RESEARCH ARTICLE

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Estimation of Temporomandibular Joint Dysfunction in Oral Cancer Survivors

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Abstract

Background: The Objective of this study was estimation of Temporomandibular joint dysfunction in oral cancer survivors. **Methods:** The hundred patients with oral cancer who had undergone radiotherapy or chemotherapy were randomly selected as per inclusion criteria. Range of motion of temporomandibular joint(TMJ), visual analogue scale (VAS), Manual muscle testing (MMT), Auscultation test, Chvostek test and swelling over orofacial muscles were used as the Outcome measures. **Results:** The findings of this study revealed that the Temporomandibular joint was significantly dysfunctional. The group analysis demonstrated statistically significant impairments in all the Outcome measures. VAS ($p<0.0001$), ROM for all four motions ($p<0.0001$), Manual muscle testing ($p<0.0001$), Provocation test (52%), Auscultation test (92%), Chvostek Test (4%), and swelling (56%) were all shown significant dysfunction of TMJ. **Conclusion:** This study showed that pain was increased during activity than at rest based on the findings of VAS pain rating scale. It was found that the range of motion of TMJ was significantly reduced; however muscular strength was minimally affected. Majority of survivors were tested positive for the provocation test and auscultation test and few for Chvostek test which indicated the involvement of facial nerve.

Keywords: Oropharyngeal carcinoma- orofacial pain- radiation focal myopathy- joint stiffness

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Introduction

Cancer is an unnatural, uncontrolled growth of cells that invade and cause adjacent tissue impairment. Oral cancer ensues with small, unfamiliar, unexplained growths or sores in the mouthparts (Borse et al., 2020). Oral squamous cell carcinoma (OSCC) is the most common type of oral cancer and is a detectable preclinical stage of the disease. According to a recent study that was conducted on the incidence and mortality rate of oral cavity cancer is 300,373 cases in total. India accounts for more than one third of the total burden and is the second-largest country concerning with oral cancer cases (Borse et al., 2020). The oral cavity, pharynx, and larynx, as well as the nasal cavity and sinuses, are among these organs. Oropharyngeal carcinoma (OPC) is a very unusual cancer in general, although it is quite frequent in the head and neck region. Radiation and surgery can harm tissues and structures essential for jaw range of motion, including the temporal mandibular joint, masticatory muscles, and oropharyngeal mucosa (Diwate et al., 2020). Men have twice as likely to develop caries or oropharyngeal cancer as women. This might be because, in the past, men were more prone to consume tobacco and alcohol in India. Malignant tumour of the oropharynx caused by Human Papilloma Virus (HPV) are also more common in men. Diverse risk factors contribute to the incidence of oral cancer such as tobacco consumption in the form of smokeless tobacco, betel chewing, poor oral health and frequent oral infections, including human papillomavirus. Various socio-ecological and behavioural factors namely exposure to smoke, silica, asbestos, and other carcinogenic elements lead to cancer. Lack of knowledge, exposure to extreme environmental conditions, and behavioural risk factors are indicators of a wide range in incidence (Borse et al., 2020).

Temporomandibular joint disorder (TMD) is an unaccountable issue for health care professionals all around the world due to its deleterious effect on the stomatognathic system (Motghare et al., 2015). TMJD is a term collectively used to describe pain and dysfunction of the muscles of mastication and the Temporomandibular joint's most common feature is pain, which is further followed by restricted mandibular movement, and clicking and popping sound from the temporomandibular joint(TMJ) during movement. Because of its negative impact on the stomatognathic system, TMJD is a

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challenging issue for healthcare professionals worldwide. Hindrance may appear suddenly as locking or may develop over time. Signs and symptoms common to this condition are soreness of mastication muscles, headaches in the temple region, attrition of teeth and sensitivity, hypermobility of teeth, pain in the area of the forehead and eyes, pain in the back of the head (possibly extending to the shoulders and neck), fullness in the ears, tinnitus, pressure on the eyes, sensitivity to light, dizzy spells, vertigo, nausea, lack of concentration. TMJD treatment necessitates a thorough understanding of the anatomy and physiology of TMJD and the masticatory systems Arthrokinematics, musculoskeletal, and neurological components (Weber et al., 2010). Swallowing and voice are affected by tradition but the effect is variable and depends on the radiation field and the radiation dose and associated chemotherapy agents (Nguyen et al., 2002).

