



The effect of using clove oil on oral mucositis healing among patients undergoing chemotherapy: A randomized control trial

Omnia Abd Ressen¹ and Fatma Makee Mahmood^{2*}

¹Academic Nurse, Ministry of Health/ Holly Karbala Health Directorate, and ²Dep. of Adult Nursing, College of Nursing, University of Karbala, Iraq.

***Corresponding author:** fatima.makki@uokerbala.edu.iq

Received: November 25th 2022; Accepted: January 17th 2023

Abstract

Almost all patients receiving high doses of chemotherapy (CT) experience chemotherapy-induced oral mucositis (CIOM), which causes the mucosal lining of the mouth to atrophy and break down, resulting in ulcers. Oral mucositis (OM) occurs in about 40 percent of patients with cancer who undergoing CT. Twenty patients undergoing CT they were diagnosed with OM were randomly enrolled in this true experimental study to determine the effect of using clove oil on OM healing. The study was conducted at Imam Al-Hussein Oncology Center and the oncology wards of Imam Al-Hassan Al-Mujtaba Teaching Hospital. The data were collected through the interviewing technique using WHO oral toxicity scale and OM assessment tool and then analyzed by using the program SPSS Version 25, both descriptive statistical analysis and inferential statistical analysis were used to analyze the study results. A total of 40% of patients had grade II and III oral toxicity at the pre-test period, after seven days of using the clove oil the result shows that 80% of patients are at grade I OM. Concerning the control group, 40% of patients have grade III OM when starting collecting data, but after seven days 60% of patients are at grade (IV), and there are significant statistical differences between pre and post seven days ($p=0.025$). In conclusions, mouth care using clove oil is potent and effective in decreasing the grade of OM and promoting OM healing of patients undergoing CT. The implementation of mouth care using clove oil is significantly enhancing and promotes OM healing and reduces OM grade. Recommendations: Further and future studies on a large sample size are needed for the evaluation of the efficacy of clove oil for their regular use in OM care to determine their effect on the healing level and grade of OM.

Keywords: Clove Oil, Oral Mucositis, Chemotherapy.

Introduction

Cancer is considered an important global issue that from which about eight million people die each year. According to the International Agency for Research on Cancer reported that 7.6 million worldwide deaths were attributed to cancer. The estimated number of new cases each year is 12.7 million. Only developing nations accounted for 63 percent of cancer-related deaths, suggesting that developing nations have a higher risk of developing the disease (Abbas and Rehman, 2018).

Since 1999, cancer has exceeded the cardiovascular diseases as the top cause of death for people below 85 years old when deaths were counted by the age (Motalebnejad, et al., 2008). According to the Iraqi Ministry of Health/ Environment Annual Statistical Report, (2020), there is a high number of patients receiving CT for cancer treatment in Iraq. Cancer represents the top ten causes of death in Iraq, which

includes malignant neoplasms as the seventh cause of death in Iraq with a percentage of 5.8%. Furthermore, the malignant neoplasms are determined as the top ten causes of death for males in Iraq, which includes malignant neoplasms of digestive organs.

The most common methods for the treatment of cancer is CT. This therapy has a number of adverse effects, despite being used to enhance the patient's quality of life. Patients suffer from morbidity and death as a result of severe adverse responses brought on by this treatment. Additionally, it contributes to affected patient's economic status (Naidu, et al., 2004). The term "chemotherapy" refers to the use of chemicals to suppress cancerous cells or disease-causing pathogens or microorganisms without significantly damaging the host cells (Alam, et al., 2018).

Inflammation of the oral mucosa brought on by CT seen in 40%–80% of patients, was first referred to as OM in late 1980. OM is currently regarded as the most important non-hematological adverse effect of cancer treatment (Chaveli and Bagán, 2016). Almost all patients receiving high doses of CT experience CIOM, which causes the mucosal lining of the mouth to atrophy and break down, resulting in ulcers. OM occurs in about 40 percent of patients with cancer who undergoing CT (Saldanha and Almeida, 2014). These patients will enter the hospitals and about 19 percent of them will suffer from delay in antitumor treatment especially for high-degree OM treatment, and this result in decrease quality of life, bad prognosis, and high patient treatment budget (Pulito, et al., 2020).

