A COMPARISON OF THE EFFICACY OF WATER FLOSSER TO INTERDENTAL FLOSS AROUND DENTAL IMPLANTS: A RANDOMIZED CONTROLLED TRIAL AND A QUALITATIVE STUDY OF PATIENTS' PERCEPTIONS

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ABSTRACT

AIM

The aim of this study was to determine the effectiveness of a water flosser device compared to flossing around implants in several clinical parameters

METHODS

This study comprised an initial quantitative study and follow-up qualitative study. Patients were randomly divided in two groups, group 1 (experiment) with water flosser and group 2 (control) with dental floss. At each appointment five clinical parameters were recorded: Full Mouth Plaque Score (FMPS), Quigley-Hein plaque index (QHI), Probing Depth (PD), Bleeding on Probing (BOP) and width of Keratinized Tissue (KT) around implants.

RESULTS

Twenty-four patients with a total of 76 implants completed at least one follow-up appointment. No statistically significant differences were found for any of the investigated parameters.

CONCLUSIONS

Based on this study, dental floss and water flosser are equally effective in maintaining peri-implant health. Longer term follow-up with a larger sample size could help to demonstrate impact in oral hygiene behaviour and clinical outcomes.

BACKGROUND

INTRODUCTION

With an increasing number of patients having dental implants, finding an effective regimen of daily oral hygiene including interproximal maintenance of dental implants is a priority for patients and clinicians to achieve long term success in implant therapy. Limited research has been conducted on this topic and there is no consensus regarding which interproximal cleaning device should be considered the gold standard for interproximal implant home care. This study focused its attention on a comparison between water flosser and dental floss around implants investigating effectiveness in maintaining dental implant health.

LITERATURE REVIEW

Plaque accumulation and the inability to control biofilm around dental implants is a contributing factor in the development of inflammation around dental implants.[1-2-3] Optimizing the removal of plaque deposits is therefore considered an important aspect of prevention of peri-implant diseases and long-term maintenance. While there appears to be consensus in the literature about the need for optimal home plaque control, there are very few clinical trials that have examined different modalities of interdental cleaning around dental implants.[4] Clinical experience and literature show that for patients interdental cleaning appears to be more difficult than brushing teeth and their compliance is lower.[5-6] Poor access for adequate interproximal hygiene around implants has been shown to be related with a statistically significant higher occurrence of peri-implant disease.[7]

Very little is known about the effectiveness of different interproximal implant home care devices around dental implants. An observational study of van Velzen and Lang[8] and a case report of Montevecchi[9] have shown that interproximal oral hygiene with dental floss can in some cases be detrimental. In these studies remnants of dental floss were found around the neck and coronal part of dental implants with rough surfaces. Remnants may have acted as ligatures and promoted plaque retention. According to van Velzen and Lang[8] the utilization of interproximal brushes or toothpicks may be preferred for daily home care practices to avoid the risk of remnants.

Several different interproximal implant home care devices are commercially available: dental floss, interproximal brushes, tooth cleaning picks and oral irrigators but available evidence is

limited regarding their comparative effectiveness.[10-11] The history of dental floss dates back to ancient times with reports of interdental teeth cleaning using natural products, however a silk dental floss was introduced in 1815 by Levi Spear Parmly, a dentist in New Orleans.[12-13] A dental water jet (now known as water flosser) was developed in Colorado in the 60's by a hydraulic engineer, John Mattingly, and a dentist, Gerald Moyer who introduced this device in dentistry in 1962.[12-14]

There have been only a few studies evaluating the effectiveness of water flossers. A four-week evaluation showed that the daily use of water flosser combined with manual toothbrush is significantly more effective in reducing gingival bleeding scores than the use of dental floss[15] around teeth. A 2008 systematic review[16] reported that water flosser did not have a beneficial effect on reducing plaque scores, however a positive tendency in improving gingival health compared with regular oral hygiene practices was found. Similarly, a 30-day clinical trial of Magnuson et al[17] showed that a water flosser was more effective at reducing bleeding around implants than string floss with no adverse events reported, however this clinical trial was very short in duration and the long term sustainability of this effect could not be determined. These findings align with a long standing hypothesis to explain the bleeding reduction; water pulsations alter host–microbial interactions in the subgingival environment and the inflammation is reduced independently of plaque removal.[18]

Based on the literature available, there is still no consensus regarding which interproximal implant home care device is the safest and most effective for long term implant maintenance.

STUDY AIM

The primary objective of this study was to compare two different interproximal devices, water flosser and dental floss around implants in several clinical parameters.

METHODS

STUDY DESIGN

This study is a randomized, controlled clinical trial in a single center to determine effectiveness of two different interproximal implant home care devices.

