

Plaque control efficacy: Interdental brushes versus dental floss

ABSTRACT:

Aims: In this study, we compared plaque control efficacy between interdental brushes & dental floss for the prevention of periodontal disease (gingivitis). We also investigated the convenient method for plaque control among these two interdental cleaning methods in routine.

Study design: Randomized clinical trial

Place and Duration of Study: Department of Periodontology at Fatima Jinnah Dental College and Hospital, Karachi, Pakistan from Jan 2019 to July 2020.

Methodology: The sample size of 180 was calculated using OpenEpi software each group (Interdental brush & Dental floss) carried 90 patients respectively at 95% confidence interval and 80% power of the test. Probability sampling technique was used. The Clinical trial was registered at ClinicalTrial.gov (Identifier: NCT05439785). Ethical approval was taken from the Ethical Review Committee of Ziauddin University(1130519MSOM). SPSS version 20 was used to analyze the study data. P-value ≤ 0.05 was considered as significant.

Results: The statistical results showed significant improvement in the plaque score and bleeding index among patients pre and post intervention ($p < 0.001$). Moreover, this study stated that interdental brush was slightly better in reducing interproximal plaque accumulation in patients of gingivitis ($p < 0.001$). The symptom of bleeding from the gingival tissue was also improved by using both interdental cleaning methods. The posterior region appeared to be a difficult site to use both the intervention (interdental brushes or dental floss). Both interdental cleaning methods assisted in the improvement of other symptoms like sensitivity, halitosis, and food impaction in the patients.

Conclusion: The findings of our research revealed that both interdental cleaning methods had a statistically significant effect in removing interdental plaque, with little variation in plaque removal seen between interdental brush and dental floss when compared to baseline. This study endorses better outcome of interdental brush in reducing dental plaque accumulation than dental floss in the gingivitis patients.

Keywords: Gingival bleeding on probing, dental plaque, dental plaque index, oral hygiene, dental floss

1. INTRODUCTION

World Health Organization (WHO) periodontal health is defined as “a condition free from inflammatory periodontal disease that permits an individual to function normally and not undergo any consequences (mental or physical) of underlying inflammatory disease”¹. Periodontal disease (PD) is an inflammatory condition of the soft and hard supporting tissues of the teeth which initially begin as gingival inflammation (gingivitis)². Gingivitis is defined as

“an inflammation of the gums”. It initiates when polymicrobial plaque collects on the tooth surface as a result of inappropriate tooth brushing³. Gingivitis can be reported with halitosis and painless gingival bleeding, either spontaneously or on brushing teeth⁴. In Contrast to periodontitis, there is no clinical attachment loss and junctional epithelium does not migrate apically and condition only involves soft-tissue area of the gingival epithelium and connective tissue⁵.

Multiple factors have been associated with the initiation of gingival inflammation and gingivitis⁶. Dental plaque and calculus, overhanging restorations, tooth anatomic factors, dental prosthesis and malocclusion⁷. Dental plaque is the most common risk factor which is defined as “collection of microorganisms found on a tooth surface as a biofilm, embedded in a matrix of polymers of host and bacterial origin”⁵. Microbial species typically involved in gingivitis are Streptococcus sp., Fusobacterium sp., Actinomyces sp., Veillonella sp., Treponema sp., and a few others⁸. The bacteria in the heavy accumulated plaque on the tooth surface will then penetrate the gingival tissue, particularly the gingival sulcus, and cause the inflammation of marginal gingiva⁹.

If gingival inflammation is treated timely, it may hinder the progression of the gingivitis and become periodontitis by inhibiting the destruction of underlying periodontal tissues¹⁰. This can be possible if a patient maintains good oral hygiene and eradicates the accumulation of interdental plaque¹¹. It is essential to brush the teeth regularly in order to prevent initiation and progression of gum diseases. It is required to mechanically remove biofilms from interdental areas by special means to keep periodontal tissues healthy¹². There are many effective interdental cleaning methods used to remove plaque, amongst which conventional tooth brushing with proper technique, interdental brushes, dental floss, water picks, and oral rinses are worthy³.