Typically, OM appears seven days following CT administration and resolves within 21 days. Pain due to OM is the most frequent side event mentioned by patients undergoing CT. Patients' quality of life is reduced by pain, which also makes it difficult to chew, swallow, and communicate. It also negatively impacts the patient's ability to eat properly, which results in nutritional deficiencies and therefore results in weight loss (Avci and Sari, 2019). Significant morbidity rates occur as a result of OM associated with cancer therapy. Oral mucositis patients experience problems in chewing, difficulties in maintenance of oral care, and good nutrition and have bad effects on quality of life regarding oral health, also they may suffer great pain and have an increased risk of infections (Ariyawardana, 2019).

Many therapeutic agents are available for OM management such as anti-inflammatory agents, benzydamine hydrochloride rinse, and oral decontamination but there is still no actually proven treatment, also many of these agents have side effects and require high cost. As a result, research on naturally occurring medicines is underway to target the therapy in a more economical way and decrease OM morbidity with fewer adverse effects than manufactured pharmaceuticals. Additionally, these herbal agents are widely accessible without a prescription, enabling individuals to take them without any supporting data from science (Nagi, et al., 2018). The natural products do not cause severe side effects and are well accepted by patients. Furthermore, they can significantly affect different pathways of cellular signaling according to their chemical structure and thus affecting the pathogenesis of OM at several levels, as well as negatively affecting cancer cells activities. Substantially, different herbal or natural compounds

have been examined and others are under tests (Pulito, et al., 2020).

The clove oil is utilized in the fragrance and flavoring sectors as well as in the treatment of illness and the promotion of healing through topical application. The United States Food and Drug Administration have classified clove oil as a product that is generally recognized as safe. Numerous pharmacological and biological benefits of clove essential oil include antioxidant, anti-fungicidal, anti-carcinogenic, anesthetic, and antiprotozoal actions (Xu, et al., 2016). Clove oil is considered the best-known herbal product used to obtain topical teeth pain relief. Good quality clove produces about 15–25% of volatile oil that has both antiseptic and local analgesic properties and these occur as a result of a number of phenolic substances that are presented in the oil, the most important one of which is eugenol, constituting 85% of the total. Furthermore, clove oil is used in mouthwashes, in concentrations of 1–5%, for its antiseptic effects (Awang, 2009). Several studies have found that the chemicals in clove-based herbal mouthwash had anti-inflammatory properties in both in vitro and in vivo settings (Kong, 2016).

Material and Methods

A true-experimental design was conducted in Kerbala Holy City at Imam Al-Hussein Oncology Center and the oncology wards of Imam Al-Hassan Al-Mujtaba teaching hospital. A 20 patients diagnosed with OM were randomly enrolled in the present study to determine the effect of using clove oil on OM healing among patients undergoing CT. A probability (Systematic random) sampling method was used to select the study sample which consists of 20 patients distributed as follow: 10 patients were participated as an experimental group for clove oil and 10 patients as a control group.

The instrument used in this study consists of three parts, the first part is concerned with the patient's socio-demographic characteristics and clinical data, the second part is used to detect the degree of OM by using Oral Toxicity Scale that was developed by the World Health Organization (WHO), (1979), and the third part concerned with Oral Mucositis Assessment Tool which is developed by Cancer Institute of New South Wales (NSW), (2019) in order to collect data through face-to-face interviews.

Before starting the clove oil interventional protocol, medical history and oral cavity history were obtained from each patient and the oral swab was taken from the patient's oral cavity and sent to the laboratory for cultivation. All patients were clinically evaluated at two separated time intervals: firstly, before

starting the intervention protocol, and the second time after seven days from the beginning of intervention protocol. This interventional protocol is designed to include how to relieve the severity and facilitate the healing process of OM by using clove oil.

