



ORIGINAL ARTICLE

Comparison between water flosser and regular floss in the efficacy of plaque removal in patients after single use

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Abstract Objective: The objective was to compare water flosser and regular floss in the efficacy of plaque removal in patients after single use.

Materials and Methods: A randomized controlled clinical trial was conducted to compare the plaque removal efficacy of water flosser and regular floss. Eighty three subjects who met the inclusion criteria were recruited from dental clinic. Silness and Løe plaque index was measured for all the subjects prior to and after the intervention by an examiner who was blind to the type of aid used. The type of floss used was randomly assigned to each side of the oral cavity; unflavored waxed regular floss (oral B) used on one side, while a water flosser (Waterpik® Cordless Plus Water Flosser) was used on the other side. A trained investigator used either unflavored waxed regular floss or water flosser as assigned. Paired *t*-test was used to compare between the two groups.

Results: The mean plaque scores at baseline were 1.10 (±0.38) and 0.94 (±0.38) respectively for regular floss and water flosser. The mean plaque scores were 0.12 (±0.13) and 0.12 (±0.15) respectively for regular floss and water flosser. There was no statistically significant difference in the plaque scores ($p = 0.58$) between the groups after the use of respective interdental aids. There was a statistically significant difference in the plaque scores before and after use of interdental aids for both the groups ($p < 0.001$). Reduction in plaque scores for regular floss and water flosser groups was 89.09% and 87.23% respectively.

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Conclusion: The results showed that water flosser was as efficient as regular floss in removing interdental plaque on single use. Water flosser could be recommended for subjects lacking manual dexterity, by care takers for better plaque control and subjects with fixed prostheses or undergoing orthodontic treatment.

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1. Introduction

Dental caries and periodontal disease are the two most common plaque associated oral diseases (Axelsson et al., 2004). Gingivitis is an inflammation of gingiva and without loss of attachment or pocket depth of less than 3 mm whereas pocket depth of greater than 3 mm or loss of attachment is called periodontitis. Although these diseases have multifactorial etiology, they can be prevented to a great extent through effective plaque control methods. Tooth brush and toothpaste are the most widely used oral hygiene measures. Efficiency of tooth brushing depends on various factors such as type of tooth brush, brushing technique, frequency and duration of brushing (Claydon, 2008). In spite of employing appropriate brushing regime, dental plaque can be effectively removed only from facial and lingual surfaces and many people fail to remove interdental plaque due to difficulty of the bristles to reach interdental spaces (Warren and Chater, 1996; Christou et al., 1998). Studies have shown that approximately 60% of the overall plaque can be removed by tooth brushing alone with each episode of cleaning (De la Rosa et al., 1979). The percentage of the interdental plaque removed by tooth brushing alone is further reduced due to inaccessible areas (Ng and Lim, 2019). The most effective way to remove the interdental plaque is by appropriate use of interdental aids. Regular floss is capable of removing up to 80% of interproximal plaque as reported by ADA (Carr et al., 2000). There are three broad categories of interdental aids based on the embrasures, wide variants of them are available in the market each one claiming to be more efficient than the other. The choice of interdental aid depends mainly on type of embrasures and awareness, motivation, skills to use interdental aids by an individual. It is reported that only 30% of the total adult population used interdental aids mainly floss (Kressin et al., 2003; Segelnick, 2004). One of the limiting factors for using interdental aids is that it is time consuming and requires for an individual to develop skill to use it correctly (Segelnick, 2004; Asadoorian and Locker, 2006). To overcome this limitation many designs of interdental aids are available in the market. Water flosser is a recent development in interdental aids for regular home use which claims to be relatively easy to use. Water flosser functions through pulsation and pressure action. These two actions help in disruption of plaque and removal of loosely lodged debris. It works in the pressure range of 50–90 psi. The handle has to be held at a 90-degree angle to the tooth and irrigate the tissues at an appropriate pressure setting (Lyle, 2012). The water flosser can also deliver antimicrobial solutions into the sulcus and interproximal regions. The main indication to use water flosser is for people with diminished manual dexterity. It can also be recommended for patients with orthodontic appliance and implants (Fried 2012). Few studies are published on this product (Deborah, 2011; Goyal et al., 2013, 2015) (Goyal et al.,

2012). Hence this research was conducted to compare water flosser and regular floss in the efficacy of plaque removal in patients after single use.

