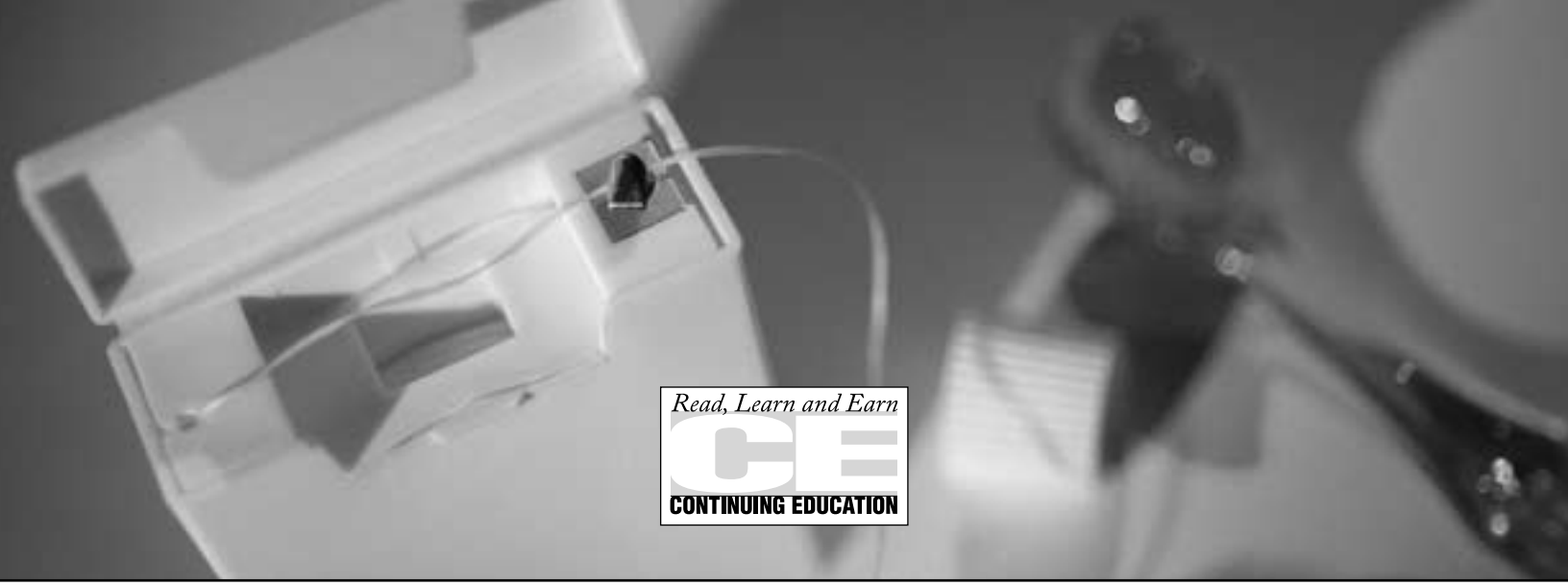

A Survey of Floss Frequency, Habit and Technique *in a Hospital Dental Clinic & Private Periodontal Practice*

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Abstract

The purpose of the study was to determine floss frequency, habits and techniques of patients entering a private periodontal office (office site) vs. a hospital dental clinic (hospital site). It was found that the flossing frequency in a hospital dental clinic is far less than in a private practice, and patients who do floss may not be using the proper flossing technique. Patients need more instruction and care with regard to their interproximal oral hygiene.

DENTAL FLOSS is the most recommended interproximal plaque remover.[1] It is also deemed essential in removing plaque from the interproximal area, where a toothbrush cannot reach.[2-6] Because the interproximal area is unreachable, the earliest periodontal lesions may form there and be more frequent and severe.[7-10] Now, more research is pointing to periodontitis and its systemic effects.[11-13] It has been theorized that periodontal pathogens work their way through the blood stream, affecting distant sites. Bacteremia caused by flossing irregularly can be avoided by daily flossing.[14]

It has been shown in numerous studies that the practice of daily flossing is quite low,[15-19] and that people are less inclined to floss than to brush.[20] Different populations have been shown to floss with different frequency. Periodontists and dentists tend to floss more frequently than the general population. Ethnicity, socioeconomic status, age and gender have all been shown to affect floss frequency.[21,22] No previous study has examined the difference in floss frequency among patients in a private periodontal practice and a hospital dental clinic.

