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RESEARCH ARTICLE

PERIODONTAL CHANGES IN PATIENTS AFTER HEAD AND NECK RADIATION THERAPY

***[1]Dr. Grishmi A. Niswade, [2]Dr. Abhimanyu K. Niswade, and [3]Dr. A. K Diwan**

[1]Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, India
[2]Department of Paediatrics, Government Medical College and Hospital, Nagpur, India
[3]Department of Radiation therapy and Oncology, Government Medical College and hospital, Nagpur, India

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ABSTRACT

Conventional radiotherapy may affect tissues adjacent to the tumour site which may include the oral cavity. This may lead to complications such as mucositis, xerostomia, dysgeusia, opportunistic infections as well as periodontal attachment loss. The purpose of this study is to determine the potential impact of head and neck radiation therapy on periodontal status. This is an observational cross sectional study. This study was conducted on 81 patients (43 males and 38 females) were selected from the Department of Radiotherapy and Oncology, Government Medical College and Hospital, Nagpur, Maharashtra, India from August 2014 to October 2014. The Test group comprised of 41 patients who were undergoing radiation therapy for malignant neoplasia in head and neck region. The Control group comprised of 40 patients with malignant neoplasia in the head and neck region who reported for the first time to the hospital OPD. The following clinical parameters were evaluated- probing pocket depth (PPD), clinical attachment level (CAL) and Gingival recession (GR). It was found there exist a statistical difference between test and control group ($p<0.005$) among all the measured variables. Dental treatment should be aimed at improving the oral hygiene status of patients through professional dental care. Patients should be constantly motivated toward maintaining a meticulous oral hygiene status before, during and after radiotherapy to prevent and control the oral and periodontal sequelae.

INTRODUCTION

Cancer is one of the leading causes of adult deaths worldwide. In its projection, the Indian Council of Medical Research (ICMR) said in 2016 the total number of new cancer cases is expected to be around 14.5 lakh and the figure is likely to reach nearly 17.3 lakh new cases in 2020. Among females, breast cancer is the most common and among males, oral cancer tops the list. Mouth cancer in males is recorded the most in the western states of the country whereas in females it is highest in Khasi hills of Meghalaya in India *(Indian Council of Medical Research)* (Ferlay *et al.,* 2010). Rates of cancer deaths are expected to rise, particularly, from increases in the age-specific cancer risks of tobacco smoking, which increase the incidence of several types of cancer (Jha, 2009). Conventional radiotherapy may affect tissues adjacent to the tumour, including at least part of the oral cavity (Perez *et al.,* 1997). The orofacial tissue of dental significance that may be affected by head and neck radiotherapy are the salivary glands, mucous membranes, taste buds, bone and teeth. Oral complications including salivary glandular tissue damage, xerostomia, radiation mucositis, dysgeusia and opportunistic infections are observed during treatment. Alveolar bone is 1.8 times as dense as soft tissues and therefore absorbs a larger portion of radiation than a comparable volume of soft tissue. Ionising radiation causes the vascular channels with in irradiated fields to narrow, diminishing the blood flow through the area; the bone virtually becomes non-vital tissue (Nectarios Andrews, 2001). Ewing *et al.* 1926 observed the formation of sclerotic connective tissue in the marrow cavity, obliterative endarteritis and periarteritis (Ewing, 1926). It is now well accepted that radiation causes endothelial cell death, hyalinisation and thrombosis and obliteration of vessels. Periosteum becomes fibrotic, osteoblasts and osteocytes necrose and marrow spaces fibrose. The result is that tissue becomes hypocellular, hypovascular and hypoxic compared with non-irradiated tissue (Marx, 1983). Ionising radiation to head and neck region can cause a change in the quality and quantity of saliva, alterations in mucosal quality and reduced barrier function, change in the vascularity and oxygenation of bone and shifts in the oral microflorawith overgrowth of commensal organisms. The side effects include xerostomia, oral micorflora changes, nutritional compromise, anorexia and malaise, bone complications, trismus and oedema (Brown *et al.,* 1975). Periodontal infection may exacerbate during cancer therapy and result in pain and

* ***Corresponding author:*** **Dr. Grishmi A. Niswade,**
Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur, India.

infection which affects the morbidity and mortality of patients undergoing radiation therapy. Pre treatment examination and treatment, patient motivation for maintenance of oral hygiene has shown to be effective in prevention of complications during radiation therapy. The purpose of this study was to determine the potential impact of head and neck radiation therapy on the periodontal health status.

