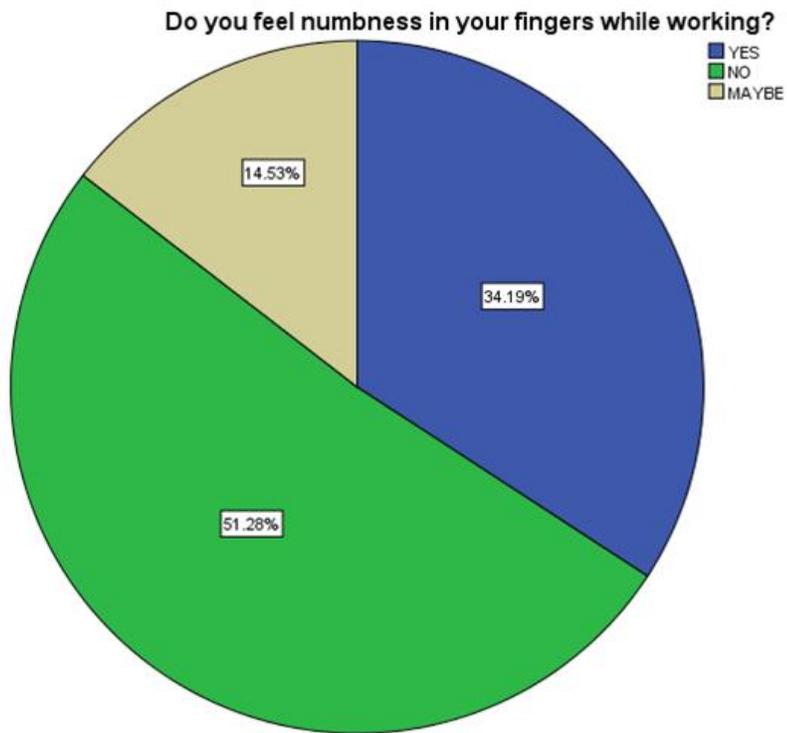


Fig. 5.12

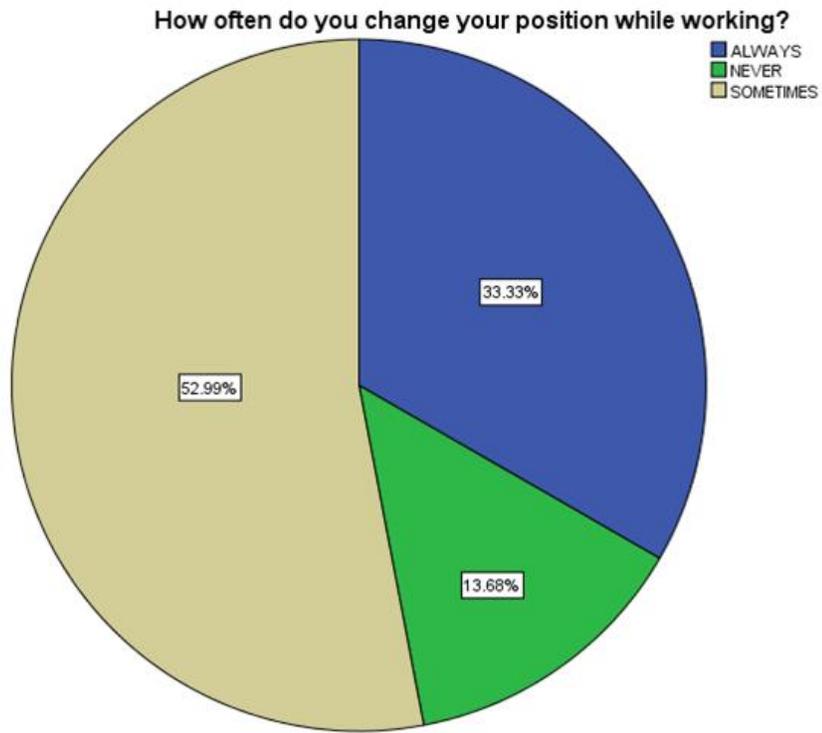


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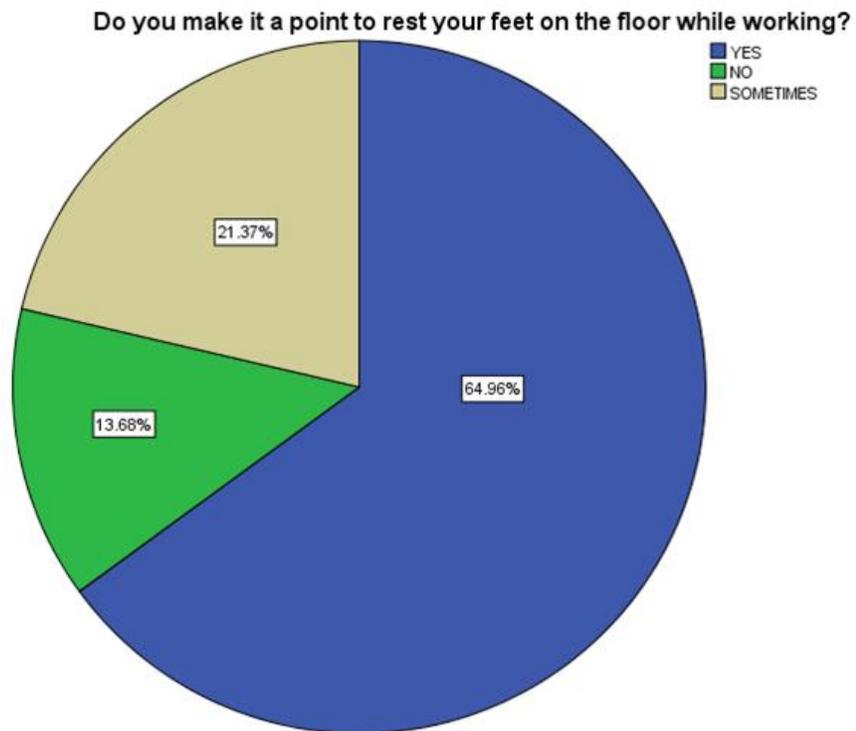