The flossing techniques employed by the general population, such as the number of times a person flosses up and down through the contact of a tooth, and whether he or she is pulling the floss around the tooth, have not been documented. Flossing can be taught, and the skill learned will be retained for at least a year.[22,23]

The purpose of this study was, first, to determine if there is a difference in flossing frequency among patients in a private periodontal practice (office site) and a hospital dental clinic (hospital site), and, secondly, to learn more about individual flossing habits.

Material and Methods

Each of eight dental residents distributed a questionnaire (Figure 1) to patients entering the dental clinic for treatment at Wyckoff Heights Medical Center (hospital site). These were outpatients in generally good health. Residents distributed 315 questionnaires from 7/30/02 until 12/10/02. Among the recipients were 183 females and 127 males, ranging in age from 8 to 102 years (mean 39.2±16.9 years). The residents went over the questionnaire with each patient, making sure the patient understood the questions. If the patient did not speak English, a translator was provided. Spanish questionnaires were also available. If the patient was illiterate, the resident would fill in the data for him or her. The residents would then collect the questionnaire and write the chart number, date of birth and gender of the patient on the back of the form. The chart number was only collected to prevent duplicate data from occurring, since returning patients might see a different resident.

The same questionnaire was handed out to 307 consecutive new patients entering a private periodontal practice (office site) in Brooklyn, NY. These questionnaires were handed out between 7/19/02 and 4/14/03. The patient's name was written on the back of the ques-

Figure 1. Floss questionnaire distributed at two study sites. ((B) Reprinted from Perry D, Schmid M, Phase I Periodontal Therapy. In: Newman M, Takei H, Carranza F, eds. Carranza's Clinical Periodontology. 9th ed. Philadelphia: WB Saunders Co. 2002:660-1, with permission from Elsevier Science.)

tionnaire instead of the chart number. All questionnaires were kept in a locked area to protect patient privacy. The recipients included 179 females and 128 males, ranging in age from 8 to 88 years (mean 49.1±13.5 years). All minors had their guardians present when filling out the questionnaire.

A total of 622 participants were included in the study; however, the number of participants varied depending upon the specific questions they responded to. The collected questionnaire was then placed in a folder, and the data were entered in a database.

The IRB boards of both Wyckoff Heights Medical Center and Touro College School of Health Sciences approved the study.

Data Processing and Statistical Analysis

Descriptive statistics, such as frequency, percent, mean and standard deviation, were used to describe the study population. Subgroup analysis was also used for individual study sites. Age was categorized into decades, except for the youngest and oldest age groups. Because of the low frequencies of certain age groups, it was then collapsed into fewer groups for statistical testing. The number of days flossing per week was also categorized into "Didn't Floss," "Infrequent Flossers" and "Frequent Flossers." Depending upon the normality of data, Student's t-test and Mann-Whitney test were used accordingly to compare the mean difference of parameters between groups. Chi-square tests were also employed to measure the association of categorical parameters and to evaluate the percent or proportion difference in the contingency table analysis. A $p<0.05$ was used to declare the significant difference.

Results

All 622 subjects who were included in the study were given the questionnaire. The gender distribution was balanced between the two sites (28.9% females and 20.6% males in the office site vs. 30% females and 20.5% males in the hospital site). In both sites, there were more females (58.7%) than males (41.3%) (data not shown). The subjects in the office site were on average 10 years older (49.1 years old) than those in the hospital site (39.2 years old). The average age of all respondents in both sites was 44.3 years, ranging in age from 8 to 102 years.

