

Original Research

Comparing the efficacy and patient preference of knotted floss technique compared to conventional flossing with floss impregnated with 0.2% chlorhexidine

Dr. Gaurav Singh¹, Dr. Vrasha Jadhav², Dr. Prashatnth Shetty³, Dr. N. Anwesh Reddy⁴, Dr. Mithila Mane⁵, Dr. Sapna Joshi⁶

^{1,5,6}Post-Graduate Student, ²Dean & HOD, ³Professor, ⁴Reader

^{1,2,3,5,6}Department of Periodontology, Yogita Dental College and Hospital, Khed Ratnagiri Maharashtra, India;

⁴Department Of Periodontology, Sree Sai Dental College And Research Institute, Srikakulam, Andhra Pradesh, India

ABSTRACT:

Introduction: The removal of plaque is vital to maintain the health of periodontal and peri-implant tissues. To compare clinical efficacy for plaque removal between dental floss with soft ellipsoidal knots and conventional floss. **Materials and Methods:** We studied 33 university students including regular and sporadic users of dental floss, with interproximal spaces <1 mm, who used floss with and without knots in a randomized manner following a split-mouth design. The Modified Navy Plaque Index (RMNPI) by Rustogi et al. was applied to determine the total removed plaque (TPI) and that removed in the gingival area (GPI) and interproximal spaces (IPI). **Results:** The reduction in GPI was greater with the knotted versus conventional floss in all cases (14.77 ± 12.38 ; 64.79% vs. 17.38 ± 13.66 ; 57.51%) and especially among no floss users (12.469 ± 10.98 ; 68.02% vs 15.833 ± 11.88 ; 58.55%). No statistically significant difference between floss types was found in TPI and IPI (globally or by floss utilization frequency) or in the mean GPI of floss users. **Conclusion:** Floss with ellipsoidal knots showed similar efficacy to remove plaque in patients with less experience of flossing compared to flossing themselves with conventional floss, and it may be an optimal solution for patients starting to use dental floss and for those with a lesser or only sporadic history of floss utilization.

Key words: Plaque control; oral hygiene; dental hygiene; dental materials; flossing.

Received: 18 May, 2021

Accepted: 22 June, 2021

Corresponding author: Dr. Gaurav Singh, Post-Graduate Student, Department of Periodontology, Yogita Dental College and Hospital, Khed Ratnagiri Maharashtra, India

This article may be cited as: Singh G, Jadhav V, Shetty P, Reddy NA, Mane M, Joshi S. Comparing the efficacy and patient preference of knotted floss technique compared to conventional flossing with floss impregnated with 0.2% chlorhexidine. J Adv Med Dent Scie Res 2021;9(7):78-82.

INTRODUCTION

Periodontal tissue inflammation (gingivitis and periodontitis) is a highly frequent oral disease^{1,2}, whose main etiologic agents are the bacteria present in plaque³. Invasion of these tissues by the plaque or its toxins triggers an inflammatory response that can, alongside other factors, lead to their destruction and evolve from gingivitis to periodontitis⁴. The removal of plaque is therefore vital to maintain the health of periodontal and peri-implant tissues^{5,6}. The efficacy of tooth brushing to remove plaque is lesser on interproximal surfaces, even when using brushes designed to improve access to these spaces⁷, and use

of interdental devices in addition to tooth brushing reduces more interdental plaque in comparison with tooth brushing alone⁸. The efficacy of other methods to clean interproximal surfaces varies according to the size of the space and the positioning of the teeth⁹⁻¹¹. For instance, dental floss is effective to clean narrow but not wide interdental spaces. Dental floss did not achieve superior outcomes in comparison to other devices for interdental cleaning¹² and was found to be less effective than interproximal brushes when both were combined with manual tooth brushing with toothpaste^{13,14}. Another study found no significant difference between these devices¹⁵, although

interdental brushes can evidently only be used in larger interproximal spaces. According to the Spanish Oral Health Population Survey in 2015, dental floss was used by one-third of the Spanish population (34%), while the proportion using interdental brushes had markedly decreased from 42% in 2010 to 18%¹⁶. Given the popularity of dental floss but the drawback of its low efficacy in wider interproximal spaces¹⁷, the development of a dental floss with ellipsoidal floss knots at regular distances has been proposed to facilitate plaque removal in these spaces. The objective of this study was to compare the clinical efficacy of dental floss with soft ellipsoidal knots and conventional dental floss to remove plaque.