Functional disruption occurs when mandibular continuity is disrupted, and the amount of the defect varies depending on the tumour location, extent, severity, and stage, as well as the soft and hard tissues involved (Gupta et al., 2013). Various types of conservation clinical techniques such as physical and histopathological examination staining, biopsy, spectroscopic and radiological technique, etc. are used routinely for detection of oral cancer (Diwate et al., 2020). During Radiation focal myopathy of the irradiated muscles, is usually associated with painful spasm which is followed by abnormal proliferation of Fibroblasts in the muscles and ligaments, a process called radiation-induced fibrosis (Abboud et al., 2020). In long health issues related to cancer, its treatment and complication are becoming more important. The most common cause of oncology-related radiation-induced fibrosis, while postsurgical scarring may also play a role (Diwate et al., 2020).

Mandibulotomy (split mandible) to gain access to tumour tissue or mandibulectomy (mandibular resection) in the case of osseous tumour involvement are transmandibular surgery used to treat an oral cavity and oropharyngeal tumours (Al-Saleh et al., 2012). Despite the advances in oral oncology, several patients have lost oral functions as a result of surgery, radiation, and/or chemotherapy problems (Agrawal et al., 2016). These negative effects go unnoticed, untreated, and unreported. Large tumours, high radiation doses, and tumour location, especially when adjoining to the masticatory muscles and the temporomandibular joint, are all some of the major risk factors for developing dysfunction (Agrawal et al., 2016). The Indian population's typical mouth opening range is 39mm to 70mm for males and 36mm to 56mm for females. Oral cancer patients have a mouth opening of more than 30mm, indicating temporomandibular dysfunction. Patients frequently have trouble doing everyday tasks, which can lead to poor dental hygiene, discomfort, weight loss, and even despair. This problem may have a significant impact on their quality of life (Diwate et al., 2020).

Material and Methods

After approval from the Institutional Protocol and Ethics Committee, this Cross-sectional study was carried out at tertiary care hospital in India. The study's major goal was to determine the severity and scope of TMJD, as well as whether or not it is caused by oral cancer.

Participants

One hundred oral cancer survivors of both genders within the age limit of 18 to 65 years of years were randomly selected for this study. According to the inclusion criteria, Oral cancer survivors treated with mandibular surgery (hemi-mandibulectomy) with preserved TMJ were taken. Patients with any infection or trauma or rheumatic disease, neurological problem, Temporomandibular fracture, Edentulism, and history of previous maxillofacial trauma were excluded.

Procedure

All patients were approached and explained about all the details related to the study, also written constant and verbal informed consent were taken. Demographic information was documented before initiating the study. Assessment of the patient was done by utilizing an inch tape and Visual Analog Scale to estimation Range of motion of TMJ and Intensity of the Pain respectively and Manual Muscle Testing was done to examine muscular strength. Other special tests were performed like Procovation test, Auscultation test, Chvostek test as well as examination of swelling.

Data Collection Tools

Range of motion

The initial step was to measure the mouth opening. The starting position of the patient was relaxed seated on the plinth. Furthermore, the mouth opening was measured with the use of an inch tape, the maximum distance between the inter incision of upper and lower dentures. The patient was instructed for maximum mouth opening and measurements were taken through the inch tape and their average was recorded as the final reading of the measurement. If the noted reading came out to be less than 35mm then it was considered that the patient possessed a restricted jaw opening i.e., TMJD. The patient was asked to move his/her jaw side to side as much as possible and then measurements were taken by inch tape and the average was recorded.