Fig. 5.14

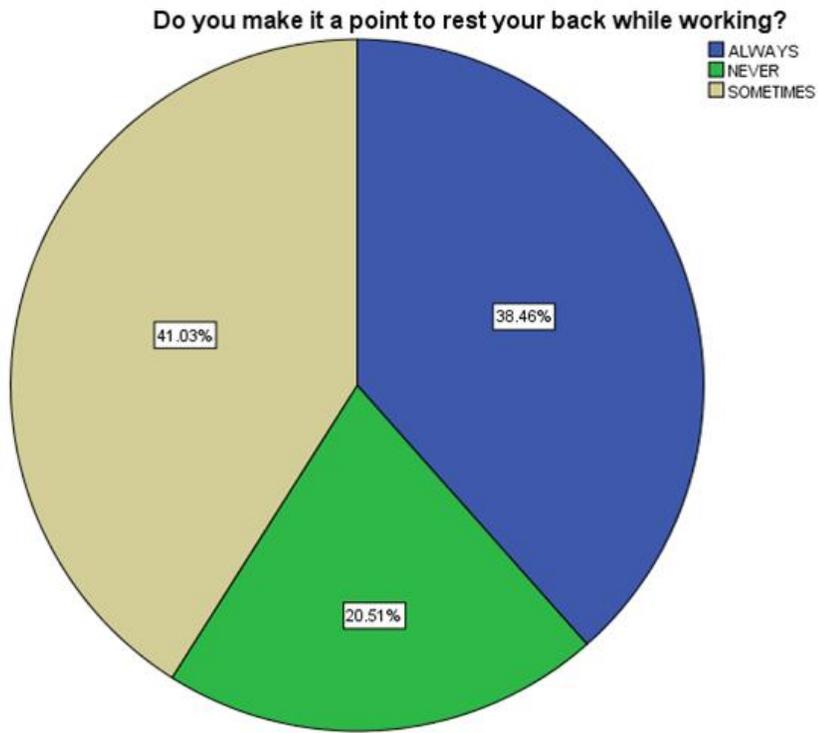


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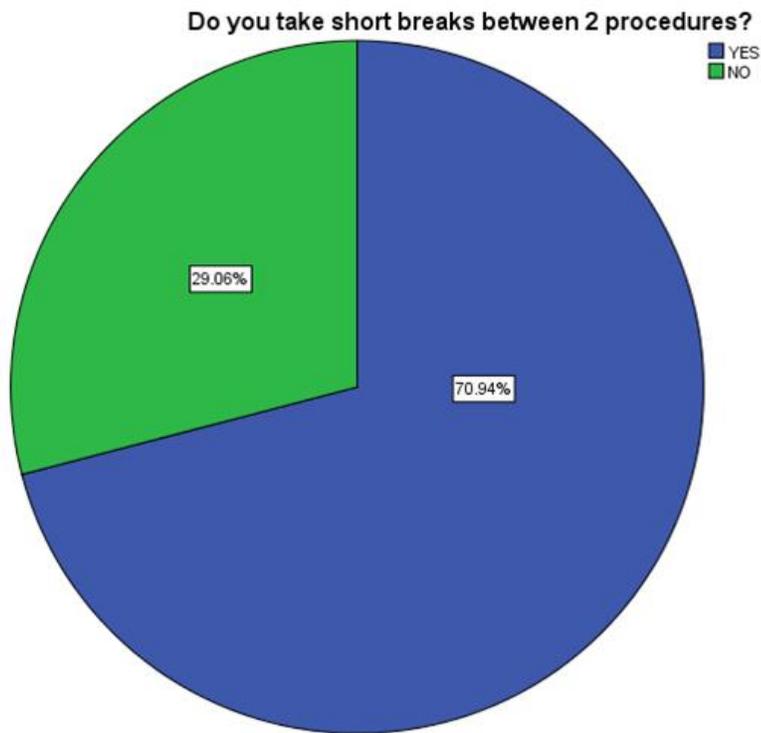