MATERIALS AND METHODS

The present study is an observational, cross sectional study in which a consecutive sample of 81 patients was recruited from the Department of Radiotherapy and Oncology, Government Medical College and Hospital from August 2014 to October 2014. Eighty – one dentate patients with malignant neoplasia in the head and neck region were included. Patients were divided into two groups. The Test group comprised of 41 patients who were undergoing radiation therapy for malignant neoplasia in head and neck region. The Control group comprised of 40 patients with malignant neoplasia in the head and neck region who reported for the first time to the hospital OPD. All participants gave written informed consent and the Ethics Committee approved the study. Radiotherapy alone or adjuvant to surgery or chemotherapy consisted of external radiation by megavolts, following the conventional scheme of high dose fractions. The possibility of oral complications and need for dental care during and after radiation treatment was explained. After periodontal evaluation, patients were referred to Government Dental College for periodontal, endodontic or restorative procedures. Patients were examined after radiation therapy in the Test group and after admission to the OPD and proper diagnosis in the Control group. The following clinical parameters were evaluated- probing pocket depth (PPD) – distance from the free gingival margin to the apical depth of periodontal probe tip penetration, clinical attachment level (CAL) - distance from the cemento-enamel junction (CEJ) to the base of the probeable crevice and Gingival recession (GR) – distance from the CEJ to the free gingival margin when the gingival margin was located on the root. For sites where the gingival margin was on the crown, GR was scored as zero. Oral hygiene conditions were identified by the Oral hygiene index- Simplified. In both the groups, six surfaces were examined on all teeth using William's Graduated periodontal probe (Hu Freidy™). Data collection was carried out by computing the mean in millimetres for each tooth, from the six probed sites. The sum of the means of each tooth was divided by the number of examined teeth to obtain the mean of the parameter for each patient. The means of each patient were added together and divided by the number of patients to determine the mean of the parameter in the test group as well as the control group. These data were submitted for statistical analysis to determine any association between the variables was done using a statistical software program using paired T-test. *P* values ≤ 0.05 were considered statistically significant.

RESULTS

The present study consisted of totally 81 patients (43 males and 38 females) with a mean age of 45.66 years. The tumor site in the study population is shown in [Figure 1]. Majority (27.59%) of the patients had tongue malignancy. Table 1, Table 2 Table 3 represents Probing Depth, Clinical attachment loss and oral hygiene index-Simplified. It was found there exist a statistical difference between test and control group ($p<0.005$) among all the measured variables.

Table 1. Probing Pocket Depth (PPD)

Group	N	Mean	Std error	Std dev	P value
Test	41	16.2	0.35	1.1	
Control	40	13.7	0.35	1.1	0.001*

Values are mean ± standard deviation unless otherwise indicated. PPD, probing pocket depth; SD, standard deviation; S, significant; NS, not significant.

Table 2. Clinical Attachment Loss (CAL)

Group	N	Mean	Std error	Std dev	P value
Test	41	17.3	0.41	1.3	0.001*
Control	40	14.8	0.27	0.87	

Values are mean ± standard deviation unless otherwise indicated. CAL, Clinical Attachment Level; SD, standard deviation; S, significant; NS, not significant.

Table 3. Oral hygiene Index –Simplified (OHI-S)

Group	N	Mean	Stderror	Std dev	P value
Test	41	2.8	0.11	0.37	0.001*
Control	40	2.9	0.10	0.34	

Values are mean ± standard deviation unless otherwise indicated. PPD, probing pocket depth; OHI-S : Oral hygiene index simplifid; SD, standard deviation; S, significant; NS, not significant.

DISCUSSION

Head and neck cancer is a major form of cancer in India, accounting for 23% of all cancers in males and 6% in females; Depending upon the sub-site of origin and the clinical extent of the disease the 5 -year survival varies from 20% to 90% (Mehrotra *et al.,* 2005). The three most common modalities used in head and neck cancer treatment are surgical resection, radiotherapy and chemotherapy, either used singly or in combination. While these modalities are effective in eliminating the tumor, they also adverselyaffect the normal head and neck structures surrounding the tumor. Radiation therapy has cytotoxic effects on both normal cells and malignant cells. Direct damage to the oral structures (soft and hard tissue) commonly occurs from radioand chemotherapy, and indirect damage may also occur from systemic toxicity. These oral complications may arise during and following cancer treatment and are commonly grouped into two broad categories: acute and chronic (Hancock *et al.,* 2003). The reported acute oral complications are mucositis, xerostomia, dysphagia, dysguisia, and opportunistic infections, and chronic complications such as trismus, irradiation caries, osteoradionecrosis, and changes in periodontal attachment. Radiation treatment induces obliterative endarteritis that results in the soft tissue ischemia and fibrosis while the irradiated bone becomes hypovascular and hypoxic (Marx, 1983). The periodontium is sensitive to the effect of radiation at high doses. Diminished vascularity and cellularity of the periodontal ligament membrane with widening of periodontal space, thickening, rupturing, and disorientation of Sharpey′s fibers have been reported (Silverman and Chierici, 1965). The direct and indirect effect of high-dose radiotherapy (RT) on the periodontium results in greater risk of periodontal attachment loss and tooth loss and greater risk for the development of osteoradionecrosis (Yusof and Bakri, 1993). The extensive periodontal destruction may occur in the absence of good oral