Recently, the emphasis in dentistry has been shifted from intervention to prevention⁵. However, changing dynamics in maintaining oral health and oral hygiene is a complex task⁹. The cleaning of the interproximal areas is regarded as particularly critical because of insufficient space available for cleaning with the use of conventional tooth brushing alone¹⁰. The association between interproximal oral hygiene (IOH) practices and reduction in plaque mechanism has been under investigations¹³. However, evidence about the most efficient means of interdental tooth cleaning remains ambiguous¹¹⁻¹⁴. In this study, we compared plaque control efficacy between interdental brushes & dental floss for the prevention of periodontal disease (gingivitis). We also investigated the convenient method for plaque control among these two interdental cleaning methods in routine.

2. MATERIAL AND METHODS

This was a randomized clinical trial conducted in the Department of Periodontology at Fatima Jinnah Dental College and Hospital, Karachi from January 2019 to July 2020. The sample size of 164 was calculated using OpenEpi software which was rounded off to 180, with each group (Interdental brush & Dental floss) carrying 90 patients respectively at 95% confidence interval and 80% power of the test¹³. Probability sampling technique was used. . The Clinical trial was registered at ClinicalTrial.gov (Identifier: NCT05439785). Figure 1 shows consolidated standards of reporting trials (CONSORT). Ethical approval was taken from the Ethical Review Committee (ERC) of Ziauddin University Karachi, according to the Institutional guidelines (reference code: 1130519MSOM). An informed consent was taken from the patients or attendant of the patient after explaining the purpose of study. All patients with gingivitis above 18 years to 50 were included in the study. Patients of both genders were included. As we only included gingivitis cases, we had to include dentition with

tight contacts and gingiva occupying 75% of the embrasure. Those who were excluded were refused to participate, using medications; had systemic problems such as, rheumatic fever, hepatic, renal diseases or diabetes mellitus; patients undergoing orthodontic treatment; pregnant women; habitual of Eating Pan/Gutka/Betel nut/smokers.

A standardized Pro-forma was prepared for data collection. Data was obtained from patients about age, gender, educational status, brushing habits, brush type and dental visit. Using the "coin toss method" the patient was selected either for interdental brush or dental floss group through "random allocation". Heads was denoted as interdental brushing, while tails indicated flossing. The coin toss and allocation procedure was carried out by the researcher's colleagues. This method facilitated to ensure that the researcher was unaware or blinded of the treatment modality being provided to the patient beforehand. We didn't endorse any particular brand of dental floss or interdental brush. We prescribed them to purchase any brand of dental floss or interdental brush. When they bought it, a video of interdental brush or dental floss was shown to respective group participants so they had a clear understanding of how to use the prescribed interdental cleaning aid.

After two weeks the patient was contacted via telephone and oral hygiene instructions were reinforced and the patient was motivated to continue practicing good oral hygiene methods. At the six week follow up, patients were re-evaluated by using plaque disclosing tablets to disclose plaque score and index. The bleeding and plaque scores were rechecked and the differences were recorded. Plaque disclosing tablets were used to disclose plaque and bleeding scores which were recorded using Silness and Loe (1964) and O'Leary et al (1972) plaque score/indexes. "O'Leary et al plaque index (PI) records the presence of supragingival plaque on all four tooth surfaces precisely". "Silness&Loe plaque index ascertains the thickness of plaque along the gingival margin". Bleeding score index was measured before mechanical debridement (scaling root planing). "Ainamo Bay 1975 bleeding index assessed all four surfaces of teeth with regards to whether probing elicits bleeding (+) or not (-)".

SPSS version 20 was used to analyze the study data. P-value ≤ 0.05 was considered as significant. The mean/standard deviation for quantitative data and frequency/percentage for qualitative variables were analyzed. To compare the efficacy of plaque control between two interventions (dental floss and interdental brushes) was measured through paired "t" tests. ANOVA test was applied to find association of age and gender with both interventions. Paired "t" test was used to compare the presence of halitosis, sensitivity and food impaction before and after the given interventions.