Fig. 5.16

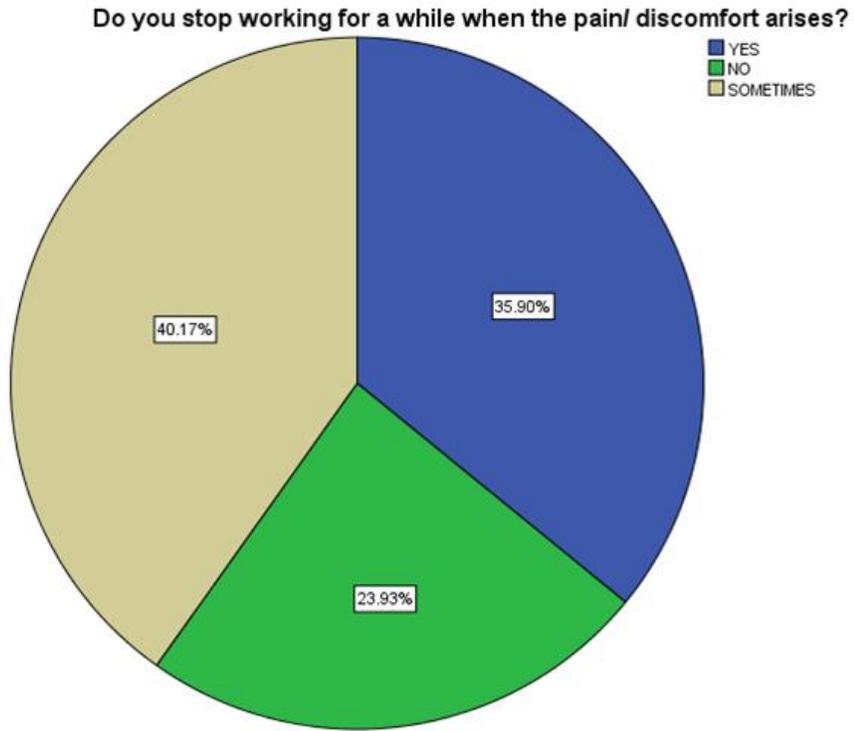


Fig. 5.17

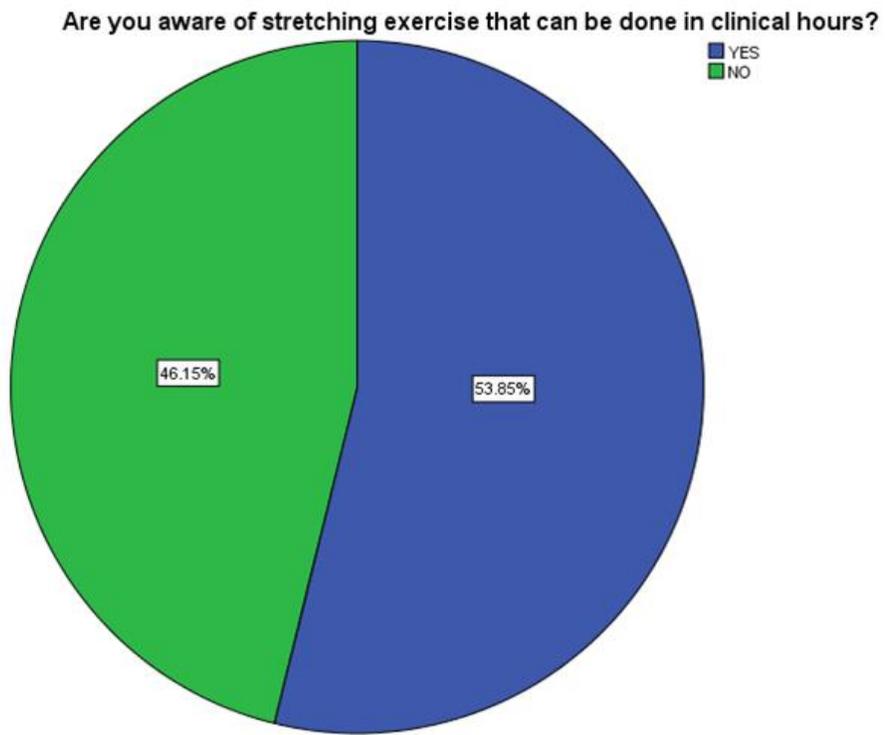


Fig. 5.18

How often do you consider ergonomic principals before purchasing work material tools or equipment?

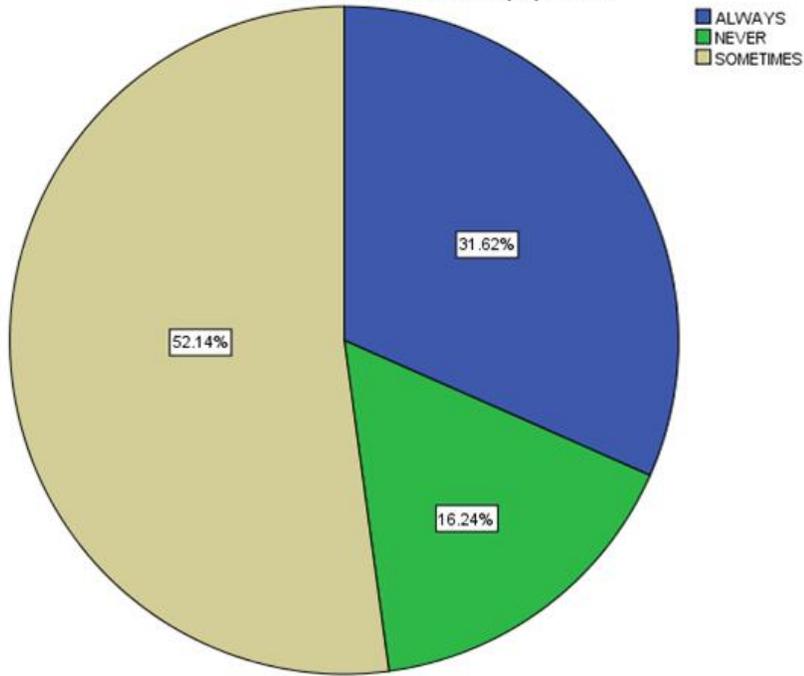