MATERIAL AND METHODS

The “knotted” dental floss was not waxed and featured soft ellipsoidal knots of 0.7 mm diameter at intervals of 10 cm. We studied 33 university students including regular and sporadic users of dental floss, with interproximal spaces <1 mm, who used floss with and without knots in a randomized manner following a split-mouth design. After obtaining informed consent for participation in the study, an appointment was made for the examination, instructing participants to carry out no oral hygiene

RESULTS

A final sample of 33 students with an average age of 20.15 ± 0.89 , (29 females, 87.9 %), including 13 (39.4 %) undergraduate/postgraduate students of dentistry and 20 (60.6 %) students on courses unrelated to healthcare. Dental floss was used regularly (at least once/week) by 13 participants (39.4 %) but not by the remaining 20 (60.6 %). 76.9% of dentistry students were users of dental floss while among others students only 15% were users of dental floss. Data were obtained on 66 quadrants in which conventional floss was used and 66 in which the knotted dental floss was used. In all cases, no statistical significant differences were detected after tooth brushing. In the conventional floss quadrants, the mean GPI was 36.38 ± 18.03 after tooth brushing and 17.39 ± 13.66 (57.51% reduction) after flossing; in the knotted floss, the mean GPI was 35.54 ± 17.17 after tooth brushing and 14.77 ± 12.38 (64.79% reduction) after flossing. No significant difference in percentage reduction with flossing was observed between conventional floss

measures during the preceding 24-h period and to consume no solids, liquids, or chewing gum during the preceding 12-h period. The Rustogi et al. Modified Navy Plaque Index (RMNPI)¹⁸ was used for plaque evaluations in this study, dividing each tooth surface into nine parts, measuring both vestibular and palatine/lingual surfaces but excluding any third molars present. Results were grouped into the following subindexes: total plaque index (TPI) for all dental surfaces, Gingiva plaque index (GPI) for surfaces closest to the gingiva, and Interproximal plaque index (IPI), for plaque on interproximal surfaces after flossing. Stained surfaces were not recorded before the tooth brushing, whose efficacy was not a study objective. In each participant, two quadrants were randomly selected (using OxMaR, an open source free software)¹⁹ for application of the conventional floss and two for application of the knotted floss. After the flossing, plaque on surfaces in each quadrant was again evaluated, using the RMNPI, with the examiner blinded to the type of floss used for each quadrant. IBM SPSS 23.0 for Windows (IBM SPSS Inc., Chicago, IL) was used for the statistical analysis, calculating means and using the Student's t-test for independent samples for comparisons; $p < 0.05$ was considered significant.

quadrants and knotted floss quadrants ($p = 0.15$). The TPI and IPI results obtained in all participants are showed in Table 1. Among the 13 participants who used dental floss, the mean GPI was 37.78 ± 19.15 after tooth brushing and 19.78 ± 16.24 (55.90% reduction) after flossing in controls versus 37.48 ± 18.13 after tooth brushing and 18.31 ± 13.98 after flossing (59.81% reduction) in cases. No significant difference in percentage reduction with flossing was observed between conventional floss and knotted floss quadrants ($p = 0.66$). Table 2 exhibits the TPI and IPI results obtained in floss users. Among the 20 participants who did not use dental floss, the mean GPI was 5.48 ± 17.71 after tooth brushing and 15.83 ± 11.88 (58.55% reduction) after flossing in controls versus 34.255 ± 16.87 after tooth brushing and 12.47 ± 10.98 after flossing (68.02% reduction) in cases. No significant difference in percentage reduction with flossing was observed between conventional floss and knotted floss quadrants ($p = 0.14$). Table 3 exhibits the TPI and IPI data obtained in participants who did not use dental floss.

Table 1. TPI and IPI values in all participants

Index	Floss type		TPI after brushing	TPI after flossing	% plaque reduction with flossing	Student's-t
TPI	Normal	Mean	19.9600	8.4597	61.5327	p= 0.43
		N	33	33	33	
	Study	SD	10.35413	6.46399	18.52685	
		Mean	19.7233	8.0806	65.1973	
		N	33	33	33	
		SD	9.83545	6.69594	18.93885	
IPI	Normal	Mean	29.1982	10.7418	65.8333	p= 0.98
		N	33	33	33	
	Study	SD	14.10783	7.74096	17.96315	
		Mean	28.0539	10.9776	65.9472	
		N	33	33	33	
		SD	13.86768	9.20681	19.34038	