Determination of Pain

The patient was explained about the visual analog scale (VAS) which contains a scale ranging from 0 to 10. '0' is the indication of no pain at all and '10'indicates severe pain. This examination was done under two circumstances, pain at rest and pain during the activity. The patient was asked to mark between 0 to 10 on basis of the pain he/she experiences first while in rest, and then while during an activity.

Chvostek Test

The patient was seated, with the examiner standing beside the patient. The examiner further tapped on the patient's parotid gland. If the facial muscles twitch, then the test would be considered positive. This test was conducted to determine whether there was any

pathological involvement of the seventh cranial (facial) nerve.

Auscultation Test

The patient was seated, with the examiner standing beside the patient. Initially, a stethoscope was placed at the TMJ of the patient. Further, the patient was asked to open his/her mouth at a regular interval. If during this movement of the mouth, there appears any kind of clicking or crepitus noise, then the test is considered to be positive.

Manual Muscle Testing

For this test, resistance was applied to the specific muscle of the patient and they were asked to overcome the resistance. Results were stated according to Grade i.e., Grade 1 – Grade 5, with Grade 1 being no muscle contraction while Grade 5 being maximum movement overcoming maximum resistance.

Mouth Elevation

Here, the patient is asked to close his/her mouth while resistance is applied over the chin or muscle mentalis.

Lateral Deviation

The patient was asked to shift or deviate his/her jaw on one side while resistance is applied on the same side.

Retraction

For this test, the examiner had placed two fingers inside the patient's lower jaw, and the patient is asked to retract the jaw while the force is applied to resist the movement. Protrusion: In this test, resistance is applied over the muscle mentalis, and simultaneously the patient is asked to protrude his/her jaw while overcoming the resistance.

Statistical Analysis

The outcome measures were evaluated at the start of the study. In this study, descriptive statistics such as bar diagrams, and percentages were used to statistically assess the acquired data.

For the estimation of TMJD in oral cancer survivors concerning the severity of pain, range of motion, and manual muscle testing, we employed the Pearson Chi-Square Test and Linear-By-Linear Association. The final results were calculated as percentages.

Results

All statistical analyses, including calculation of the mean and standard deviation of pain assessment, range of motion and manual muscle testing was done using SPSS statistical software (version 21.0 for windows; SPSS, Inc., Chicago, USA). In this study, descriptive statistics such as bar diagrams, and percentages were used to statistically assess the acquired data. For the estimation of TMJD in oral cancer survivors concerning the severity of pain, range of motion, and manual muscle testing, we employed the Pearson Chi-Square Test and Linear-By-Linear Association. The final results were calculated as percentages.

Demographic variables

Around 100 oral cancer survivor's overall Demographic variables is represented in Table 1 and Table 2 such as gender which contains 74% males and 26% females then along that co-morbidities were also mentioned like hypertension (16%) diabetes (8%) and habits like tobacco chewing (24%), smoking (16%) and alcohol consumption (8%). Age wise Distribution of oral cancer survivor

Table 1. Demographic Variables

Variables	No. of Individuals	% of Individuals
Gender		
Male	74	74%
Female	26	26%
Co-morbidities		
Hypertension	16	16%
Diabetes	8	8%
Habits		
Tobacco chewing	24	24%
Smoking	16	16%
Alcohol	8	8%
Mishri	16	16%
None	36	36%