Fig. 5.19

Do you feel any difficulties or muscular strain while working in someone else's clinic(as a consultant)?

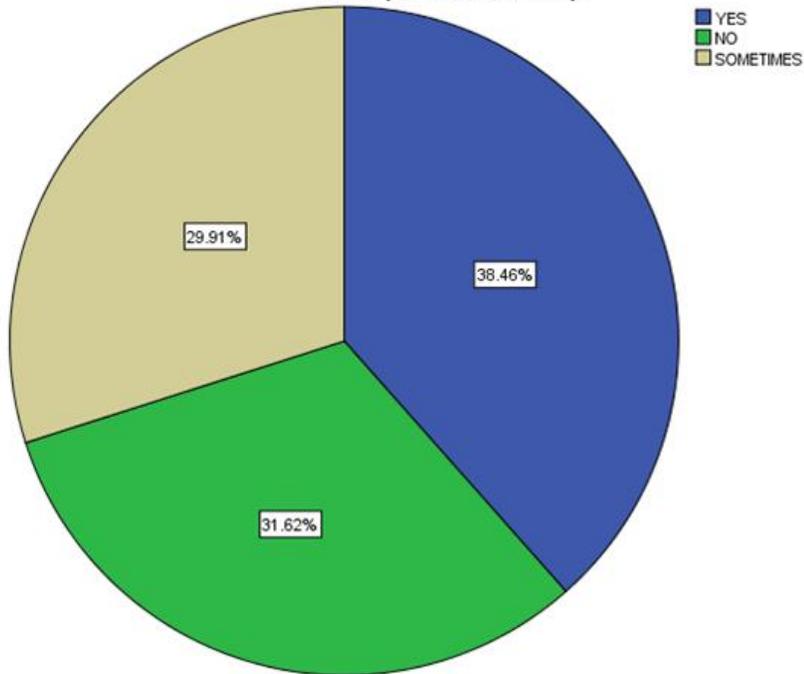


Fig. 5.20



Fig. 5.21

Fig. 5. Shows results according to individual questions.

