This study had two objectives. First - to ascertain the relative cleansing efficacy of a mechanical floss-holding device and an hand-held waxed dental floss and secondly, to determine the patient acceptance of each of these methods of using dental floss. It was illustrated that floss held by a mechanical device was as effective as regular hand-held floss in reducing gingival bleeding. Also, patients that expressed a preference preferred the mechanical flossing device by a ratio of four to three.
EVALUATION AND PATIENT ACCEPTANCE OF A MECHANICAL DENTAL FLOSSING DEVICE AS COMPARED TO HAND-HELD FLOSS

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Introduction and Specific Aim

Many articles in the dental literature deal with the use of dental floss to clean interproximal tooth surfaces. Bass and Arnim\(^2,1\) were leaders in recommending the use of floss as an effective oral health cleaning aid but Parmly\(^11\) preceded them when he wrote..."The third part is the waxed silken thread, which, though simple, is the most important. It is to be passed through the interstices of the teeth, between their necks and the arches of the gums, to dislodge that irritative matter which no brush can remove, and which is the real source of disease. With this apparatus thus regularly and daily used, the teeth and gums will be preserved free from disease." This was written in 1819.

No published studies were found that compared hand-held floss to mechanically held floss. One study\(^12\) was completed by Porst, but it has not been published.

Kresch\(^5\) studied the "flossing habits" of patients using the hand-held vs. the mechanically held floss, but no attempt was made to compare efficacy between either type of flossing method.

A 1972 clinical study\(^7\) comparing three types of dental floss demonstrated unwaxed floss reduced gingival bleeding 74% while waxed floss reduced gingival bleeding 45%. The floss was manipulated daily by a dentist. In a later study\(^8\), when the patient manipulated the floss, the reduction in gingival bleeding was 76% for unwaxed floss and 60% for waxed floss. Another clinical study\(^5\), by Hill, Levi and Glickman, demonstrated waxed and unwaxed floss cleaned the proximal surfaces with very little difference. In a study utilizing
the electron microscope it was observed that waxed and unwaxed floss cleaned the teeth equally well.

It has been my clinical observation, as well as many others, that many people are unable or unwilling to successfully manipulate dental floss well enough to clean the interproximal surfaces. This may be due to their lack of digital dexterity or they may feel hand manipulation is too much trouble. Therefore, a mechanical floss holding device* was selected to compare with hand-held floss** to determine the relative effectiveness in cleaning, as well as patient acceptance of each method.

The primary objective of this study, then, was to evaluate the relative cleansing efficacy of a mechanical dental floss-holding device in comparison with hand-held dental floss.

As a secondary objective, the study sought to determine the patient acceptance of each of these methods of using dental floss.

** Materials and Methods **

The mechanical flosser selected was the EZ Dental-Flosser. This plastic instrument is commercially available and contains a replaceable cartridge of waxed dental floss. Adequate instructions accompany the device.

Johnson's small size, waxed dental floss was used as the standard for comparison, for two reasons. First, as indicated in the introduction, it is not unqualifiedly clear that unwaxed dental floss is more efficacious than its waxed counterpart in removing dental plaque, and, second, waxed dental floss was used in the mechanical flosser.