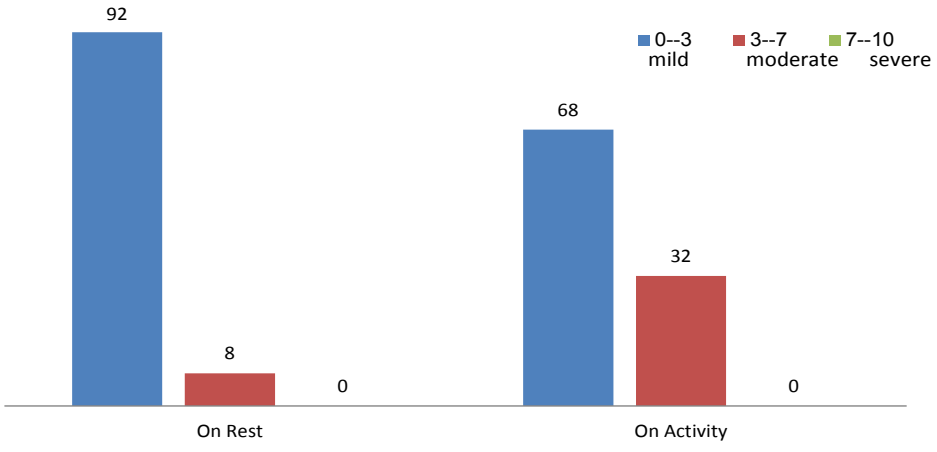

Figure 1. Pain Assessment

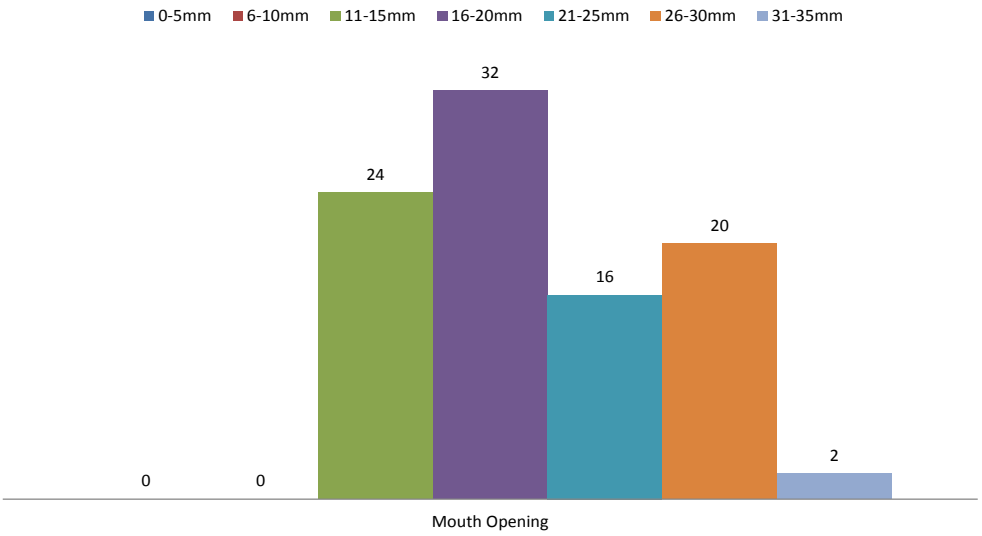

Figure 2. Range of Motion (Mouth Opening)

Table 2. Age-Wise Distribution

Variables	No. of Individuals	Mean(m)	% of individual
Age			
18-27 years	0	0	0
28-37 years	12	0.12	12%
38-47 years	40	0.4	40%
48-57 years	20	0.2	20%
58-65 years	28	0.28	28%

individuals is shown in which depicted minimum ranges from 28-37 years ie. 12%. Maximum patient ranges from the age group of 38-47 years ie. 40%. Moderately patient ranges were seen in age groups 48-57 (20%) and 58-65 (28%).

Pain assessment

Pain severity at rest and activity is represented in

Table 3. Pain Assessment

	On Rest	On Activity
Mean (M)	0.94	2.8
Standard deviation(S.D)	1.533	1.531
p value	<0.0001	<0.0001

Figure 1 in the oral cancer survivor individuals, maximum of 92 individuals have mild pain at rest, 8 individuals have moderate pain at rest and 0 individuals have severe pain on rest. while 68 individuals have mild pain during

Table 4. Range of Motion

	Mouth opening	Lateral Right	Lateral Left	Protrusion
Mean (m)	21.12	4.28	40.48	2.4
Standard Deviation (S.D)	5.403	2.92	2.83	1.363
P value	<0.0001	<0.0001	<0.0001	<0.0001