Oral swab was taken from all patients in both experimental group (clove oil group), and in the control group before starting interventional protocol in order to confirm OM by the presence of bacterial or fungal infection. During the period of the clove oil interventional protocol, which consists of seven days, the researchers were followed up the patients three times per day and reminded them to adhere to the steps of mouth care using clove oil interventional protocol and to the instructions attached to the protocol (Appendix A), this was done through phone by establishing communication group through social media sites, which include (WhatsApp and Telegram) and was named as clove oil experimental group. Also, patients who did not have social media sites were followed up using the telephonic (SIM-Card) communication.

Clove oil mouth care was considered as in-house-adopted protocol and all patients in this group were instructed to adhere to the correct method of the steps of the interventional protocol using clove oil, as well as to adhere to the list of instructions attached with the steps, in order to make the interventional protocol successfully. The gargling procedure was prepared according to a standardized method and was administered as a topical method to the mouth and in a similar amount, dosage form and duration for all patients in the experimental group and under the supervision of the researchers.

The gargling procedure was included putting two to three drops of clove oil into the small single-use container and diluting clove oil by adding one-fourth to one-half teaspoonful of olive oil to the container. After that, mixing these oils using disposable spoon and then saturate a single-use cotton swab in the oil mixture. After cotton swab saturation, placing it on the painful and inflamed areas of the mouth for 10 seconds, and then gargling with about 20 to 30 ml of distilled water using a disposable cup for 30 seconds and spit out it. These steps were repeated three times daily after each meal (Nivetha, et al., 2014, and Basch, et al., 2008). The steps of the interventional protocol were firstly applied by researchers in front of the patients and their relatives, in order to practically teach them how to apply the correct steps and to ensure that no errors will be occur in the steps when the patients starting

mouth care using the clove oil. All patients in the control group were assigned to thorough oral cavity assessment to identify any problems not related to OM and were clinically evaluated at two separate time intervals: firstly, when interviewing the patients and the second time after seven days from the first evaluation.

The relevant data were collected by using the interviewing technique by the researchers, and then analyzed by using IBM Statistical Package of Social Sciences (SPSS) Version 25 Program, and the statistical procedures that used were include: Chi square test (χ^2) to study the relationship between the demographic characteristics of patients in both study groups, Frequency (f.), mean of score (MS), standard deviation (SD), percentage (%), Marginal Homogeneity Test (MH) to study the differences between the grade of oral OM and mucositis pre and post applying the procedure in both groups, and Kendal-Tau test (τ) to study the differences between the study groups pre and post applying the procedure.

Table (2) reveals that the distribution of patients undergoing CT according to the OM degrees at pre and post self-administered interventional protocol using clove oil, 40% of patients have grade II and III OM before applying clove oil, but after being given intervention for seven days 80% of patients are at grade (I), and there are significant statistical differences between pre and post applying clove oil ($P=0.003$). Therefore, the application of clove oil significantly reduces the degree of OM and enhances OM healing in patients receiving CT, as symptoms were absent in the majority of patients after applying it.

Table (3) reveals that the distribution of patients undergoing CT according to the OM degrees in control group, 40% of patients have grade III OM when starting collecting data, but after seven days 60% of patients at grade (IV), and there are significant statistical differences between pre and post seven days ($p=0.025$). Therefore, not using clove oil mouth care significantly increases the degree of OM and reduces OM healing in patients receiving CT.

Table (4) reveals no significant statistical differences ($P=0.725$, $P=0.573$) in OM degree between clove oil and control group before using clove oil, but after seven days there are significant statistical differences ($P=0.000$, $P=0.000$) between both groups in favor the clove oil group. Therefore, clove oil cures and enhance healing of OM much more than not using it.

Results and Discussion

As shown in Table (1): the distribution of experimental and control groups according to their

socio-demographic characteristics and duration of CT.

Table (1): Distribution of experimental and control groups according to their socio-demographic characteristics and duration of CT.

