International Journal of Medical Science in Clinical Research and Review
Online ISSN: 2581-8945
Available Online at http://www.ijmscrr.in Volume 05|Issue 05 (September-October)|2022|Page: 926-930

Original Research Article

Influence of External Pin Fixation Combined With Hyperbaric Oxygen Therapy In Stage 3 Osteoradionecrosis: A Case Series

Authors

[1]Dr. Mahima Choudhary ; MDS
3rd year Post-Graduate Resident, Department of Oral and Maxillofacial Surgery, Mahatma Gandhi Dental College and Hospital, Jaipur, India

[2]Dr. Vikas Kunwar Singh ; MDS
Professor and Head of Department of Oral and Maxillofacial Surgery, Mahatma Gandhi Dental College and Hospital, Jaipur, India

[3]Dr. Ruchika Tiwari ; MDS
Professor, Department of Oral and Maxillofacial Surgery, Mahatma Gandhi Dental College and Hospital, Jaipur, India

[4]Dr. Gaurang Thanvi ; MDS
Senior Lecturer, Department of Oral and Maxillofacial Surgery, Mahatma Gandhi Dental College and Hospital, Jaipur, India

[5]Dr. Rahul Gupta ; MDS
3rd year Post-Graduate Resident, Department of Oral and Maxillofacial Surgery, Mahatma Gandhi Dental College and Hospital, Jaipur, India

[6]Dr. Tamanna Jamwal ; MDS
3rd year Post-Graduate Resident, Department of Oral and Maxillofacial Surgery, Mahatma Gandhi Dental College and Hospital, Jaipur, India

Corresponding Author: Dr. Mahima Choudhary, 3rd year Post-Graduate Resident, Department of Oral and Maxillofacial Surgery, Mahatma Gandhi Dental College and Hospital, Jaipur, Rajasthan, India

Article Received: 02-09-2022 **Revised:** 19-09-2022 **Accepted:** 09-10-2022

ABSTRACT:

Introduction- Osteoradionecrosis is a common complication in head and neck cancer patients undergoing radiotherapy. Hyperbaric oxygen therapy is an effective treatment used in osteoradionecrosis patients accomplished by having the patient breathe 100% oxygen in a pressure-tolerant chamber pressurized at 2.4 atmospheres absolute for 1 hour. External fixation is a minimally invasive procedure of splinting and stablilizing the mandible using pin fixation. ***Materials and Methods-*** This prospective study was conducted at Mahatma Gandhi Dental Hospital, Jaipur, India from 2020-2022 to determine the influence of external pin fixation combined with hyperbaric oxygen therapy in stage 3 osteoradionecrosis patients. 8 patients were included in the study. Wound healing was the primary outcome of the study and its evaluation was documented after completion of hyperbaric oxygen therapy and at 6 months on the basis of complete soft tissue coverage to bone without any evidence of infection, inflammation or fistula. ***Results-*** After completion of hyperbaric oxygen therapy, external pin fixation combined with therapy has positive effect on wound healing with high success rate in stage 3 osteoradionecrosis patients with 62.5% patients showing complete healing and 37.5% patients showing incomplete healing. At 6 months follow-up, 87.5% patients showed complete healing and 12.5% patients showed incomplete healing.

KEYWORDS: Radiotherapy, Pathological Fracture, Prophylactic, Wound Healing, Osteoradionecrosis Staging Clinical Presentation Management

INTRODUCTION:

Osteoradionecrosis (ORN) is a common complication in head and neck cancer patients undergoing radiotherapy.[1] Due to the relatively increased bone density, decreased vascularity of the mandible and greater dosage of radiation received, osteoradionecrosis is more common in the mandible than in the maxilla. Clinically, osteoradionecrosis may present as pain, exposed necrotic bone, oro-cutaneous fistula, pathological fracture and suppuration.[2] Ionizing radiation used in radiation therapy has adverse effects on soft and hard tissues. Damaged soft tissues cause progressive endarteritis, hyalinization, and fibrosis leading to ischemia of affected tissues. Similarly, these events in bone lead to destruction of local vascular systems and cellular components resulting in decreased osteocytes and osteoblasts, fibrosis formation and decreased bone remodeling eventually leading to bone necrosis.[1] The histopathological evidences suggested the radiation-induced obliteration of the inferior