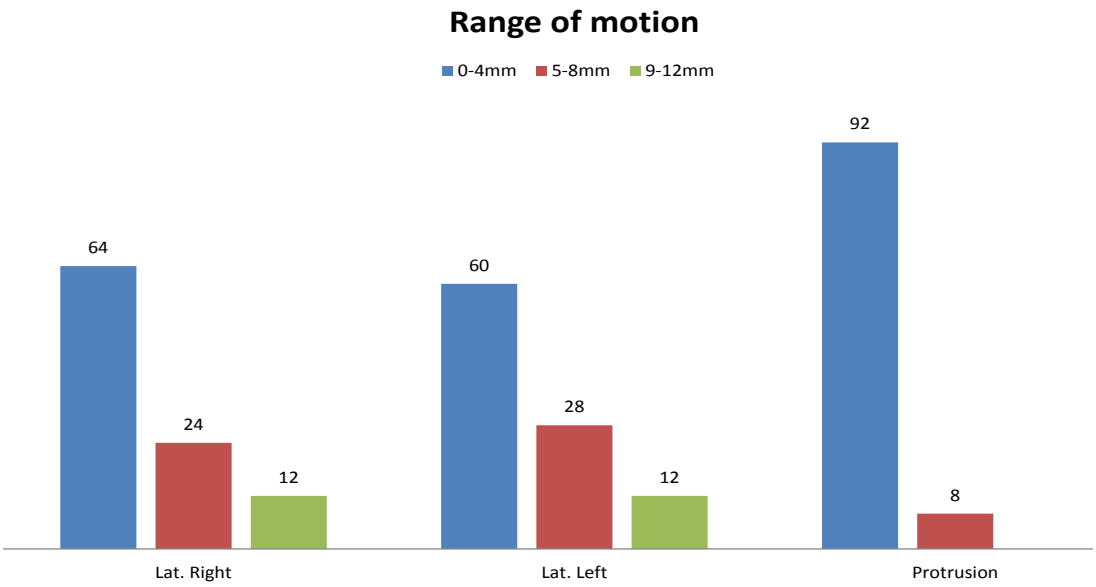

Figure 3. Range of Motion of TMJ

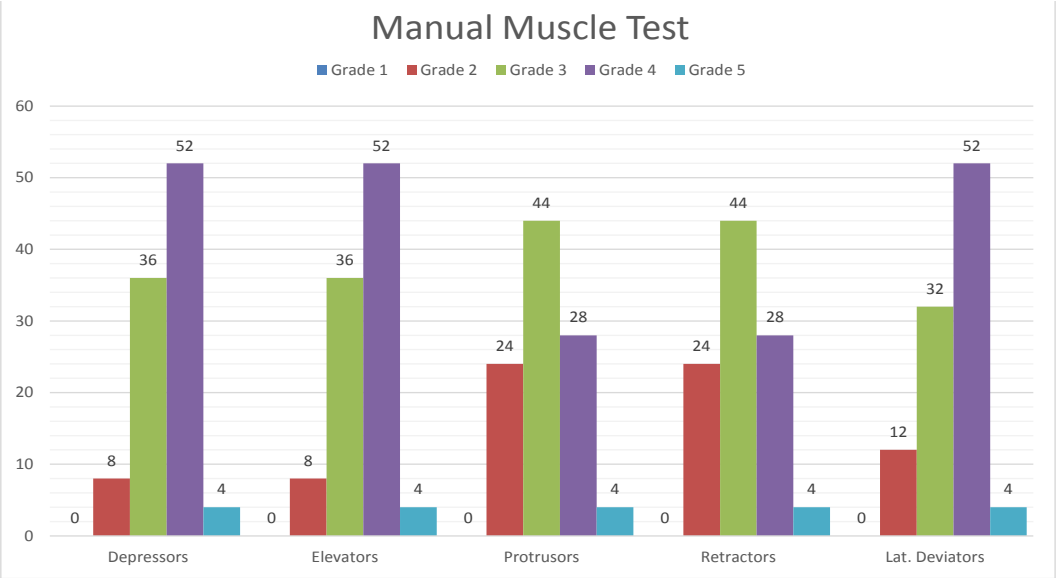

Figure 4. Manual Muscle Testing

Table 5. Manual Muscle Testing

	Depressor	Elevators	Protrusion	Retraction	Lateral deviation
Mean (M)	3.52	3.52	3.14	3.12	3.48
Standard deviation (S.D)	0.7032	0.703	0.829	0.82	0.7585
p value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 6. Other Outcome Measures

	Present no. of individuals	Absent no. of individuals
Auscultation test	92	8
Provocation test	52	48
Chvostek test	4	96
Swelling	56	44

activity, 32 individuals have moderate pain on activity and 0 individuals have severe pain. Overall, 40 individuals experienced moderate pain. And in Table 3 The mean and standard deviation of pain in rest and activity is done which shows p value (<0.0001) on rest and (<0.0001) on activity that means the pain during activities was significantly more than the pain at rest.

Range of motion assessment

A histogram Figure 2 representing Range of Motion of Mouth opening which shows 24 individuals with ranges between 11-20mm, 16 individuals with ranges between 21-25mm, 20 individuals with ranges between 26-30 mm and only 2 individuals with range between 31-35mm and a maximum range of mouth opening is seen in 32 individuals ranging between 16mm-20mm. Its p-value is <0.0001. i.e., considered extremely significant.

As shown in Table 4 mean and standard deviations of range of motion specifically mouth opening, lateral right, lateral left and protusion. P value of all the ranges are (<0.0001) and Figure 3 shows a) 64 individuals ranged from 0-4 mm for the lateral right range of motion,24 individuals from 5-8 mm, and 12 individuals from 9-12 mm.

b) 60 individuals ranged from 0-4mm for a lateral left range of motion, 28 individuals from 5-8mm, and 12 individuals from 9-12mm.

c) 92 individuals ranged from 0-4mm for protrusion, 8 individuals from 5-8mm.

this shows maximum individuals were ranged from 0-4mm for protusion.

Manual Muscle Testing of TMJ muscles,