TPI, Total plaque index; IPI, Interdental plaque index; SD, Standard deviation

Table 2. TPI and IPI results in habitual floss users

Index	Floss type		TPI after brushing	TPI after flossing	% plaque reduction with flossing	Student's-t
TPI	Normal	Mean	21.2908	8.7585	63.7554	p= 0.90
		N	13	13	13	
	Study	S	8.62118	6.60958	17.16224	
		Mean	21.8400	9.7077	62.9208	
		N	13	13	13	
		S	9.36685	7.28280	19.69452	
IPI	Normal	Mean	32.8815	12.5000	64.7293	p= 0.98
		N	13	13	13	
	Study	SD	13.75391	8.88386	18.17998	
		Mean	32.1685	13.6662	64.9573	
		N	13	13	13	
		SD	13.63202	10.91186	21.43934	

Table 3. TPI and IPI in non-habitual floss users

Index	Floss type		TPI after brushing	TPI after flossing	% plaque reduction with flossing	Student's-t
	Normal	Mean	19.0950	8.2655	60.0880	
		N	20	20	20	
TPI		SD	11.47255	6.53295	19.65938	
	Study	Mean	18.3475	7.0230	66.6770	
		N	20	20	20	
		SD	10.12189	6.24702	18.79544	p= 0.28
	Normal	Mean	26.8040	9.5990	66.5510	
		N	20	20	20	
IPI		SD	14.15689	6.89827	18.25739	
	Study	Mean	25.3795	9.2300	66.5906	
		N	20	20	20	
		SD	13.68996	7.70720	18.40029	p= 0.99

DISCUSSION

In this comparison between conventional and “knotted” dental floss, the RMNPI was employed to evaluate changes in the plaque on free tooth surfaces (i.e., readily cleaned with toothbrush), on surfaces closer to the gingival sulcus, and interproximal surfaces 21. TPI and IPI indexes were reduced to a similar degree by both types of floss, while a greater reduction in GPI was obtained on quadrants cleaned with the knotted floss, although significance was not reached ($p=0.15$). The lack of significant difference in TPI values was expected, because surfaces cleaned with dental floss represent only a minority of the surfaces considered in this index. The similarity in IPI values may be attributable to the identical effects in small interproximal spaces of conventional floss and the floss between knots. Other studies using different indexes found no significant difference between conventional floss and floss of variable diameter²², between nylon and polytetrafluorethylene flosses²³, or among waxed, unwaxed, woven, and shred-resistant flosses²⁴. The RMNPI was used by another research group to compare plaque removal between the utilization of an electric toothbrush alone and in combination with three conventional dental flosses and electrical flossing device²⁵. The authors reported that significantly more plaque was removed by the combination of dental floss and tooth brushing than by brushing alone, finding no statistically significant differences among the flosses studied. Our finding of a tendency towards a greater reduction in gingival plaque index with utilization of the knotted versus conventional floss would be consistent with a more effective cleaning action of the knots in the wider interdental spaces at gingival level, acting in a similar manner to an interproximal brush. The larger volume of the knot would also be expected to clear more readily the plaque accumulated on central and gingival parts of tooth surfaces, which are more difficult to reach using conventional dental floss. Interestingly, no difference was observed between the

utilization of conventional and knotted floss among participants who were floss users ($p= 0.66$), whereas there was a tendency for a greater reduction with the utilization of knotted floss among those who were not ($p= 0.14$). It is possible that the greater experience of floss users would result in its more effective utilization on more surfaces, while less skillful floss users may find that the knots make it easier to remove plaque from these central and gingival areas. The proportion of the present study population who used floss at least once a week (39.4%) was higher than reported for the general population of Spain (34%) in 2015¹⁶. The proportion of floss users was markedly higher among the students of dentistry than among the other students in our study population, attributable to their greater awareness of dental hygiene needs.

CONCLUSION

Dental floss with ellipsoidal knots and conventional dental floss showed similar efficacy to remove plaque overall, although a non-significant tendency was observed for greater efficacy with the knotted floss in areas closer to the gingival sulcus, especially among participants who did not use dental floss. This knotted floss may be especially useful for patients with less experience of flossing to start this vital dental hygiene habit.

REFERENCES

1. Eke PI, Dye BA, Wei L, Slade GD, Thornton-Evans GO, Borgnakke WS, et al. Update on Prevalence of Periodontitis in Adults in the United States: NHANES 2009 to 2012. *J Periodontol.* 2015; **86**: 611-622.
2. König J, Holtfreter B, Kocher T. Periodontal health in Europe: future trends based on treatment needs and the provision of periodontal services—position paper 1. *Eur J Dent Educ.* 2010; **14**: 4-24.
3. Loe H, Theilade E, Jensen SB. Experimental Gingivitis in Man. *J Periodontol.* 1965; **36**: 177-187.
4. Page RC. The role of inflammatory mediators in the pathogenesis of periodontal disease. *J Periodontol Res.* 1991; **26**: 230-242.