3. RESULTS AND DISCUSSION

In the study, there were a total of 90 patients recruited in each group. In group 1 (Interdental brush) out of 90, 77 patients turned up on the follow-up visit but remaining 13 patients didn't show-up and were unable to be contacted. Out of 13, 9 patients were male and 4 females. In group 2 (Interdental floss) out of 90, 74 patients turned up however 16 patients didn't come for the follow-up visits. Out of 16 lost patients, 5 were male and 11 females. The mean age of study participants was 32.32 ± 9.5 and 29.04 ± 9.5 in the first and second group respectively. Most of the patients presented with gingival inflammation belonged to the second and third decade of life.

In addition to conventional tooth brushing for the plaque control on the surfaces of teeth, an interdental cleaning method should be implemented to remove microbial plaque from interproximal areas where normal toothbrushes can't reach easily¹⁵. In this study, we found that interdental cleaning methods (interdental brush and dental floss) in conjunction with conventional brushing appeared to be more effective in reducing plaque from interdental

areas table 1. The improvement in post-intervention plaque score, which was statistically significant ($p < 0.001$), indicates that females use interdental brushes more consistently than males. Contrarily, men found using dental floss to be more convenient than women ($p < 0.001$). In both groups, there was no statistically significant improvement was found in the post-bleeding score in both genders after using interventions. After using the respective interdental cleaning aid, patients in their second and third decade of life showed a marked betterment in plaque scores ($p < 0.001$) and bleeding scores (IB $p = 0.02/DF$ $p = 0.001$). This may indicate that the people who fall in this age group visit dental clinics less and are unable to maintain their good oral hygiene.

Interdental cleaning methods (ICM) are less likely used by the ordinary people in routine, may be due to the technique sensitivity, lack of awareness, cost or fear of trauma to the oral soft tissue^{16, 17}. In this study, we compared the efficacy of only two interdental devices (interdental brush and dental floss) so that patients can buy it at a reasonable price and we trained them to use it competently. Some of the studies found interdental brush more effective than dental floss in reducing plaque deposits^{18, 19}. Our study endorses the similar outcome that interdental brush was slightly better in reducing plaque from interproximal areas in gingivitis patients.

A study conducted by Rasines G.J concluded that the interdental brush displayed promising results in reducing pocket depth and bleeding index than dental floss in the patients²⁰. However, bleeding score was improved with both interdental cleaning aids efficiently in this study. Other studies also suggested that interdental brush combined with toothbrushes is more effective at removing plaque from embrasures than brushing of the teeth alone or tooth brushing combined with dental flossing²¹. In this respect, our study also showed slightly higher efficacy of interdental brush in removing interproximal biofilm matrix in comparison to dental floss with daily use of tooth brushing practices.

According to our research data most of the study participants in both the groups brush their teeth once a day (average 65.5%) especially before meals. The study statistics displayed that most of the study participants in either group don't have a clear understanding of toothbrush type and usually use medium-bristled toothbrushes (average 59.5%) for longer duration which was further aggravating their preexisting condition of gingivitis. Majority of the study participants of both the groups mentioned that they were having dental scaling for the first time due to lack of knowledge (pie-chart 1). Also, stated that they do not use any adjunct oral hygiene aids other than conventional brushing.

The most distressing symptom results due to gingival inflammation or recession is the presence of tooth sensitivity^{3, 21}. This issue makes patients restless and unable to eat, drink cold beverages or brush teeth properly²². In this study, there were 48% patients in group 1 and 73% patients in group 2 presented with the complaint of sensitivity due to periodontal disease. The result showed that in both the study groups, the pre and post data analysis of sensitivity demonstrated a noticeable improvement in this symptom among the patients ($p < 0.001$, 0.006). There was not a major difference in the improvement of sensitivity issue among the patients of both the groups (Interdental brush and dental floss). Both interventions were found to be efficient in resolving sensitivity issues among the patients of gingivitis.

Halitosis (bad breath) is a chronic symptom which cannot be resolved only with mints, mouthwash or regular brushing²³. In contrast to "morning breath" or a strong smell that lingers after a food, halitosis stays for a long period of time and may indicate a sign of something more alarming³. In the study groups, the pre and post data analysis of halitosis showed a marked improvement in the symptom among both the groups of patients ($p < 0.001$,

0.019) table 2. However, in group 2 (Dental floss) 17.2% patients reported no improvement in halitosis but this symptom was improved among all the patients after using interdental brush. We can conclude that interdental brush was more effective in cleaning plaque from the interproximal areas which ultimately resolved the issue of halitosis among the patients of gingivitis.