alveolar artery as a major factor in the onset of osteoradionecrosis.[3] Radiation, trauma and infection is the most frequently seen sequence in osteoradionecrosis.[4] The wound healing is affected by osteoradionecrosis in the following pathologic sequence- hypovascularization, hypocellularization, tissue hypoxia resulting in tissue breakdown and nonhealing wound.[3] Hyperbaric oxygen therapy (HBOT) is an effective and established treatment protocol used in osteoradionecrosis patients which is accomplished by having the patient breathe 100% oxygen through a tight-fitting mask, hood, or endotracheal tube in a pressure-tolerant chamber, either alone in a monoplace chamber, or with more than one patient or a therapist in a multiple chamber which is pressurized at 2.4 atmospheres absolute and, depending on the protocol, patients remain inside the chamber for 1 hour.[2,5] HBOT is aimed at increasing the blood to tissue oxygen gradient to enhance the diffusion of oxygen into the tissues.[5] This leads to neo-vascularization in hypoxic areas by increasing fibroblastic activity and capillary growth.[6] External fixation is a minimally invasive procedure of splinting and stablilizing the mandible using pin fixation in the cases such as pathological fractures in osteoradionecrosis, comminuted fractures, osteomyelitis, tumors or excision of large cysts.[7,8] It can also be used in children for the stabilization of injuries.[9]

MATERIALS AND METHODS:

This prospective study was conducted at Mahatma Gandhi Dental Hospital, Jaipur, India from 2020 to 2022 to determine the influence of external pin fixation combined with hyperbaric oxygen therapy in stage 3 osteoradionecrosis patients (Table 1). 8 patients were included in the study, out of which 6 were male patients and 2 were female patients. Patients belonged to the age group 40-65 years.

Table 1: Jenwitheesuk criteria for staging of ORN patients[1]

Stages of Osteoradionecrosis	Signs and Symptoms
Stage 1	Asymptomatic exposed bone
Stage 2	Exposed bone with associated symptoms- pain, soft tissue inflammation, or infection
Stage 3	Stage 2 + sequestrum, pathological fracture, or oro-cutaneous fistula

The inclusion criteria for the study were stage 3 ORN patients (Table 1), written and informed consent provided and compliance with the treatment regimen whereas the exclusion criteria for the study were age less than 18 years, denial to participate, pregnant or nursing patients, immuno-compromised patients. For all the patients, medical history, physical examination, and orthopantomogram (OPG) radiograph were performed and written informed consent for publication of their clinical details and/or clinical images was obtained from the patients. External pin fixator (Figure 1) was applied for all the patients to achieve stabilisation and better healing and the armamentarium used for the external pin fixation has been shown in Figure 2.

Fig. 1 External pin fixator placed in the patient

Fig. 2 Armamentarium used in the external pin fixation

For the Hyperbaric Oxygen Therapy, patients were given 30 dives after the external pin fixation daily at 2.4 atmospheres absolute for 90 min in a monoplace chamber. The wound healing was the primary outcome of the study and its evaluation was documented after completion of HBO therapy and at 6 months. Lesion was defined as 'healed' when there was complete soft tissue coverage to bone without any evidence of infection, inflammation or fistula and 'non-healed' when there was incomplete soft tissue coverage to bone along with any evidence of infection, inflammation or fistula.