hygiene. Periodontitis in patients scheduled for head and neck radiotherapy results in acute and chronic complications such as osteoradionecrosis. Maintenance of good oral hygiene in patients undergoing radiotherapy may reduce morbidity of the known oral and periodontal side effects. Patient stated to receive the head and neck radiation therapy need dental consultation at the earliest possible time. Pre-irradiation treatment depends on patient prognosis, compliance, and residual dentition, in addition to fields, ports, dose and, immediacy of radiotherapy. The loss of integrity of the gingival crevicular tissues, as a result of periodontitis and radiotherapy induced thinning of these tissues together with xerostomia, mucositis, altered diet, and poor oral hygiene that often follow high-dose radiotherapy to the jaws, can create oral problems that affect the quality of life, which can cause interruption to cancer therapy (Marx and Johnson, 1987). The periodontal blood vessels are affected by radiation leading to widening of periodontal ligament space and destruction of bony trabeculae which may result in increased risk of periodontal disease and altered healing with diminished capacity for bone remodeling and repair (Epstein *et al.,* 1994). Lloryet al. in 1972 showed a radiation-induced downshift of periopathogens (Llory *et al*., 1972). Leung et al 1998reported that due to radiation-induced hypo-salivation and a concomitant increase in plaque accumulation there is a shift in oral micro flora, andrisk of periodontal infection is also increased (Leung *et al.,* 1998). Schwarz *et al* in 1999 found a greater number of shallow periodontal pockets in radiated patients. The reduced probing pocket depth does not indicate the histological pocket depth since the probe generally penetrates coronal level of junctional epithelium due to inflammation of underlying connective tissue or may be due to disparity between probing technique, probing force, or angle of insertion of the probe (Schwarz *et al.,* 1999). Studies by Epstein (Epstein, 2001) and Yusuf and Bakri (Yusof, 1993) showed that direct and indirect effects of high dose of radiotherapy on periodontium resulted in increased attachment loss. Marx *et al.* in 1987 reported that generally increasing the doses of irradiation above 7000 rads carries the risk and severity of osteoradionecrosis (Marx and Johnson, 1987). Marciani *et al.* in 1992 reported that dosage can indicate potential irradiation injury (Marciani and Ownby, 1992).

Smaller irradiation doses administered at higher dose rates may be more injurious than higher doses dispensed at lower dose rates. Marques *et al.* in 2004 stated thatradiotherapy canadd to a greater or lesser degree to progression of attachment loss (Marques and Dib, 2004). Oral mucositis is the most distressing of all the complications following head and neck radiotherapy. Damage to oral mucosa is in ten selyassociated with radiation dose, fraction size, and volume of irradiated tissue, fraternization scheme, and type of ionizingradiation. The severe mucosal reaction to radiotherapy is a result of mitotic death of epithelial cells, since the cell cycle time of the basal keratinocytes is about 4 days. There is an increased clinical attachment loss observed after radiotherapywhich may be due to changes invascularity and cellularity of periodontal ligament and hypovascular, hypocellular, and hypoxic changes in alveolar bone and also due to altered immune response. In the absence of good oral hygiene rampant periodontal destruction may occur which can be manifested as loss of attachment suggesting progression of periodontal disease. This may lead to dentinal sensitivity and root caries which negatively affects the quality of life of the individuals. For a patient about to undergo tumoricidal radiotherapy for malignancy in the maxillofacial region, diseases of teeth and supporting structures are a worrisome finding because oral pain and infections are common and possibly severe sequelae to radiotherapy for head and neck tumors in patients with healthy mouth. Oral hygiene maintenance measures can give better outcome in maintenance of periodontal health during and after radiotherapy. Furthermore, dental treatment should be aimed at improving the oral hygiene status of patients through professional dental care. Patients should be constantly motivated toward maintaining a meticulous oral hygiene status before, during and after radiotherapy to prevent and control the oral and periodontal sequelae. The periodontist is an important member in the oncological team as increased oral hygiene maintenance can lead to reduction in post-radiation complications of periodontium.

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