Studies performed by Fish et al and Murphy et al suggest that taking micro breaks while working improve efficiency during dental procedures [34] Other methods of improving ergonomics and reducing MSDs include indirect mirror viewing, observing recommended practices for nutrition and regular exercise , proper lighting The physical inactivity among dentists seems to put them at risk for the occurrence of MSDs. This is a major reason leading for loss of work efficiency as well as early ill health retirement among dentists [34].

Apart from this, there are a number of stretching exercises that can be performed to relieve the strain on the muscles while working [2]. finger Stretch, hip stretch, spinal twist, back stretch etc. A number of chair side stretches have also been recommended by several authors that can be followed comfortably on the dental chair [3,34].

A few researchers have also recommended the use of ergonomically designed instruments to reduce the load on the muscles. This survey shows that only 31.9% of the periodontists frequently consider ergonomic principles and

designs of the work related materials and tools before purchasing the equipment. The instruments with larger diameter handles and lighter weight are recommended as they decrease finger and wrist MSDs [35-37].

Four Handed dentistry has been suggested to be an ergonomic concept and has reduced the occurrence of musculoskeletal disorders in dentists It has been reviewed that by appointing a dental assistant to help you carry out dental procedures, the clinician twists his body less often in search of instruments or materials thus reducing lower back pain [4] Although it could not cease the pain, literature drops a hint that the painful sites were changed. In this survey we realise that only 54.3% of the periodontists make use of a dental assistant while working. It must be kept in mind that a well-trained dental assistant reduces the physical burden on the clinician thus improving his efficiency.

Different ergonomic assessment tools have also been developed to evaluate inappropriate positions in dentistry. RULA, which stands for Rapid Upper Limb Assessment, is a survey

method for individual workers in dentistry. RULA ensues to assess the seriousness of the state of affairs. It indicates the level of intervention required to reduce the risk of injury due to physical loading on the operator. Higher the RULA score, higher the level of intervention required [38]. Teaching that inculcating ergonomic habits into young dentists is one of the best ways to avoid occupational musculoskeletal disorders in dentistry. Some of the methods that can be used include promoting training on both ergonomics and stress reduction in dental schools as a prevention strategy. Separate course on ergonomics in the dentistry curriculum and periodical evaluating the ergonomics practices of students is also a very efficient way of dealing with this; formulating global guidelines for developing ergonomic dental equipment; prevent manufacturing and sale of non-ergonomic dental equipment; periodical screening of dental professionals for MSD related symptoms to diagnose them early and so that effective treatment can be provided; promoting world-wide research on this subject, etc [2,39-42]. These results are the unfortunate consequence of training programs placing emphasis on what is done as opposed to how it is accomplished.

To ensure a ergonomically safe practice one has to stress on following things so as to avoid the ill effect

1. Lighting and magnification
2. Gloves – wearing proper size gloves.
3. Supervised exercise – evidence says poor medical and physical condition may increase the risk of musculoskeletal disorders hence special care should be taken when performing regular exercises it should be done under professional supervision.
4. Proper temperature – there are no specific norms as per how much the hand or finger temperature should be while working although research says that 25°C is ideal hand temperature to ensure better grip strength and dexterity.
5. Posture
6. Patient positioning
7. Smart patient appointment management
8. Ergonomically designed instruments
9. Four hand dentistry

4. CONCLUSION

Maintaining the correct posture at all times results in less stress on the joints and muscles

while working which increases the efficiency of the work also improves quality of life. Based on the results of this survey it can be concluded that the knowledge of periodontists in India towards ergonomics and musculoskeletal disorders is quite good as most of the knowledge based questions were answered with appropriate responses but their attitude and practice is not as satisfactory as expected. The reasons might be variable hence more stress on working with a proper posture has to be given during dental graduate and post graduate teaching programs so doctors inculcate these habits since the beginning. More care must be taken in implementing this knowledge into practice to prevent occupational hazards that might ruin one's career. Periodic reminders for breaks and stretching exercises can be set in the clinics also dental assistants can be trained to practice a four handed dentistry which will improve the work efficiency multiple folds with least strain on the body.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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