2. Materials and methods

2.1. Study design

A randomized controlled clinical trial was conducted to compare the plaque removal efficacy of water flosser and regular floss. It was a Single blind study with split mouth technique. This study was approved by the Ethical Review Board of Princess Nourah Bint Abdulrahman University (IRB Log Number 17-0240).

2.2. Sample size and eligibility criteria

The sample size was estimated to be 83, which was calculated based on previous studies with 80% power and 5% alpha. Subjects were recruited from dental clinic of Princess Nourah Bint Abdulrahman University. Subjects aged 18–50 years old, with fair to poor oral hygiene, minimum of 20 scoreable teeth (not including 3rd molars), pocket depth ≤ 3 , didn't use any floss type for the last 24 hours and who gave informed consent were included in the study.

2.3. Plaque assessment and intervention procedures

Examiners were trained to use regular floss, water flosser and to record index before recruiting the subjects. Split-mouth technique was used to compare between the regular floss and the water flosser in a single visit. Silness and Løe plaque index (Silness and Løe, 1964) was measured for all the subjects prior to the intervention by an examiner who was blind to the type of aid used. Standardized oral hygiene instructions were demonstrated to all subjects using modified bass technique and a standardized brush (soft bristled brush with fluoridated toothpaste) were given. Subjects were asked to brush their teeth as instructed. The type of floss used was randomly assigned to each side of the oral cavity; unflavored waxed regular floss (oral B) used in one side, while a water flosser (Waterpik® Cordless Plus Water Flosser) used in the other side. Regular floss was coded as '1' and water flosser was coded as '2'. For each subject a coded chit was picked and assigned to right side and the other floss was assigned to left side. A trained investigator used either unflavored waxed regular floss or water flosser as assigned. Silness and Løe plaque index was measured again after the intervention. The same investigator measured the plaque index before and after intervention. She was blinded for the type of floss used on each side.

2.4. Statistical analysis

Data was entered into excel sheet and analyzed using JMP 14.2.0 (SAS Institute Inc.). Mean and standard deviation, percentage reduction in the plaque scores were calculated. Paired *t*-test was used to compare between the two groups and before and after the intervention within the groups. A *p* value of ≤ 0.05 was considered to be statistically significant.

3. Results

A total of 83 subjects enrolled for the study. Baseline plaque scores for an individual were recorded and calculated separately as left and right side of the oral cavity. It was a split mouth design and the sides were randomly assigned to either of the groups. Based on this, either the right or left side plaque scores were considered as baseline scores for regular floss or water flosser respectively. Regular floss was used for 36 subjects on the right side and for 47 subjects on the left side vice versa for water flosser.

The mean age of the study subjects was 26.73 (± 7.23). (Table 1). The mean plaque scores were 1.10 (± 0.38) and 0.94 (± 0.38) respectively for regular floss and water flosser. There was statistically significant difference in the plaque scores (< 0.026) between the groups at baseline. The mean plaque scores were 0.12 (± 0.13) and 0.12 (± 0.15) respectively for regular floss and water flosser. There was no statistically significant difference in the plaque scores ($p = 0.58$) between the groups after the use of respective interdental aids (Table 2).

Statistically significant difference ($p < 0.001$) was observed in the plaque scores before and after use of interdental aids for both the groups. Mean reduction of plaque scores after intervention for regular floss and water flosser was 0.99 (± 0.41) and 0.82 (± 0.36) respectively. Regular floss group showed 89.09 percent reduction in plaque scores whereas water flosser group showed 87.23 percent reduction in plaque scores (Table 3).

4. Discussion

A randomized controlled clinical trial was conducted to compare the plaque removal efficacy of water flosser and regular floss. Literature review did not reveal any study conducted among Saudi subjects using water flosser, hence this could be

considered as the first study conducted among Saudi subjects. Attempt was made to control factors which could probably affect the outcome. A split mouth technique was used to prevent individual variations and standardized oral hygiene instructions were demonstrated to all subjects and were asked to brush their teeth before using the floss to minimize intra oral variations. The water flosser or floss was used by the trained dentist rather than subjects. Healthy subjects without any signs of periodontitis were included in the study as the objective was to assess the efficacy among healthy individuals as a first part of the study. Silness and L oe plaque index was used in this study. This index is valid, reliable, and easily learned. It has been suggested as acceptable index to test the efficacy of oral hygiene products in plaque removal (Fischman, 1988).