Food impaction is the manifestation of deficient proximal contact between teeth, and interdental floss was recommended to remove the adherent food particles from the spaces²⁴. Both the interventions had facilitated the reduction of the impaction of food particles in the interproximal spaces with statistically significant results ($p < 0.001$). The concern of food impaction between teeth was well solved by using interdental brush in all the patients. However, 13.5% patients in the study group 2 (dental floss) still presented with the same problem on the follow up visit even using the dental floss the entire month. These adjuvants, when added to traditional oral hygiene, have been demonstrated to increase biofilm control during periodontal maintenance therapy (PMT), resulting in better periodontal status maintenance^{25, 26}.

UNDER PEER REVIEW

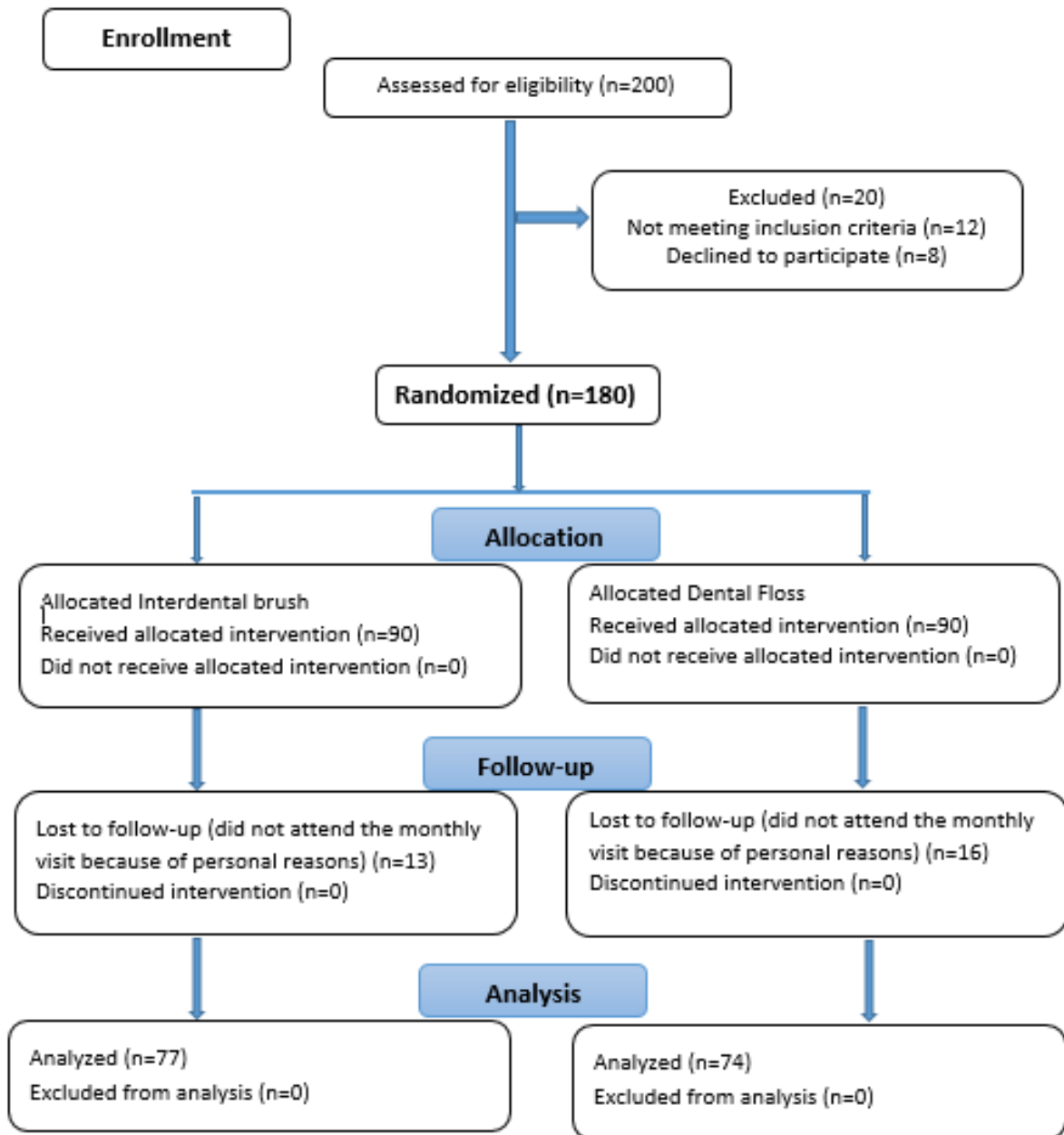


FIGURE 1: Shows study consolidated standards of reporting trials(CONSORT)