PATIENT RECRUITMENT

This trial involved 33 adult patients with previously placed and restored dental implants. All the participants were maintenance patients of the Dr. Sam Borden Graduate Periodontics Clinic, Dr. Gerald Niznick College of Dentistry, University of Manitoba with at least a single implant with a screw retained crown. All participants were properly informed about the study and gave verbal and written consent prior to their inclusion in the study.

INCLUSION/EXCLUSION CRITERA

Inclusion Criteria:

- Male or female, 18 years of age and over
- Patients that presented with at least a single implant with a screw-retained crown and a diagnosis of peri-implant health or peri-implant mucositis (defined according to the 2017 World Workshop[19])
- Patients with general good health that did not have a condition contra-indicating routine dental treatment

Exclusion Criteria:

- Patients younger than 18 years of age
- Patients with implants with cemented crowns
- Patients with diagnosis of peri-implantitis (defined according to the 2017 World Workshop[19])
- Patients with any contact hypersensitivity to the related materials used in the study
- Tobacco users (vaping included)

RANDOMIZATION PROCESS

After recruitment, the patients were randomly assigned to one of the two groups, group 1 water flosser and group 2 conventional flossing. A computerized scheme was utilized for randomization. The principal investigator was blind to the assigned device, the dental hygienist was in possession of the key-sheet.

PROCEDURES

This study was a randomized, controlled clinical trial in a single center. All clinical measurements were taken by a single blinded investigator (periodontal resident) while a single dental hygienist was responsible for prophylaxis and delivery of oral hygiene instructions to the study participants. At each appointment five clinical parameters were recorded: Full Mouth Plaque Score (FMPS) recorded at four sites around each tooth or implant and Quigley-Hein plaque index (QHI) of the implants after the use of a disclosing solution, Probing Depth (PD), Bleeding on Probing (BOP) of the study implants recorded at six sites (distobuccal, mid-buccal, mesiobuccal, distolingual, mid-lingual and mesiolingual) using a UNC 12 Colorvue probe and the width of the keratinized tissue (KT) at the buccal surface of the study implants.

Group 1 (experimental): patients were provided with water flosser *(Waterpik Water Flosser WP-600, Water Pik, Inc, Fort Collins, CO, USA)* and were asked to refill it with tap water. The recommended tip was the standard JTR tip set in floss mode with the power button set at 5. Patients were also asked to change the water daily and to clean each implant for 30 seconds. Instructions on how to properly use the device were provided by the dental hygienist and the patient was asked to try the device in the clinic.

Group 2 (control): patients were provided with multiple packages of dental floss (*TePe Bridge and Implant Floss, TePe Munhygienprodukter, Malmö, Sweden)* in order to be able to floss daily for 12 months. Patients were instructed to floss once a day, preferably at nighttime. A demonstration of how to properly use the dental floss was done by the dental hygienist with the help of a hand mirror and patients were asked to replicate the same procedure in front of the hygienist.

Both groups also received a research bag comprising manual tooth brushes (*TePe soft toothbrush, TePe Munhygienprodukter, Malmö, Sweden*) and toothpastes (*Colgate Cavity Protection, Colgate-Palmolive, New York, USA*).

During each appointment the study investigator measured clinical parameters, described above, and participants received reinforcement of the oral hygiene instructions (OHI) and supportive periodontal therapy (SPT) by a single dental hygienist. Once the study was concluded patients were asked to fill-out a two-question questionnaire inquiring 1) how much they liked their interproximal device and 2) how easy it was to use, indicated on an emoji rating scale 1 to 5.

STUDY DURATION

The clinical trial lasted for a period of 11 months from October 2019 to September 2020. The interval of the follow-up appointments ranged between three and six months.

STATISTICAL METHODS

Table 1 presents a mean of the clinical measures for the five clinical parameters from baseline to follow-up 2. A two-Sample T-Test assuming unequal variances was used to compare statistical differences between the groups at follow-up 1 for the five clinical parameters investigated (table 2). A Whitney U test was used to analyze two answers from a questionnaire that was given to the patients at the end of the study (table 3) to compare differences in how the two groups ranked the interproximal devices.

RESULTS

Thirty-three patients, seventeen male and sixteen female completed the baseline appointment. The age of this group ranged between 48 and 85 years old with a mean age of 68. All these patients were long term maintenance patients of the Periodontology Clinic of the University of Manitoba for an average of 8.5 years in the clinic. Four patients could not complete their first follow up because the study was interrupted before their first recall appointment, one patient did not want to return to the clinic because she was worried about COVID-19 while the study was still ongoing and four patients were dismissed because they were not compliant with the study protocol because they stopped using the assigned device or because they used non prescribed aids such as electric toothbrushes. The final sample of twenty-four patients were equally distributed between the two groups who were fully compliant and completed at least one follow-up appointment; a total of ten compliant patients completed two follow-ups appointments before the study was interrupted due to the COVID-19 pandemic. Among these 24 patients some had more than one implant with a total of 76 implants included in the study measures.