RESULTS:

A total no. of 8 patients with stage 3 osteoradionecrosis were included in this study. Both sexes were included in the study, 6 were males (75%) and 2 were females (25%). (Figure 3)

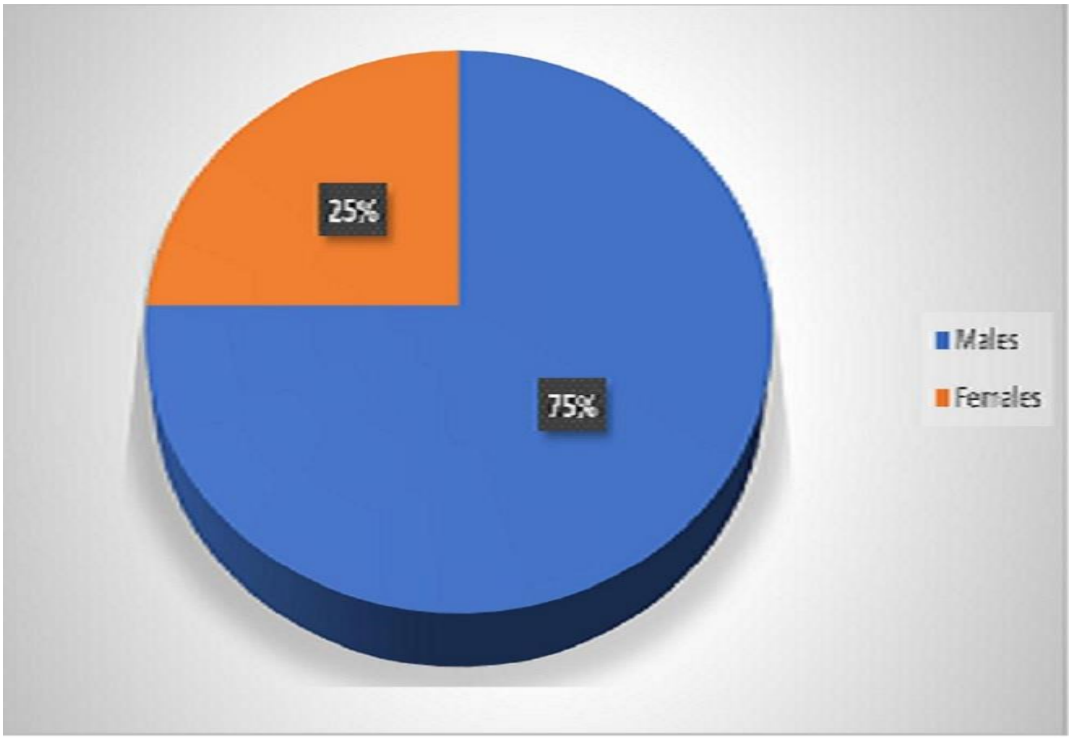

Fig. 3 Gender Distribution

After completion of HBO therapy, the results revealed positive effect of external pin fixation combined with therapy on wound healing in stage 3 osteoradionecrosis patients with 5 patients showing complete healing (62.5%) and 3 patients showing incomplete healing (37.5%). At 6 months follow-up, 7 patients showed complete healing (87.5%) and 1 patient showed incomplete healing (12.5%). (Figure 4)