In the present study there was a statistically significant difference in the plaque scores between the groups at the baseline although the scores were almost similar indicating clinical insignificance. This could be due to unequal distribution of right and left sides among the groups in spite of using random assignment. There could be a possibility of variation in the oral hygiene maintenance based on right or left handed person.

Various studies conducted to assess the effectiveness of water flosser compared to other interdental aid found water flosser to be more effective. In a study four oral hygiene methods were compared. They found that water flosser combined with sonic was better than sonic alone (Bowen, 2012). Another study compared water flosser with air floss and results showed water flosser to be better than air floss in reducing plaque and gingival bleeding after four weeks of use (Goyal et al., 2015). The third study showed water floss to be better than regular floss in plaque reduction after single use (Goyal et al., 2013). A compendium of three randomized controlled trials found that use of manual tooth brushing along with water flosser was better than either manual tooth brushing and regular floss or tooth brushing alone (Barnes et al., 2005; Deborah, 2011; Rosema et al., 2011). A systematic review found that groups using tooth brush plus oral irrigation had better oral health in general compared to tooth brush alone. In the same systematic review it was also observed that groups using oral irrigation had better gingival, bleeding and plaque scores compared to groups using floss at the end of one month (Worthington et al., 2019). In contrast to these results the present study showed water flosser (Waterpik  Cordless Plus Water Flosser) was similar to string floss in removing plaque interdentally. Only one study is in accordance with the current study (Deborah, 2011). In the present study both the aids were used by the dentist rather than the subject. This could have led to efficient removal of plaque by both the methods. Whereas in the previous studies they were used by the patients for four weeks and hence the difference could have been observed. The patients might have not been able to use regular floss effi-

Table 1 Age distribution of study subjects.

Age in years	Mean age (SD)	26.73 (7.23)
	Range	18–49

Table 2 Pre and post flossing mean plaque scores for regular floss and water flosser and paired *t* test values (inter group comparison).

		Mean (SD)	Mean difference (SD of mean difference)	<i>p</i> value
Pre flossing scores	Regular floss	1.10 (± 0.38)	0.16 (± 0.65)	$< 0.026^*$
	water flosser	0.94 (± 0.38)		
Post flossing scores	Regular floss	0.12 (± 0.13)	0.008 (± 0.13)	0.585
	water flosser	0.12 (± 0.15)		

* Statistically significant.

Table 3 Mean and percentage reduction of plaque scores after intervention and paired *t* test values (intra group comparison).

	Mean reduction (SD of mean reduction)	p value	Percentage reduction in plaque scores after Intervention
Regular floss	0.99(±0.41)	<0.001*	89.09
Water flosser	0.82(±0.36)	<0.001*	87.23

* Statistically significant.

ciently. However the results of the study should be extrapolated with caution. The plaque removal ability was assessed after single use and by the trained dentist. Only female subjects were included as most patients who report to the dental clinic are females. The results could be different when used by the subjects themselves and on a long term basis. Future studies can be conducted to assess the effectiveness of water flosser on the long term use, among patients with periodontitis, acceptability and compliance by the subjects and cost effectiveness of water flosser.

5. Conclusion

The results of this research showed that water flosser was as efficient as regular floss in removing interdental plaque on single use. Water flosser could be recommended for subjects lacking manual dexterity, by care takers for better plaque control and subjects with fixed prostheses or undergoing orthodontic treatment.

Ethical statement

This study was approved by the Ethical Review Board of Princess Nourah Bint Abdulrahman University (IRB Log Number 17-0240).

CRedit authorship contribution statement

Hoda Abdellatif: Conceptualization, Supervision, Writing - review & editing. **Nassreen Alnaeimi:** Investigation, Writing - original draft. **Hessah Alruwais:** Investigation, Writing - original draft. **Rawan Aldajan:** Investigation, Writing - original draft. **Mamata Iranna Hebbal:** Methodology, Formal analysis, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known Competing interest that could influence the present research.

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