Table 2 reports differences at follow-up 1 between the treatment group (water flosser) and the control group (dental floss). Differences were assessed using a two-Sample T-Test assuming unequal variances and resulted in no statistically significant differences. The sample size of

patients who completed at least two follow-ups (10 patients) was considered too small to be used for statistical analysis.

The feedback questionnaire also did not produce statistically significant differences in the mean rankings provided by the two groups (table 3).

Table 1: Clinical measures across baseline and follow-ups in experimental and control group

Clinical Measures	Baseline (n = 24) Control n = 12 Treatment n = 12	Follow-up 1 (n = 24) Control n = 12 Treatment n = 12	Follow-up 2 (n=10) Control n = 4 Treatment n = 6
QHI Control Treatment	 0.70 0.47	 0.65 0.31	 0.58 0.42
MAX PD Control Treatment	 3.31 3.61	 3.28 2.94	 2.76 3.08
BOP Control Treatment	 7.52 14.82	 9.68 8.83	 6.67 12.25
KT Control Treatment	 1.98 2.29	 2.02 2.33	 2.19 2.17
FMPS Control Treatment	 40.08 42.50	 33.92 38.75	 16.50 27.33

*means shown

Table 2: Comparison of changes from control to treatment group at follow-up 1

Clinical Measures	Intervention vs Control T value (p-value)
QHI	-1.5 (0.14)
MAX PD	-0.8 (0.39)
BOP	-0.29 (0.77)
KT	0.83 (0.41)
FMPS	0.56 (0.57)

t-test

Table 3: Comparison of responses to Feedback Questionnaire

Clinical Measure		Control n = 12	Treatment N = 12	Sig
Liked interproximal device –	**mean**	3.75	4.25	.53
	mean rank	11.33	13.67	
Easy using interproximal device –	**mean**	3.42	3.83	.41
	mean rank	11.46	13.54	

Mann Whitney U test

DISCUSSION

LIMITATIONS

The present study was impacted by the COVID-19 pandemic. The clinic was shut down in March 2020, cutting short the opportunity to complete follow up measures; at that time only 11 patients had completed at least one follow-up. The clinic was reopened in August 2020 and all patients willing to attend the clinic were booked for a final follow-up between August and September 2020. The clinical trial was then permanently interrupted due to university restrictions linked to the code red status of the Province of Manitoba. Patients were informed to be free to return to the oral hygiene practices that they preferred. The early closure of the trial and some patient drop-offs determined a small sample size and that may have influenced the study results and an overall lack of statistical significance. The COVID-19 related clinic closures also contributed to another limitation of this study, the uneven interval in the recall appointments ranging between three to six months and that could have had an effect in both Hawthorne effect and compliance. It is in fact reported in the literature that patients tend over time to forget oral hygiene instructions and that compliance decreases.[20]

Even if all the measurements were taken by the principal investigator another possible limitation is the non-calibration of the examiner.

OUTCOME

Within the limitations of this data, it appears that in a short-term interval, ranging between three to seven months, water flosser and dental floss are equally effective around implants in maintaining similar clinical parameters. The tendency of water flosser to produce a greater BOP reduction

compared to dental floss, even if not statistically significant is consistent with the finding of the 30-day clinical trial of Magnuson[17] that shows that water flosser is more effective at reducing bleeding around implants than string floss with no adverse events reported. Similar findings but around natural teeth are reported in Chaves's study[18] and in the systematic review of Husseini 2008[16] that reports that oral irrigators do not have a beneficial effect in reducing visible plaque but show a positive trend in improving gingival health as an adjunctive device to tooth brushing.
The allocated dental floss (*TePe Bridge and Implant Floss*) was a spongy floss with stiff plastic ends. The choice of this interproximal device was to standardize the control group even if in the literature the relationship between type of dental floss and differences in plaque removal is controversial. The study of Wong and Wade 1985[21] found that super floss was superior than conventional floss in plaque removal. On the other hand the study of Ong 1990[22] found that the differences between three types of dental floss were not statistically significant.

CONCLUSION

Based on the results of this clinical trial, dental floss and water flosser are equally effective in maintaining clinical parameters around dental implants. Further research is needed to corroborate this outcome. If these findings were confirmed, due to rising concerns in the literature involving the use of dental floss around implants, water flosser could be considered the first choice device for implant maintenance.

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