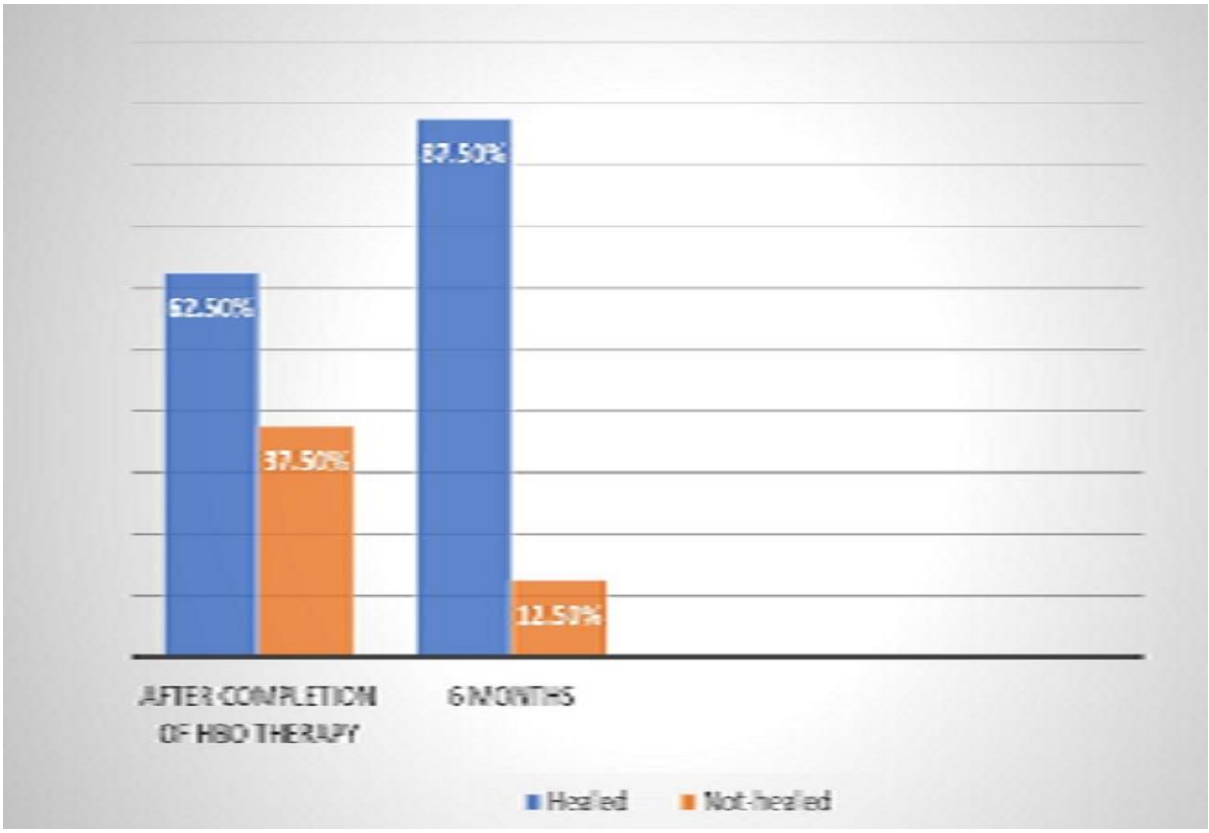

Fig. 4 Wound healing in stage 3 osteoradionecrosis patients treated with external pin fixation combined with Hyperbaric Oxygen Therapy after completion of HBO Therapy and at 6 months follow-up

No significant complications were seen in the patients.

DISCUSSION:

Osteoradionecrosis has been recognized as a common consequence seen in the patients of head and neck cancer who underwent the radiation therapy since the early 1900s.[10] 8 patients of stage 3 osteoradionecrosis included in this study were treated with external pin fixation followed by HBO therapy to determine its effect on wound healing. Patients showed positive response to the treatment resulting in complete healing in 62.5% patients on completion of HBO therapy and in 87.5% patients at 6 months follow-up. No significant complications were seen in the patients. Mahdian concluded in his study that along with enabling the wound healing in the osteoradionecrosis patients, external fixation successfully prevents the complications in the patients.[11] Shaw suggested HBO therapy as a prophylactic treatment to prevent the unfavorable outcomes of ORN before any combination of surgery.[12] Vudiniabola concluded that HBO therapy was the effective treatment in stage 1 patients and proposed that the stage 1 patients can be successfully managed conservatively with HBO therapy alone.[13] Jenwitheesuk in his study stated the efficacy of adjunctive HBO therapy in 84 osteoradionecrosis patients and reported its significant role in enhancing the wound healing.[1] Although, there is a controversy about using the HBO therapy in overt osteoradionecrosis. Annane inferred that HBO therapy didn't show beneficial effect on patients with overt osteoradionecrosis and also recommended not using HBO therapy to treat severe form of osteoradionecrosis.[14]

CONCLUSION:

Hyperbaric oxygen therapy is an effective and established treatment protocol used in

osteoradionecrosis patients. In our study, we combined hyperbaric oxygen therapy with external pin fixation in stage 3 osteoradionecrosis patients. This study revealed a high success rate of HBOT combined with external pin fixation for stabilisation of mandible and enhancing the wound healing in the patients without any significant complications.

FUNDING:
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST:
The authors declare that they have no conflict of interest.

This study was approved as an 'exempt study' by the Ethical Board of the Mahatma Gandhi Hospital. The patients were informed about the study and necessary consent was taken from the concerned personnel.