Variables		Experimental (clove oil) group		Control group	
		f.	%	N	%
Age (years)	20-30	2	20.0	1	10.0
	31-40	3	30.0	5	50.0
	41-50	4	40.0	2	20.0
	>50	1	10.0	2	20.0
Gender	Male	5	50.0	4	40.0
	Female	5	50.0	6	60.0
Marital status	Single	2	20.0	1	10.0
	Married	8	80.0	7	70.0
	Divorced	0	0.0	1	10.0
	Widowed	0	0.0	1	10.0
Educational levels	Read and write	1	10.0	2	20.0
	Primary	4	40.0	1	10.0
	Middle school	1	10.0	4	40.0
	Secondary	3	30.0	2	20.0
	University or above	1	10.0	1	10.0
Smoking	Current smoker	0	0.0	1	10.0
	Previous smoker	3	30.0	5	50.0
	Never smoked	7	70.0	4	40.0
Duration of chemotherapy	< 4 months	4	40.0	6	60.0
	4 – 8 months	5	50.0	1	10.0
	8 – 12 months	0	0.0	2	20.0
	≥12 months	1	1.0	1	10.0

Table (2): Comparison degree of OM pre and post the application of clove oil.

Oral Mucositis Grade	Clove Oil				MH/p
	pre		post		
	f	%	f	%	
I	0	0	8	80	2.921 0.003**
II	4	40	2	20	
III	4	40	0	0	
IV	2	20	0	0	
V	0	0	0	0	
M±SD	2.8 ± 0.789		1.2 ± 0.422		

MH: Marginal Homogeneity Test, **: p value ≤0.01.

Table (3): Comparison degree of OM at pre and post the first measurement in the control group.

Oral Mucositis Grade	Control group				MH/p
	Pre		post		
	f	%	f	%	
I	0	0	0	0	2.236 0.025*
II	3	30	1	10	
III	4	40	3	30	
IV	3	30	6	60	
V	0	0	0	0	
M±SD	3 ± 0.817		3.5 ± 0.707		

MH: Marginal Homogeneity Test, * p value ≤0.05.

Table (4): Comparison degree of OM between clove oil group and control group at pre and post the application of clove oil.

Oral Mucositis Grade	pre					post				
	Clove Oil		Control group		τ p	Clove Oil		Control group		τ p
	f	%	f	%		f	%	f	%	
I	0	0	0	0	0.122 0.725	8	80	0	0	0.825 0.000**
II	4	40	3	30		2	20	1	10	
III	4	40	4	40		0	0	3	30	
IV	2	20	3	30		0	0	6	60	
V	0	0	0	0		0	0	0	0	
M±SD	2.8 ± 0.789		3 ± 0.817		U/p 43/ 0.573	1.2 ± 0.422		3.5 ± 0.707		U/p 1/ 0.000**

1/ 0.000**, τ: Kendal-Tau test, U; Mann-whitney test, **: p value ≤0.01.

Oral mucositis is considered from the most common complications of CT as it occurs after the integrity of mucous membrane was broken. Consequently, a wide variety of side effects will occur as a result of CIOM such as discomfort, severe pain, difficulty swallowing, malnutrition, loss of body weight, and dehydration. Different interventional protocols have been developed to treat and prevent OM. Therefore, a safe, potent, and simple protocol is necessary to be established for the treatment and prevention of this problem. It is possible to improve OM healing through adopting self-administered protocol using clove oil because the severity of OM is significantly related to oral hygiene. No adverse effects were reported from patients of both groups.

As shown in table (2) the results represent that 40% of patients had grade II and III OM at the pre-test period of using of clove oil, after seven days of using the it the result in this table show that 80% of patients are at grade I OM, and there is a significant statistical difference of OM before and after applying the clove oil at p-value of 0.003. Therefore, the

application of clove oil was significantly reducing the degree of OM and enhances OM healing among patients undergoing CT, symptoms of OM have disappeared for the majority of patients after applying mouth care by using clove oil, these results come along with the result of the study that was conducted by Kong, et al., (2016) reported that clove-based herbal mouthwash significantly shortened the duration of grade ≥2 OM. It also showed that the use of clove-based herbal mouthwash shortened the duration of grade 3 OM and reduced the incidence of grade 3 OM. Therefore, from the researchers' opinion, the application of clove oil significantly reduces the degree of OM in CT patients, as symptoms were absent in the majority of patients after applying it as shown in figure (1), the researchers attribute the reason of the current study results to the clove oil effectively on stopping the growth of different types of bacteria and fungi and relieving oral pain, also it has antioxidant and antiseptic activity toward oral pathogens.