When examining the flossing frequency of respondents in both groups, Figure 2 shows that 13.5% of the respondents answered that they flossed daily (frequent flossers), while 29.5% of

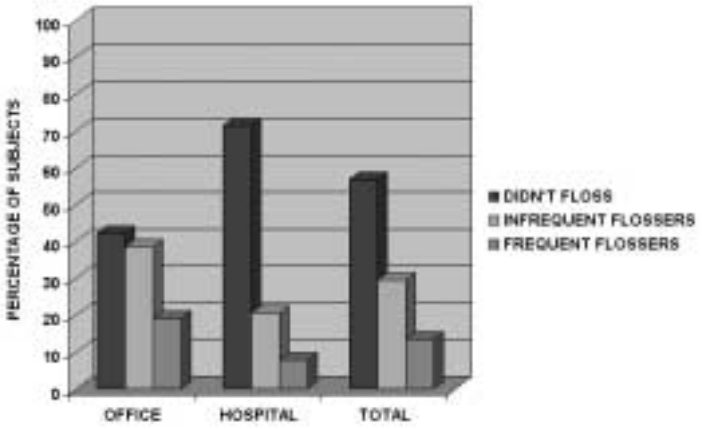

Figure 2. Flossing frequency by respondents at office and hospital study sites. Infrequent: Flossed 1-6 days a week. Frequent: Flossed every day. There was statistically significant association between flossing frequency and study sites ($p<0.0001$, Chi-square test).

the respondents said they flossed only one to six days a week (infrequent flossers), and 57% reported not flossing at all. A significantly higher percentage of females (47.8%) were found to floss more than males (35.7%), ($p=0.0030$, Chi-square test, data not shown).

The hospital site had a statistically significantly lower percentage of frequent flossers (7.9%) than the office site (19.3%) (Figure 2). Therefore, the office site responders were 2.4 times more likely to be frequent flossers than the hospital site. Figure 2 also shows that 71.4% of the hospital site reported not to floss at all as compared to the office site, which reported 42.2%. In terms of age, the middle-aged group (31 to 60 years of age) showed statistically significant more frequent flossers (47% vs. 23.7%) than the older ($p=0.0001$) and younger age groups (12.2%, $p<0.0001$) (Figure 3).

When flossing frequency between the two sites was analyzed, it seemed that there was no significant difference in gender at the office site in contrast to the hospital site, where a significantly high-

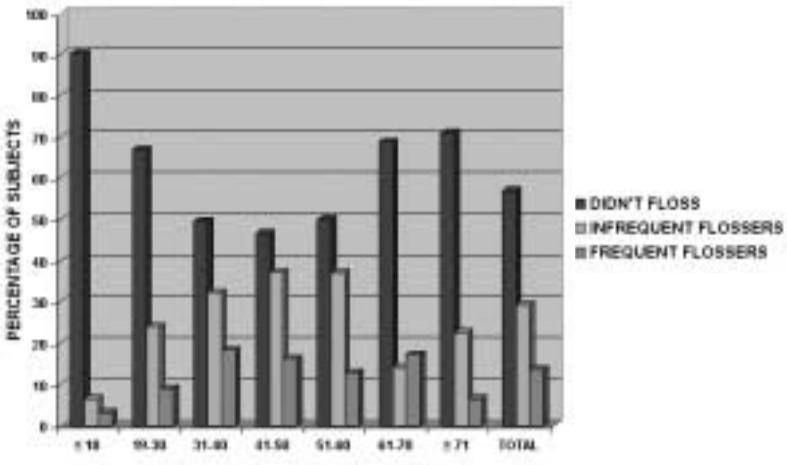

Figure 3. Flossing frequency by age at both study sites. Infrequent: Flossed 1-6 days a week. Frequent: Flossed every day. There was statistically significant association between flossing frequency and age ($p<0.0001$, Chi-square test).