REFERENCES

1. Jenwitheesuk, K., Mahakkanukrauh, A., Punjaruk, W., Jenwitheesuk, K., Chowchuen, B., Jinaporntham, S., ... & Limrattanapimpa, P. (2018). Efficacy of adjunctive hyperbaric oxygen therapy in osteoradionecrosis. *BioResearch open access*, *7*(1), 145-149.
2. David, L. A., Sàndor, G. K., Evans, A. W., & Brown, D. H. (2001). Hyperbaric oxygen therapy and mandibular osteoradionecrosis: a retrospective study and analysis of treatment outcomes. *JOURNAL-CANADIAN DENTAL ASSOCIATION*, *67*(7), 384-385.
3. Aitasalo, K., Niinikoski, J., Grénman, R., & Virolainen, E. (1998). A modified protocol for early treatment of osteomyelitis and osteoradionecrosis of the mandible. *Head & Neck: Journal for the Sciences and Specialties of the Head and Neck*, *20*(5), 411-417.
4. Mainous, E. G., & Hart, G. B. (1975). Osteoradionecrosis of the mandible: Treatment with hyperbaric oxygen. *Archives of Otolaryngology*, *101*(3), 173-177.
5. Fattore, L., & Strauss, R. A. (1987). Hyperbaric oxygen in the treatment of osteoradionecrosis: a review of its use and efficacy. *Oral surgery, oral medicine, oral pathology*, *63*(3), 280-286.
6. Sahni, T., Hukku, S., Jain, M., Prasad, A., Prasad, R., & Singh, K. (2004). Recent advances in hyperbaric oxygen therapy. *Med Update*, *14*, 632-9.
7. Van Camp, P., Gemels, B., Heijsters, G., & Schepers, S. (2018). Case report of maxillofacial fracture in a patient under bisphosphonates in the absence of ONJ disease: Guidelines?. *International journal of surgery case reports*, *51*, 318-322.
8. Cornelius, C. P., Augustin, J. B., & Sailer, L. K. (2009). External pin fixation for stabilization of the mandible—comeback of a method: historical review and first experiences with the 'mandible external fixator'. *Oral and maxillofacial surgery*, *13*(1), 1-14.
9. Cascone, P., Marcozzi, M. M., Ramieri, V., Bosco, G., Vellone, V., & Spallaccia, F. (2017). Mandibular condylar fractures in children: morphofunctional results after treatment with external fixation. *Journal of Craniofacial Surgery*, *28*(7), 1742-1745.
10. Mounsey, R. A., Brown, D. H., O'Dwyer, T. P., Gullane, P. J., & Koch, G. H. (1993). Role of hyperbaric oxygen therapy in the management of mandibular osteoradionecrosis. *The Laryngoscope*, *103*(6), 605-608.
11. Mahdian, N., Onderková, A., Brizman, E., Pavlíková, G., Vlachopulos, V., Drahoš, M., & Foltán, R. (2020). External fixation greatly improves outcomes in the surgical treatment of osteoradionecrosis of the jaws without affecting quality of life: a five-year retrospective study. *British Journal of Oral and Maxillofacial Surgery*, *58*(9), e45-e50.
12. Shaw, R. J., & Butterworth, C. (2011). Hyperbaric oxygen in the management of late radiation injury to the head and neck. Part II: prevention. *British Journal of Oral and Maxillofacial Surgery*, *49*(1), 9-13.
13. Vudiniabola, S., Pirone, C., Williamson, J., & Goss, A. N. (2000). Hyperbaric oxygen in the therapeutic management of osteoradionecrosis of the facial bones. *International journal of oral and maxillofacial surgery*, *29*(6), 435-438.
14. Annane, D., Depondt, J., Aubert, P., Villart, M., Géhanno, P., Gajdos, P., & Chevret, S. (2004). Hyperbaric oxygen therapy for radionecrosis of the jaw: a randomized, placebo-controlled, double-blind trial from the ORN96 study group. *Journal of clinical oncology*, *22*(24), 4893-4900.