TABLE 1: Analysis of means and standard deviations of the pre and post plaque and bleeding score of the interdental cleaning method (Group 1 Interdental Brush/ Group 2 Dental Floss)

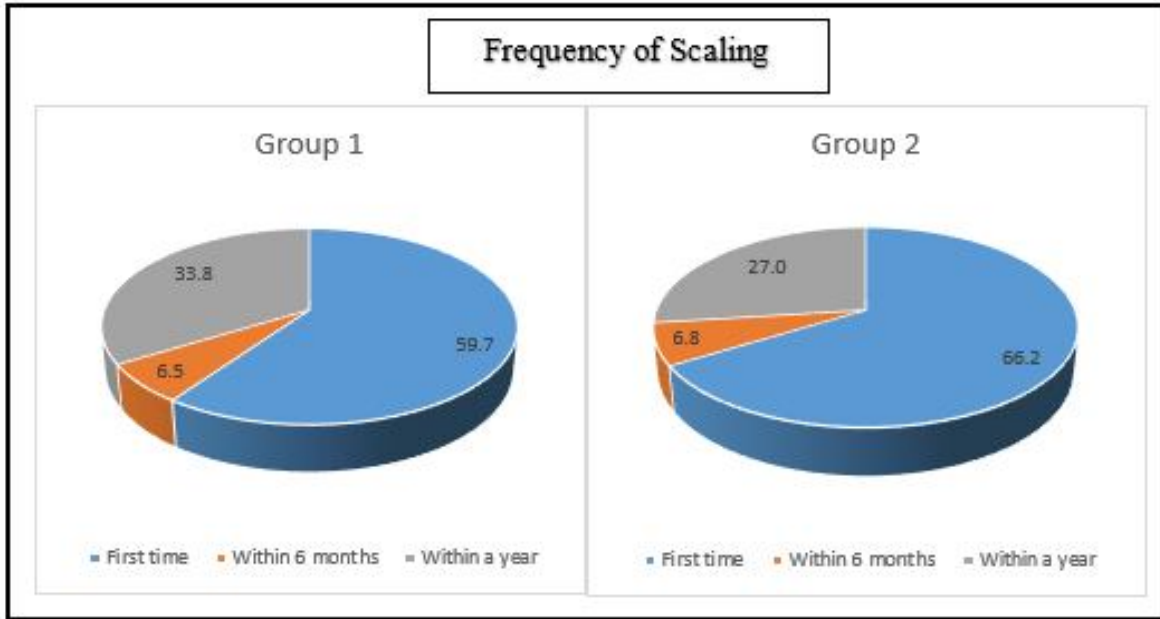
GROUPS	S:No	VARIABLES	Mean	Std. Deviation	Minimum	Maximum	p-value
Group 1 Interdental Brush	PLAQUE SCORE						
	1	Pre-intervention	55.7383	14.64	24.77	91	<0.001*
		Post intervention	34.5966	14.03	16.36	73	
	BLEEDING INDEX						
	2	Pre-intervention	46.4131	14.26	20.34	84.25	<0.001*
		Post-intervention	30.13	10.5	14.32	69.65	
Group 2 Dental Floss	PLAQUE SCORE						
	1	Pre-intervention	66.22	14.6	35	90.21	<0.001*
		Post-intervention	35.03	14.0	11.69	61	
	BLEEDING INDEX						
	2	Pre-intervention	41.34	14.2	19.64	69.64	<0.001*
		Post-intervention	23.37	10.5	8	54.50	

*p-value <0.05 is considered to be statistically significant

TABLE 2: Evaluation of oral symptoms such as sensitivity, halitosis and food impaction pre and post intervention in group 1 (Interdental brush) through paired t-test.