TABLE 1

Floss Frequency by Gender at Office and Hospital Study Sites

	Office Site			Hospital Site		
	No Floss	Floss*	Total	No Floss	Floss*	Total
Female	72 (40.2)*	107 (59.8)	179	117 (63.9)*	66 (36.1)	183
Male	57 (44.5)	71 (55.5)	128	107 (84.3)	20 (15.7)	127
Total	129 (42.0)	178 (58.0)	307	224 (72.3)	86 (27.7)	310

(*) Included frequent and infrequent flossers
(**) Values in parentheses are percentages
There was no statistically significant association between gender and floss frequency (p=0.4510, Chi-square test) at the office site
There was a statistically significant association between gender and floss frequency at the hospital sites (p<0.0001, Chi-square test)

TABLE 2

Flossing Habits and Technique by Respondents at Office and Hospital Study Sites

	Office Mean ± sd	Hospital Mean ± sd	p-value*
Age (years)	49.1 ± 13.5*	39.2 ± 16.9	< 0.0001
Floss Habit:			
#Days/Week	4.4 ± 2.2	3.7 ± 2.3	0.031
#Times/Day	1.5 ± 0.6	1.6 ± 0.8	0.216
Floss Technique:			
#Times Up & Down	2.6 ± 1.3	2.5 ± 1.3	0.725

(*) significant level, Student's -t test

TABLE 3

Technique of Flossing Around Tooth by Study Site

Study Site	Floss Around Tooth		Total
	No	Yes	
Office	71 (40.1)*	106 (59.9)	177
Hospital	32 (39.0)	50 (61.0)	82
Total	103 (39.8)	156 (60.2)	259

(*) Values in parentheses are percentages
There was no statistically significant association between flossing around the tooth and study sites (p=0.8680, Chi-square test)

TABLE 4

Association of Two Flossing Techniques

#Times Floss Up & Down	Floss Around Tooth		Total
	No	Yes	
1	23 (60.5)*	15 (39.5)	38
2	41 (42.3)	56 (57.7)	97
3	25 (35.7)	45 (64.3)	70
4	6 (24.0)	19 (76.0)	25
≥ 5	3 (16.7)	15 (83.3)	18
Total	98 (39.5)	150 (60.5)	248

(*) Values in parentheses are percentages
There was a statistically significant association between floss up & down and around tooth (p=0.0070, Chi-square test)

er prevalence of females flossed than males (36.1% vs. 15.7%, p<0.0001, Chi-square test) (Table 1).

When other floss habits were examined, the subjects who flossed did so for an average of 4.2 days a week (± 2.2). Most respondents (57.4%) flossed only once a day (33% flossed twice a day and 9.6% flossed three times a day). There was no gender difference in the number of days in a week one flossed (4.1 in female and 4.2 in male, p=0.8360) and the times a day one flossed (1.6 vs. 1.4, p=0.1590) (data not shown). When the two sites were compared, there were significant differences in the number of days a week one flossed (4.4 in office vs. 3.7 in hospital, p=0.031). The number of times in a day one flossed was similar in the two sites (Table 2).

Looking at the flossing technique, the average number of times all subjects reported to floss with an up-and-down motion was 2.6 times (± 1.3). There was no statistically significant difference between the two sites (Table 2). For all respondents there were no statistically significant differences between females (2.5 ± 1.2) and males (2.8 ± 1.5) in the number of times they flossed with an up-and-down motion (p=0.0740, Mann-Whitney test, data not shown). Figure 4 shows that there was no association between the age and the number of times the subjects flossed with an up-and-down motion (p=0.2550). Those individuals flossing with the proper technique around their teeth flossed statistically significantly more times up and down than those who did not floss around their teeth (2.8 times vs. 2.3 times, p<0.0001, data not shown). However, there was no significant difference between the study sites (Table 3).