Figure (1) comparison of oral mucositis before and after the application of clove oil.

Regarding OM degrees for the control group, the result of table (3) indicates that 40% of patients had grade III OM at the pre-test period, after seven days the result show that 60% of patients at grade IV, and there is a significant statistical difference between the pre-test and post-test at p-value of 0.025, the result of the study that was conducted by Kartın, et al., (2014) stated that 14 patients in the control group developed grade I OM in the second week but just two patients in the intervention group developed grade I OM ($p < 0.05$). Also, one patient in the intervention group while six patients in the control group developed grade IV OM ($p < 0.001$) by the seventh week. The researchers attribute the

cause of this result of the present study to not using clove oil mouth care which significantly increases the degree and prolong the healing of OM among patients undergoing CT, the result of the study that was conducted by Yavuz and Yılmaz, (2015) which assigned the samples to a control group at the first step and the results showed a statistically significant difference between the degree of OM in the control group, it was reported that both the degree of OM and pain levels decreased when patients regularly performed mouth care.

Finally, regarding comparison degree of OM between clove oil group and control group, table (4) shows that there are no statistically significant

differences at p-value of 0.725, at p-value of 0.573 in OM degree between clove oil and control group before using clove oil, but after seven days of using it there are significant statistical differences at p-value of 0.000, at p-value of 0.000 between both groups in favor the clove oil group. Therefore, clove oil cures enhance healing of OM much more than not using it. Gupta and Prakash, (2021) stated in their study that clove oil was active against both groups of bacteria (oral pathogens) and fungi, thus clove oil was proved to be more effective. Also, they stated that clove oil was proved to be a much better antagonistic agent, exhibiting wide range of antimicrobial activity against the microbes causing oral or dental problems, and that it had antifungal effect. This findings also agreed with the study that was conducted by Kartir, et al., (2014) reported that oral mucositis severity was lower in the experimental groups that receiving oral care protocol compared to the control group, also the result of their study demonstrates that OM rate may be reduced with the application of oral care protocol. Agrawal et al., (2014) reported in their study that clove oil shows antimicrobial activity and this suggests its usage as an adjuvant to oral cavity therapy. It acts as an antioxidant and anti-inflammatory agent at low concentrations. Clove oil is an important herbal medication which has a variety of different uses like antifungal, antioxidant, antiviral, anti-inflammatory, antibacterial, antipyretic, analgesic, antimycotic, antiulcerogenic, and a wide variety of uses. Therefore, the researchers attribute the reason for significant OM healing when using clove oil compared to the control group to many of the chemical properties in the composition of cloves that accelerate the healing process and facilitate wound healing. Thus, clove oil cure OM much more than not using it.

Conclusion and Recommendation

This study concludes that using clove oil in mouth care is powerful and effective method for decreasing OM grade and enhancing their healing, therefore it is providing comfort to patients undergoing CT, the study emphasized that there are no significant statistical differences in healing levels of OM related to any of the socio-demographic and clinical data. The study recommended the necessary to provide regular and continuous instructions for patients undergoing CT to improve their oral care using simple and natural plant products of clove oil, further and future studies should be done on a larger sample size to investigate the efficacy of clove oil for their regular use in the OM care and to

determine its effect on the healing level and grade of OM. Furthermore, Nursing staff must give additional focus on the prevention of OM, early diagnosis, managing it when it occurs, decreasing and preventing oral infection related to OM, and patient education regarding oral care. Also, it is preferred to be adopted for the daily use of toothpaste that can help to decrease the overall burden of OM complications and treatment budget for both patients and the hospital.