GROUPS	S:No	VARIABLES	YES	NO	IMPROVED	p-value
Group 1 Interdental Brush	SENSITIVITY					
	1	Pre-intervention	37 (48.1%)	40 (51.9%)	-	<0.001*
		Post-intervention	16 (20.8%)	40 (51.9%)	21 (27.3%)	
	HALITOSIS					
	2	Pre-intervention	26 (33.8%)	51 (66.2%)	-	<0.001*
		Post-intervention	0 (0%)	51 (66.2%)	26 (33.8%)	
	FOOD IMPACTION					
	3	Pre-intervention	26 (33.8%)	51 (66.2%)	-	<0.001*
		Post-intervention	0 (0%)	51 (66.2%)	26 (33.8%)	
Group 2 Dental Floss	SENSITIVITY					
	1	Pre-intervention	54 (73%)	20 (27%)	-	<0.006*
		Post-intervention	15 (20.3%)	20 (27%)	39 (52.7%)	
	HALITOSIS					
	2	Pre-intervention	29 (39.2%)	45 (60.8%)	-	<0.019*
		Post-intervention	5 (6.7%)	45 (60.8%)	24 (32.4%)	
	FOOD IMPACTION					
	3	Pre-intervention	54 (73%)	20 (27%)	-	<0.001*
		Post-intervention	10 (13.5%)	20 (27%)	44 (59.5%)	

*p-value <0.05 is considered to be statistically significant



PIE-CHART 1: Frequency of Scaling among study participants

4. CONCLUSION

In the study, we have received good patients' compliance and effective use of interdental cleaning methods (interdental brush and dental floss). The findings of our study revealed that both interdental cleaning methods had a significant effect in removing interdental plaque, with little variation in plaque removal seen between interdental brush and dental floss when compared to baseline. This study endorses better outcome of interdental brush in reducing dental plaque inter-proximally than dental floss in the gingivitis patients. Interdental brush was observed to be more comfortable and effective to use in routine but technique sensitive in comparison to dental floss.

CONSENT

"All authors declare that 'written informed consent was obtained from the patient. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal."

ETHICAL APPROVAL

Ethical approval was taken from the Ethical Review Committee (ERC) of Ziauddin University Karachi, according to the institutional guidelines (reference code: 1130519MSOM)

"All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

REFERENCES

1. Lang NP, Bartold PM. Periodontal health. *J Periodontol.* 2018; 98(1): 9-16.
2. Hujoel, P.P. & Lingström, P. J. J. O. C. P. Nutrition, dental caries and periodontal disease: a narrative review. *J. Clin. Periodontol.* 2017; 44(18): 79-S84.
3. De Vries K. Gingivitis. *Australian Journal of Pharmacy.* Vol. 96. Australian Pharmaceutical Publishing Company Ltd; 2015: pp. 64–7.
4. Trombelli L, Farina R, Silva CO, Tatakis DN. Plaque-induced gingivitis: Case definition and diagnostic considerations. *J. Periodontol.* 2018 89(1): 46-73.
5. Newman and Carranza's *Clinical Periodontology*, 13th Edition - May 29, 2018, Austin O'Saben: eBook ISBN: 9780323533232
6. Murakami S, Mealey BL, Mariotti A, Chapple ILC. Dental plaque-induced gingival conditions. *J. Periodontol.* 2018; 89(1): 17-27.
7. Mostafa, B., & El-Refai, I. Prevalence of Plaque-Induced Gingivitis in a Sample of the Adult Egyptian Population. *Open access Maced. J. Med. Sci.* 2018; 6(3): 554–58.
8. Patini R, Staderini E, Lajolo C, et al. Relationship between oral microbiota and periodontal disease: a systematic review. *Eur Rev Med Pharmacol Sci.* 2018; 22(18): 5775-88.
9. Sälzer, S., Slot, D. E., Van der Weijden, F. A. & Dörfer, C. E. Efficacy of inter-dental mechanical plaque control in managing gingivitis – a meta-review. *J. Clin. Periodontol.* 2015; 42(16): 92-105.
10. Poklepovic, T, Worthington, H. V., Johnson, T. M., et al. Interdental brushing for the prevention and control of periodontal diseases and dental caries in adults. 2013a *Cochrane Database Syst. Rev.* Cd009857.
11. Uysal, O., Ustaoğlu, G., Behçet, M., Albayrak, O. & Tunalı, M. Applying nano-ha in addition to scaling and root planing increases clinical attachment gain. *J periodontal implant sci.* 2021; 51 e41:1-17.
12. Tonetti MS, Eickholz P, Loos BG, et al. Principles in prevention of periodontal diseases: consensus report of group 1 of the 11th European Workshop on Periodontology on Effective Prevention of Periodontal and Peri-Implant Diseases. *J. Clin. Periodontol.* 2015; 42(16): 5–11.
13. Soldani, F. A., Lamont, T., Jones, K., et al. One-to-one oral hygiene advice provided in a dental setting for oral health. *Cochrane database syst. rev.* 2018; 10, cd007447.
14. Imai, P. H., Yu, X. & Macdonald, D. Comparison of interdental brush to dental floss for reduction of clinical parameters of periodontal disease: a systematic review. *Can. J. Dent. Hyg.* 2012; 46.