Table 4 shows the subjects flossing with the proper technique around the tooth: 39.5% flossed with an up-and-down motion once; 57.7% had flossed up and down twice; 64.3% had done it three times; 76% had done it four times; and 83.3% had done it at least five times. The greater the number of times one flossed with an up-and-down motion, the more likely one was to floss with the proper technique around the tooth (p=0.0070, Chi-square test). Results from Table 4 also show that individuals who do floss are about 20% more likely to use the correct technique around the tooth. It can also be noted that 39.5% of the subjects who flossed were not flossing around the tooth.

In general, 36.2% of the participants who practiced dental flossing preferred waxed dental floss, compared to 10.7% who preferred unwaxed and 6.8% who preferred mint floss. Implication from statistical testing might not be appropriate, since many of the participants indicated the "bland name" of dental

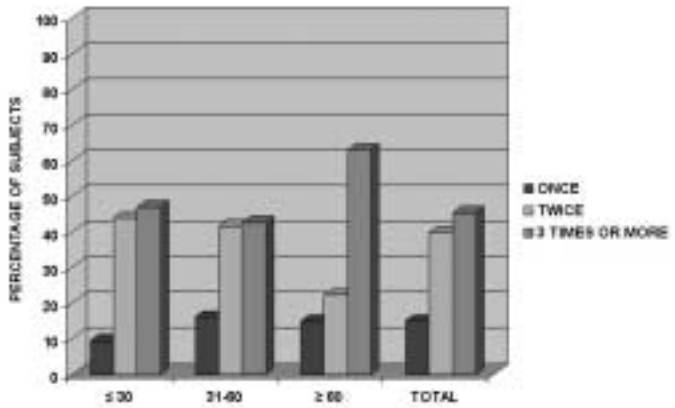

Figure 4. Number of times subjects flossed up and down by age groups at both study sites. There was no significant association between age and flossing up and down (p= 0.2550, Chi-square test).

floss instead of type of floss. The term "bland" was used to describe the subject's featureless response and wide range of answers to this question. Their answers ranged from giving the brand name of the floss to descriptive terms such as "flat" and "thin." A higher percentage of males (43.5%) used waxed floss than females (33.3%), and a similar percentage of males and females used mint floss. Waxed floss was used by 38.6% at the office site, and 32.4% at the hospital site. However, 10.3% of the participants at the hospital site used mint floss as compared to 4.6% at the office site.

Discussion

The data of the current study showed that daily flossing was practiced 2.4 times more often by the responders of the private periodontal practice office (19.3%) than at the hospital dental clinic (7.9%). Daily flossing is part of the ADA and NIH recommendations.[24,25] It is well documented that plaque and gingival scores are reduced when patients floss their teeth.[2-6,26-30] In an online survey of 201 periodontists, 88% of the specialists reported that patients were most negligent when it came to floss frequency compared to 61% who thought it was the flossing technique.[31]

Daily flossing among periodontists was reported to be 82%, though 74% said they recommended that their patients floss once a day.[32] In a study of 79 male dentists,[33] daily flossing was reported to be 56.3%. Although the dental profession is flossing more frequently than other populations, it seems we still need to improve and start practicing what we preach.

Regrettably, the reported practice of flossing in the general population is very low. Kuusela et al.[17] said the "use of dental floss was rare" when they looked at 11-, 13- and 15-year-olds in 11 countries in a WHO survey study. They found daily flossing from 2-25%. Honkala et al.[16] found that floss was used daily only 1% of the time among more than 3,000 Finnish adolescents. About 8% in more than 41,000 12- to 16-year-old children in England[18] reported daily flossing during the previous week. When adults were surveyed for floss frequency, the range was higher.