Acknowledgments

Great thanks to the Research Ethics Committee in College of Nursing/ University of Kerbala for research advice and guidance, also the deepest thankfulness to the Kerbala Health Directorate/ Imam Al-Hussein Oncology Center and Imam Al-Hassan Al-Mujtaba teaching hospital staff especially those in oncology wards for their cooperation and assistance in supporting this study. Furthermore, special thanks to all the patients who participated in this study whether volunteers in the experimental group or participants in the control group.

Financial disclosure: No financial support.

Conflict of interest

No adverse effects were reported from patients of both groups and no one was harmed during the conduction of the study.

Ethical clearance

This study was done after obtaining the approval of the intervention on patients when reviewing it by the Ethical Committee of College of Nursing/ University of Kerbala.

References

- Abbas, Z., & Rehman, S. (2018). An overview of cancer treatment modalities. *Neoplasm*, 1, 139-157. Retrieved from: <http://dx.doi.org/10.5772/intechopen.76558>.
- Agrawal, M., Agrawal, S., Rastogi, R., Singh, P., Adyanthaya, B., & Gupta, H. (2014). A review on uses of clove in oral and general health. *Indian Journal of Research in Pharmacy and Biotechnology*, 2(4), 1321. Retrieved from [https://www.ijrpb.com/issues/Volume%20_Issue%204/ijrpb%20\(4\)%2016%20Mayank%20Agrawal%201321-1324.pdf](https://www.ijrpb.com/issues/Volume%20_Issue%204/ijrpb%20(4)%2016%20Mayank%20Agrawal%201321-1324.pdf).
- Alam, A., Farooq, U., Singh, R., Dubey, V., Kumar, S., Kumari, R., ... & Dhar, K. (2018). Chemotherapy treatment and strategy schemes: A review. *Open Access J Toxicol*, 2(5), 555600. Retrieved from: <http://DOI:10.19080/OAJT.2018.02.555600>.