15. Kotsakis GA, Lian Q, Ioannou AL, Michalowicz BS, et al. A network meta-analysis of interproximal oral hygiene methods in the reduction of clinical indices of inflammation. *J. Periodontol.* 2018; 89(5):558-570.
16. Gallie A. Home use of interdental cleaning devices and tooth brushing and their role in disease prevention. *J. Evid. Based Dent. pract.* 2019; 20(4):103-104.
17. Koregol AC et al. Interdental cleaning where we stand today: a questionnaire study. *Int J Community Med Public Health.* 2022; 9(6):2508-12.
18. Ng, E., & Lim, L. P. An Overview of Different Interdental Cleaning Aids and Their Effectiveness. *Dent. J.* 2019; 7(2), 56.
19. Larsen, H., Slot, D., Van Zoelen, C., Barendregt, D. & Van Der Weijden, G. The effectiveness of conically shaped compared with cylindrically shaped interdental brushes – a randomized controlled clinical trial. *Int. J. Dent. Hyg.* 2017a; 15(3), 211-218.
20. Rasines, G. J. E.-B. D. 2019. The use of interdental brushes along with toothbrushing removes most plaque. *J. Evid. Based Dent. Pract.* 2019; 10, 74, <https://doi.org/10.1038/sj.ebd.6400666>.
21. Marchesan, J., Morelli, T., Moss, K., et al. Interdental cleaning is associated with decreased oral disease prevalence. *J. Dent. Res.* 2018; 97(7), 773-78.
22. Papapanou PN, Sanz M, Buduneli N, et al. Periodontitis: Consensus report of workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *J. Periodontol.* 2018; 89(1):173-82.
23. Deepak, S., Nivedhitha, M. J. J. O. A. P. E. Proximal contact tightness between two different restorative materials—An in vitro study. *J. Adv. Pharm. Res.* 2017; 7(2): 153-55.
24. Slot, D., Dorfer, C. & Van Der Weijden, G. The efficacy of interdental brushes on plaque and parameters of periodontal inflammation: a systematic review. *Int. J. Dent. Hyg.* 2008; 6(4): 253-64.
25. Crocombe LA, Brennan DS, Slade GD, Loc DO. Is self-interdental cleaning associated with dental plaque levels, dental calculus, gingivitis and periodontal disease? *J. Periodontal. Res.* 2012; 47(2):188–197.
26. Costa, F. O., Costa, A. A. & Cota, L. O. M. J. J. O. P. The use of interdental brushes or oral irrigators as adjuvants to conventional oral hygiene associated with recurrence of periodontitis in periodontal maintenance therapy: A 6 year prospective study. *J-Global.* 2020; 91(1), 26-36.