A higher percentage of daily flossers (18 years of age and older) was found in Minnesota (41%), Wisconsin (44%), in a national telephone survey in 1990 and 1991 (44% and 59% respectively), and in a large HMO in Minneapolis (41%).[34] A study in Detroit, MI (18 years and older) reported 31.6% of respondents floss daily.[19] Another study in North Carolina (16 to 69 years of age) showed daily flossers at 29.5%; and 17% reported that they did not floss at all.[15] The data in this study showed a much higher percentage (57%) of non-flossers (71.4% at the hospital site and 42.2% at the office site reported not flossing at all) and a lower percentage of individuals who flossed daily (Figure 2). It is interesting to see that for 18-year-olds and younger there were only 3.2% daily flossers (Figure 3).

When considering age, Hugoson et al.[35] compared data from three cross-sectional studies in Sweden. They found that the reported floss frequency was highest in the 70- to 80-year-old range, which is in contrast to the current study that showed a statistically significantly higher floss frequency in the middle-aged group as compared to the older and younger group. Gift[36] found that an older age group did less flossing than middle-aged, which is in agreement with my study. Lang et al.[37] found that individuals 30 years of age and above had a significantly higher percentage of daily flossing than 18- to 29-year-olds, which was the youngest group in their study.

The racial profile might be one of the reasons why there was such a big difference between the two sites regarding floss frequency. Davidson et al.[21] showed an "ethnic-specific pattern of association with oral hygiene scale scores." It was found that 35- to 44-year-old whites in San Antonio used floss 65.2%; whites in Baltimore 78.9%; Hispanics in San Antonio 51.6%; and African-Americans in Baltimore 53.8%. The same was shown in the older age group of 65- to 74-year-old whites (San Antonio) who reported flossing—71.9%; whites in Baltimore—64.5%; Hispanics (San Antonio)—33.7%; and African-Americans (Baltimore)—34.5%. No racial difference (white vs. non-white) was found in a study by Lang et al.[37]

The individuals at the hospital site were mostly Hispanic (percent of visits by ethnicity at the time of the study were 67% Hispanics, 15% black, 12% white and 3% Asians) (Personal communication). The Hispanic population may not be flossing as frequently as other populations, and further intervention for this specific population may be indicated. Education level and socioeconomic status have also been shown to play a possible role in affecting floss frequency.[22]

Other possible reasons for this discrepancy are that the patients entering a private periodontal practice office usually are referred by their general dentist, who may have already taught them how to floss. Floss frequency has been shown to increase when a patient is given oral hygiene instructions within the last year.[16] Similarly, Macgregor et al.[18] showed that if their respondents had gone to the dentist in the past week they reported flossing more frequently (a 10% rise in infrequent flossing and about a 2% rise in daily flossers). It has also been shown that the more frequent the oral hygiene instruction, the lower the plaque score.[38] Though, Murtomaa et al.[39] found that a history of flossing instructions had no effect on the subject's flossing frequency. Another reason might

be that patients seeking treatment in a private periodontal practice may have noticed signs of periodontal disease themselves and may already have taken steps to educate themselves on flossing before going to a periodontist.

Today, with an increasing number of dental school graduates entering into hospital general practice residency programs, the oral hygiene of the patients must not be overlooked. These patients may need more instruction and care with regard to their oral hygiene.

In this study, 48.8% of the women flossed more frequently than men (35.7%), ($p=0.0030$, Chi-square test), which has also been shown in other studies. Murtomaa et al.[39] found in Finnish first-year university students that 40% of the females vs. 25% of the males reported using floss, though only 2% were daily flossers. Ronis et al.[22] found that women were almost twice as likely to floss daily than men. Honkala et al.[16] also reported that females flossed more than males. In a report of 12- to 14–year-old students, it was found that girls reported more frequent use of floss,[40] though it is interesting to see in this study that the difference occurred only at the hospital site (females 36.1% vs. males 15.7%, $p<0.0001$, Chi-square test) (Table 1).

It should also be mentioned that in any questionnaire inherent errors (such as the Hawthorne effect) occur. The best way to know exactly how a person is flossing and how often would be to observe the person without his or her knowledge. This would be impractical because of problems related to privacy. The photos in the questionnaire and the explanation of the questioners helped clarify the answers. If a patient did not respond to a part of the questionnaire, it was because he or she did not know the answer. The different N's were due to the specific information a participant provided.