Mean and standard deviations of strengths of all TMJ muscles is represented in Table 5 ie. Depressors, elevators, protrusion, retraction and lateral deviation with p value (<0.0001) that means it is significant.

Manual muscle testing of the TMJ muscles and its grades Is shown in Figure 4. All muscles have only 4 individuals with grade 5. maximum individual had grade 4 MMT for depressors (52 individuals), elevators (52 individuals) and lateral deviators (52 individuals) while grade 3 for protrusors (44 individuals) and retractors (44 individuals)

Special test

Special tests were carried out and its results are shown in Table 6 such as

a) Auscultation test: which revealed that 92% have shown positive results and 8% of the people had negative results.

b) Provocation test: concluded that 52% of the people showed positive results while 48% have shown negative results.

c) Chvostek test: After analyzing the data it is

concluded that 4% of the people are tested positive while 96% have shown negative results.

d) Swelling: This revealed that 56% of people were having swelling while 44% have shown negative results.

Discussion

A key purpose of this study was to determine the level of TMJD in oral cancer survivors, such as mobility, muscle tension, and pain. Postural stress was increased in oral cancer survivors as a result of various treatment modalities such as Chemotherapy, Radiotherapy, and Temporo-mandibular Surgery. Oral cavity cancer accounts for 4% of all cancers, with squamous cell carcinoma being the most common. It is mostly a condition that strikes people after the age of 45, and it primarily affects the tongue and mouth floor. Oral cancer was found to be more common in men, and it is linked to tobacco use in all forms and alcohol consumption. Squamous cell carcinomas are characterized by an intra-oral ulcer that appears as a white spot. Saliva secretion was at its peak in some of the patients. Alcohol is known to be a facilitator, while nicotine is known to be a lower-level carcinogen than tobacco products.