- Ariyawardana, A., Cheng, K., Kandwal, A., Tilly, V., Al-Azri, A., Galiti, D., ... & Elad, S. (2019). Systematic review of anti-inflammatory agents for the management of oral mucositis in cancer patients and clinical practice guidelines. *Supportive Care in Cancer*, 27(10), 3985-3995. Retrieved from: <https://doi.org/10.1007/s00520-019-04888-w>.
- Avci, S., & Sari, H. (2019). Effect of an evidence-based nursing intervention on the diagnosis of oral mucositis in the pediatric stem cell transplant unit. *Asia-Pacific Journal of Oncology Nursing*, 6(3), 292-299. Retrieved from: https://doi.org/10.4103/apjon.apjon_5_19.
- Awang, D. (2009). *Tyler's herbs of choice: the therapeutic use of phytomedicinals*. CRC Press. Retrieved from: <https://perpus.univpancasila.ac.id/repository/EBUPT181142.pdf>.
- Basch, E., Gasparyan, A., Giese, N., Hashmi, S., Miranda, M., Sollars, D., ... & Weissner, W. (2008). Clove (*Eugenia aromatica*) and clove oil (eugenol). Natural standard monograph (www.naturalstandard.com) copyright© 2008. *Journal of Dietary Supplements*, 5(2), 117-146. Retrieved from: DOI: 10.1080/19390210802335391.
- Cancer Institute NSW, 2019. Version 5. Retrieved from: <https://www.eviq.org.au/clinical-resources/assessment-tools/10-oral-mucositis-assessment-tool>.
- Chaveli-López, B., & Bagán-Sebastián, J. (2016). Treatment of oral mucositis due to chemotherapy. *Journal of clinical and experimental dentistry*, 8(2), e201. Retrieved from: <https://doi.org/10.4317%2Fjced.52917>.
- Gupta, C., & Prakash, D. (2021). Comparative Study of the Antimicrobial Activity of Clove Oil and Clove Extract on Oral Pathogens. Retrieved from: DOI: 10.17140/DOJ-6-144.
- Iraqi Ministry of Health/ Environment Annual Statistical Report. 2020.
- Kartin, P., TAŞCI, S., Soyuer, S., & Elmali, F. (2014). Effect of an oral mucositis protocol on quality of life of patients with head and neck cancer treated with radiation therapy. *Clinical Journal of Oncology Nursing*, 18(6). Retrieved from: <http://doi.org/10.1188/14.cjon.e118-e125>.
- Kong, M., Hwang, D., Yoon, S., & Kim, J. (2016). The effect of clove-based herbal mouthwash on radiation-induced oral mucositis in patients with head and neck cancer: a single-blind randomized preliminary study. *OncoTargets and therapy*, 9, 4533. Retrieved from: <https://doi.org/10.2147%2FOTT.S108769>.
- Motallebnejad, M., Akram, S., Moghadamnia, A., Moulana, Z., & Omid, S. (2008). The effect of topical application of pure honey on radiation-induced mucositis: a randomized clinical trial. *J contemp dent pract*, 9(3), 40-47. Retrieved from: <https://pubmed.ncbi.nlm.nih.gov/18335118/>.
- Nagi, R., Patil, D. J., Rakesh, N., Jain, S., & Sahu, S. (2018). Natural agents in the management of oral mucositis in cancer patients-systematic review. *Journal of Oral Biology and Craniofacial Research*, 8(3), 245-254. Retrieved from: <https://doi.org/10.1016/j.jobcr.2017.12.003>.
- Naidu, M., Ramana, G., Rani, P., Suman, A., & Roy, P. (2004). Chemotherapy-induced and/or radiation therapy-induced oral mucositis-complicating the treatment of cancer. *Neoplasia*, 6(5), 423-431. Retrieved from: <https://doi.org/10.1593/neo.04169>.
- Nivetha, R., Murthykumar, K., Ashwin, K., Kumar, N., & Priyadarshini, R. (2014). Effects of natural products on oral health: A review. *Asian J Pharm Clin Res*, 7(5), 279-282. Retrieved from: <https://doi.org/10.1111/scd.12358>.
- Pulito, C., Cristaudo, A., Porta, C. L., Zapperi, S., Blandino, G., Morrone, A., & Strano, S. (2020). Oral mucositis: the hidden side of cancer therapy. *Journal of experimental & clinical cancer research*, 39(1), 1-15. Retrieved from: <https://doi.org/10.1186/s13046-020-01715-7>.
- Saldanha, S., & Almeida, V. (2014). A comparative study to assess the effectiveness of turmeric mouth wash versus saline mouth wash on treatment induced oral mucositis (Tiom) in a selected hospital at Mangalore. *Journal of Clinical Research & Bioethics*, 5(6), 1. Retrieved from: DOI: 10.4172/2155-9627.1000200.
- World Health Organization. (1979). WHO handbook for reporting results of cancer treatment. World Health Organization. Retrieved from: https://apps.who.int/iris/bitstream/handle/10665/37200/WHO_OFFSET_48.pdf?sequence=1.
- Xu, J., Liu, T., Hu, Q., & Cao, X. M. (2016). Chemical composition, antibacterial properties and mechanism of action of essential oil from clove buds against *Staphylococcus aureus*. *Molecules*, 21(9), 1194. Retrieved from: <https://doi.org/10.3390/molecules21091194>.
- Yavuz, B., & Bal Yılmaz, H. (2015). Investigation of the effects of planned mouth care education on the degree of oral mucositis in pediatric

oncology patients. Journal of Pediatric Oncology Nursing, 32(1), 47-56. Retrieved from:

<https://doi.org/10.1177%2F1043454214554011>.

Appendix:

Instructions to be adhered:

1. Any medications or mouthwash solutions for oral mucositis were not allowed in the study groups.
2. All patients were also instructed to maintain good oral hygiene and clean their teeth with a soft toothbrush three times a day (after every meal). They were also advised to replace their toothbrush regularly to minimize the risk of infection.
3. All patients were advised to maintain adequate oral fluid intake and diet and received pretreatment dietary counseling which include avoid mouth irritants like alcohol and tobacco, spicy foods and rough or crunchy foods because they may damage the mucosal lining or gums which may exacerbate the problem.
4. Avoid eating, drinking, or smoking for at least (30) minutes after using the gargling procedure.