* EZ Denta-Flosser
** Johnson's Dental Floss Waxed
Subjects in this study were active duty or retired military members and their dependents who were chosen from among patients routinely processed through either Oral Diagnosis or the Oral Health Control Center at a large Army installation. A three-stage selection process was used. In stage one, the following three criteria had to be satisfied. First, there had to be a definite clinical need for oral prophylaxis; second, patients could not have routinely used dental floss more than once per week; and, third, they had to be able to return for a prophylaxis two weeks after the initial examination. In stage two, patients were examined by investigator #1 to ensure they possessed at least 20 contacting teeth and had no fixed prosthodontic devices. If these conditions were met, the investigator completed a Gingival Bleeding Index (GBI) as developed by Carter and Barnes but modified as follows: while in the original method unwaxed dental floss was passed through the interproximal areas using a double incisogingival motion and scored as either bleeding or no bleeding, the study method used floss with three vertical strokes in each interproximal area and a bleeding score was assigned based on a scale of zero to three. A score of zero indicated no bleeding; one, blood on the floss; two, blood oozing around the papilla; and, three, copious bleeding. Interproximal areas distal to the second molars were not scored nor were those between the maxillary and mandibular central incisors inasmuch as the patients were instructed to use both the hand-held floss and the mechanical flosser in the latter areas. Patients who successfully met the criteria established in stages 1 and 2 proceeded to stage 3 and were referred to investigator #2 who selected subjects for
the groups as follows: the first patient was chosen for either the control or treatment group by a statistically accepted random sampling method and the next patient was placed in the other group, and so on alternately. Patients would enter the treatment group only if they indicated they would like to participate in a scientific dental floss study and agreed to use the floss as prescribed by the investigator. Patients refusing to use dental floss were not placed in the control group since it was felt the controls should not have been aware they were to participate in a dental floss study.

The subjects were given explicit instructions regarding each of the treatment modalities, to include flossing the right/left side with the hand-held floss and the opposite side with the mechanical dental floss holder.

Investigator #2 decided, on a random basis, which side the subjects would use the hand-held and mechanically held floss.

The study was of two weeks duration, with the final modified GBI scores being taken on day 14.

Results

As described in the "Rationale" section, this study had two objectives. The first was to ascertain the relative cleansing efficacy of the mechanical floss-holding device and hand-held waxed dental floss. Patient acceptance of each of these two modalities was the second goal.

Four subjects in the experimental group and nine in the control group were not able to appear for their second examination; nevertheless, sufficient numbers of subjects in each group remained to allow a meaningful study. There were 36 in the treatment group and 31 in the
A paired-difference test\textsuperscript{9,10} was employed in analyzing the modified GBI data, rather than the Student's "t" test, because the samples were not independent. That is to say, each subject in the experimental group used the floss holder on one side of his dentition and the hand-held floss on the other. The paired-difference test evaluates the null hypothesis that the difference of the means of two dependent samples is equal to zero. It was found (Table I) there were statistically significant differences between the mean initial and final modified GBI scores for the hand-held and mechanical flossing groups. At the generally accepted confidence level, however, there was no difference between comparable scores in the control group. (Table I)

No statistically significant differences were found (Table II) when using the paired-difference test to compare the initial, less the final GBI scores between patients using the hand-held floss and those using the mechanical device.

Preference (Table III) responses indicated that 39 percent preferred the mechanical flosser, with the remainder equally divided between the hand-held floss and no preference. This is a four to three ratio in favor of the mechanical flosser. Or, another method of evaluating the responses is that of those subjects who expressed a preference, 56 percent opted for the mechanical flossing device; 44 percent, the hand-held dental floss.

Discussion

This study demonstrated there were statistically significant
Improvements in the gingival bleeding scores of subjects in the treatment group; however, there was no statistical difference between the mechanical flossing device and the hand-held dental floss in reducing gingival bleeding. When comparisons were made between the control and treatment groups, the mean modified GBI scores decreased to a greater extent in the treatment group than those in the control. This also was statistically significant.

A questionnaire was given to the patients in the treatment group on day 14 and one of the questions was, "Since given the floss and instructions as a participant in this clinical study, did you use the floss daily, every day except one, about every other day, less than 1/2 of the time or you did not use it at all?" Of the 18 participants that answered this question, only five (5) said they used it daily. 13 used it less than daily. Of these 13, five used it less than 1/2 of the time. 4 patients complained of not being able to get the flosser in-between their posterior teeth and one could not get the flosser tight enough. 3 thought the flosser was easier to use. If this study were to be repeated, it would be better for the investigator to ask these questions and record the answers rather than have the patients do this for themselves. It would have been interesting and perhaps meaningful if we had known the use factor for each individual or group.