In this study, the technique of flossing up and down through the contacts of each tooth was reported to be on average 2.6 times. This question was explained by showing the patient the photo and describing an up-and-down motion between the teeth. This is significant, since most floss studies do not address this phenomenon. In a recent marketed brand of whitening floss, hygienists flossed the patient's teeth 30 strokes (15 times with up-and-down motions).[41] The study was used to show the effectiveness of the product. However, if we are recommending whitening floss, we are obligated to tell our patients that they must use it 15 times up and down. From this study we can see that people do not normally use floss in this manner.

Several recommendations have been published in textbooks regarding floss techniques, especially the number of up-and-down motions between the teeth (about one to six times).[42-46] However, the basis for these recommendations of oral hygiene instructions is not usually specified. When it is discussed in the literature, it is usually mentioned that the oral hygiene instructions were given to the experimental subjects by a hygienist, in a video or written instruction.[27,30]

The number of times one flosses up and down is not usually mentioned. However, Smith et al.[47] used two strokes as their criteria when determining the effectiveness of a flossing machine on plaque removal. Waerhaug,[48] when studying the healing of the dento-epithelial junction after flossing, had the subjects move the floss back and forth three to five times while being pressed against the tooth surface. Wunderlich et al.,[27] when assessing bleeding, had the floss passed through the contact of the tooth into the sulcus and then an inciso-gingival motion was applied for one double stroke. In future research, the exact number of up-and-down motion should be noted. Future studies should determine if the number of times a person flosses up and down through the contact of each tooth would have any effect on gingival and plaque scores and whether there is a specific number of times that should be recommended.

There is agreement in most of the periodontal literature that one should floss around the teeth. Dental and dental hygiene students are commonly taught to make a "C" shape with the floss and wrap it around the teeth.[42,43,49]

Bauroth et al.[50] studied the efficacy of an essential oil mouthrinse vs. dental floss and found that in the basically healthy periodontium, the essential oil mouthrinse was about three-times more effective in decreasing gingival inflammation scores and about six-times more effective in decreasing plaque scores than flossing at six months. One reason they mentioned for such a discrepancy in plaque scores might have been the failure to wrap the floss around the line angles of the tooth, where the remaining plaque was measured. They speculated that the plaque removed by the floss under the contact area was enough to decrease the gingivitis scores. The current study shows that people who floss are about 20% more likely to use the proper technique around the tooth. However, approximately 40% of the individuals who are flossing are not practicing the proper flossing technique around the tooth. It was interesting to see that when the number of times one flossed up and down increased, the more likely the person was to be flossing around the tooth.

Other studies have compared waxed to unwaxed floss and found that all types of floss work similarly in terms of plaque removal and gingival inflammation reduction.[5,26-29,30] My study shows that more people reported using waxed than unwaxed floss (36.2% vs. 10.7%). This may be because waxed floss is usually preferred over unwaxed,[15] and the common thought among dentists is to recommend the one most preferred, since it may be used more frequently.

Floss is the most widely recommended interproximal aid, yet it is the most poorly practiced. The understanding of individual habits and techniques should help the dentist develop and direct an effective oral hygiene program. The program should include constant reinforcement to teach the essentials of flossing.

Conclusion

The following conclusions may be drawn: 1. The technique of flossing up and down between the contacts of each tooth was reported to be on average 2.6 times. 2. Daily flossing was practiced 2.4-times more often by the subjects at the private periodontal practice office (19.3%) than at the hospital dental clinic (7.9%). 3. There is a statistically significantly higher floss frequency among middle-aged

subjects as compared to older and younger subjects. 4. Women flossed significantly more frequently than men, which was seen only at the hospital site ($p<0.0001$). 5. Almost 40% of the individuals who reported flossing are not practicing the proper technique of flossing around the tooth. ■

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