5. Bauman GR, Mills M, Rapley JW, Hallmon WW. Plaque-induced inflammation around implants. *Int J Oral Maxillofac Implants*. 1992; **7**: 330-337.
6. Bernimoulin JP. Recent concepts in plaque formation. *J Clin Periodontol*. 2003; **30**: 7-9.
7. Yankell SL, Shi X, Spirgel CM. Laboratory interproximal access efficacy of four elmex caries protection toothbrushes. *J Clin Dent*. 2012; **23**: 27-31.
8. Graziani F, Palazzolo A, Gennai S, Karapetsa D, Giuca MR, Cei S, Filice N, Petrini M, Nisi M. Interdental plaque reduction after use of different devices in young subjects with intact papilla: A randomized clinical trial. *Int J Dent Hyg*. 2018; **16**: 389-396.
9. Jordan RA, Hong HM, Lucaciu A, Zimmer S. Efficacy of straight versus angled interdental brushes on interproximal tooth cleaning: a randomized controlled trial. *Int J Dent Hyg*. 2014; **12**: 152-157.
10. Chongcharoen N, Lulic M, Lang NP. Effectiveness of different interdental brushes on cleaning the interproximal surfaces of teeth and implants: a randomized controlled, double-blind cross-over study. *Clin Oral Implants Res*. 2012; **23**: 635-640.
11. Hoenderdos NL, Slot DE, Paraskevas S, Van der Weijden GA. The efficacy of woodsticks on plaque and gingival inflammation: a systematic review. *Int J Dent Hyg*. 2008; **6**: 280-289.
12. Imai PH, Hatzimanolakis PC. Interdental brush in Type I embrasures: Examiner blinded randomized clinical trial of bleeding and plaque efficacy. *Can J Dent Hyg*. 2011; **45**: 25-32.
13. Yankell SL, Shi X, Emling RC. Efficacy and safety of BrushPicks, a new cleaning aid, compared to the use of Glide floss. *J Clin Dent*. 2002; **13**: 125-129.
14. Worthington HV, MacDonald L, Poklepovic Pericic T, Sambunjak D, Johnson TM, Imai P, Clarkson JE. Home use of interdental cleaning devices, in addition to toothbrushing, for preventing and controlling periodontal diseases and dental caries. *Cochrane Database Syst Rev*. 2019; **4**: CD012018.
15. Slot DE, Dörfer CE, Van der Weijden GA. The efficacy of interdental brushes on plaque and parameters of periodontal inflammation: a systematic review. *Int J Dent Hyg*. 2008; **6**: 253-264.
16. Consejo General de Colegios de Dentistas de España. Libro Blanco: La salud bucodental en España 2015. Madrid: Grupo ICM de comunicación; 2016. <http://www.consejodentistas.es/pdf/libros/libro-blanco/index.html> Accessed February 3, 2019.
17. Sicilia A, Arregui I, Gallego M, Cabezas B, Cuesta S. Home oral hygiene revisited. Options and evidence. *Oral Health Prev Dent*. 2003;1 Suppl 1:407-22
18. Rustogi KN, Curtis JP, Volpe AR, Kemp JH, McCool JJ, Korn LR. Refinement of the Modified Navy Plaque Index to increase plaque scoring efficiency in gumline and interproximal tooth areas. *J Clin Dent*. 1992; **3**: C9-C12.
19. O'Callaghan CA. OxMaR: open source free software for online minimization and randomization for clinical trials. *PLoS One*. 2014;9:e110761.
20. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates Publishers; 1988.
21. Kiger RD, Nylund K, Feller RP. A comparison of proximal plaque removal using floss and interdental brushes. *J Clin Periodontol*. 1991; **18**: 681-684.
22. Stevens AW Jr. A comparison of the effectiveness of variable diameter vs. unwaxed floss. *J Periodontol*. 1980; **51**: 666-667.
23. Ciancio SG, Shibly O, Farber GA. Clinical evaluation of the effect of two types of dental floss on plaque and gingival health. *Clin Prev Dent*. 1992; **14**: 14-18.
24. Carr MP, Rice GL, Horton JE. Evaluation of floss types for interproximal plaque removal. *Am J Dent*. 2000; **13**: 212-214.
25. Terézhalmy GT, Bartizek RD, Biesbrock AR. Plaque-removal efficacy of four types of dental floss. *J Periodontol*. 2008; **79**: 245-251.