In 1976, Kresch, reported only 24.8% of all patients returning for their six month recall and 30% of patients returning for their 3 month recall appointment used floss at least five times per week.
These patients were given regular floss** as well as a floss holder* and attended from 2-5 plaque control/oral health educational visits. This rather extensive training program was not sufficient to alter the habits of these randomly selected clinic patients to use floss daily. However, 21 of the 22 that did floss regularly preferred the mechanical flossing device.

Conclusion

Floss held by a mechanical device was as effective as regular hand-held floss in reducing gingival bleeding. The gingival bleeding of the non-flossing group remained unchanged. Patients that expressed a preference, preferred the mechanical flossing device by a ratio of four to three.

The authors thank LTC David Brunner, US Army Dental Corps and LT Robert Hatch, both formerly of US Army Institute of Dental Research and SP6 Wayne Radi for their support in this project.

This study was supported by the US Army Institute of Dental Research.

* EZ Denta Flosser
** Johnson's Dental Floss Waxed
Bibliography


Military Disclaimer

Commercial materials and equipment are identified in this report to specify the investigative procedure. Such identification does not imply recommendation or endorsement, or that the materials and equipment are necessarily the best available for the purpose. Furthermore, the opinions expressed herein are those of the authors and are not to be construed as those of the Army Medical Department.
TABLE I

Modified GBI Score Change Within The Treatment
And Control Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean GBI Change</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Flosser</td>
<td>-.116</td>
<td>98%</td>
</tr>
<tr>
<td>Hand-Held Floss</td>
<td>-.151</td>
<td>99%</td>
</tr>
<tr>
<td>Control</td>
<td>-.047</td>
<td>94%</td>
</tr>
<tr>
<td>Group</td>
<td>Mean GBI Change</td>
<td>Significance Level</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Mechanical vs. Hand-Held</td>
<td>.0358</td>
<td>82%</td>
</tr>
</tbody>
</table>
### Table III

Patient Preference of Hand-Held or Mechanically Held Floss

<table>
<thead>
<tr>
<th>Preference</th>
<th>Number Selecting</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand-Held</td>
<td>11</td>
<td>30.5</td>
</tr>
<tr>
<td>Mechanical</td>
<td>14</td>
<td>39</td>
</tr>
<tr>
<td>No Preference</td>
<td>11</td>
<td>30.5</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>100</td>
</tr>
</tbody>
</table>
The illustration should have the following caption:

Handout given to study participants using floss.

Figure 1 was produced by Preventive Dentistry Products, Inc.
TO WIND FLOSS

PS A N E E

TO USE FLOSSER

Initially use a mirror. Start with the lower front teeth. Place floss at a 45-degree angle and with a slow back-and forth motion slide the floss below the contact point between adjacent teeth. Move floss firmly up and down on the side of one tooth and then repeat on the side of the other tooth. Each time without hurting yourself, so to just below the gum line into the crevice at the base of each tooth. CAUTION: Do not force floss into the gums. Remove floss with the same back and forth motion up through the point of contact. DO NOT PULL FLOSS OUT.

Repeat this flossing procedure in all the spaces between the teeth. Remember there are two sides to be flossed on each tooth. NOTE: Back molars are easily reached from mouth corners using the curved side of the handle to hold floss.

IMPORTANT: Any tooth areas that cause the floss to shred may indicate tartar deposits, cavities, overhanging fillings or other problems and you should consult your dentist.

After flossing all teeth, unwind floss and pull about three inches of fresh floss from cartridge and rewind by following TO WIND FLOSSER directions. Then cut off excess used floss with FLOSS CUTTER.

TO CLEAN TONGUE:

Grasp flossing head and use outer, narrow edge of floss cartridge for cleaning tongue surface.

TO REMOVE AND REPLACE FLOSS CARTRIDGE:

Remove empty floss cartridge by pressing in on ejector button. Pull out about 10 inches of floss from new cartridge. Thread floss up through hole in handle cavity, then snap new cartridge into place in handle.