TMJD can be stated as a multifactorial disorder that includes Structural, functional, and huge impact on psychological life. According to this study, it is most commonly associated with dysfunction as difficulty in teeth clenching, jaw grinding or doing any repetitive activity or motion such as gum chewing. It is observed that there is a maximum decrease in the range of motion of the mouth. Secondly the patients present with pain in front of the tragus along with radiation to the ear, toward the neck region, lower jaw, and also over the temporal region. There was an increase in pain during Swallowing and some experienced loss of speech. The swelling was present over the cheek and under the ear lobe. The postural position of the Patient suffers biomechanical alterations originating from stomatognathic modifications (Surgery), causing clinically visible alterations and affecting the performance of the involved structures.

Vaibhav et al., (2015) conducted a cross-sectional study in 240 adolescents aged from 10-19 years studying in schools in Greater Noida. This study was designed for TMJD signs and symptoms are related to harmful oral habits. (AAOP) American Academy of Orofacial Pain recommended Questionnaires were distributed among the selected subjects. In this study, patient history and clinical examination were used to determine harmful oral habits. They found a significant relation between nail-biting, lip/object biting, and grinding of teeth with signs and/or symptoms of TMD. Hence, it can be concluded that there is a need for preventive dental treatment and community dental education so that young adults realize the importance of early diagnosis and treatment of TMJD.

Another study by Snehal Naykodi examined the prevalence of trismus in the head, neck, and face cancer (HNF) on patients undergoing radiotherapy. She concluded that 81% of patients had a high prevalence of trismus undergoing radiotherapy.

Another study was done by Padmanidhi Agarwal et al., (2016) in their study; HNF cancer patients who had taken radiation showed a high prevalence of trismus. they also found a high prevalence of trismus in HNF cancer patients who had taken radiation. They concluded Trismus was noted in 53.3% of patients at the time of diagnosis, which increased significantly post-surgery (86.7%) and post-radiotherapy (85.7%) and gradually decreased (65.4%) at six months. A thorough examination of the TMJ was taken, checking the jaw range of motion during mouth opening and closing, palpating for swelling, manual muscle testing to check the strength of muscles of mastication. Examination of clicking and popping sound of TMJ By using auscultation test along with provocation test.

After the Examination, it was already known that there was major dysfunction of the Temporomandibular joint in a cancer patient undergoing radiotherapy. Radiotherapy is a long-term and unavoidable treatment but it comes with its inevitable drawbacks. This radiation worsens the present condition of TMJ. However, if physiotherapy can be given in adjunct with radiotherapy, it can result in a lesser extent of dysfunction and it may also help in improving quality of life.

There were some limitations for this study, group size was small; hence study results cannot be generalized for any kind of cancer. It was limited to one geographical location. Also, there was a limited duration of time for the study. We suggest the further group take more sample size than the present study, and it may include all kinds of mandibular surgeries indicated for oral cancer. An individual can also be selected from cancer centers for a greater number of patients.

In conclusion, this study showed that pain was increased during activity than at rest based on the findings of VAS pain rating scale. It was found that the range of motion of TMJ was significantly reduced; however muscular strength was minimally affected. Majority of survivors were tested positive for the provocation test and auscultation test and few for Chvostek test which indicated the involvement of facial nerve.

Author Contribution Statement

Ishana Kadam conducted a literature review for this manuscript, developed the introduction section of the manuscript, and also conducted a discussion of the study, findings, collected data, and analyzed the data. Dr. Shinde Sandeep provided a description of the background information, collected data and analyzed the data, and participated in the prescription of the manuscript. Dr. Prachiti Bhore helped in the preparation and finalizing of the manuscript, all the authors read and approved the final manuscript.

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Ethics Committee

The study was approved by the institutional ethical committee of Krishna Institute of Medical Sciences Deemed to Be University, Karad, Maharashtra.

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Statement conflict of Interest

The authors declare that there are no conflicts of interest concerning the content of the present study.

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