Plaque-removing Effects of Interdental Instruments in Molar Region

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Abstract

Many types of interdental instrument, such as dental floss and interdental brushes, can be purchased easily and sell in large numbers. Many studies have compared the effects of such instruments. Few studies have investigated their relationship with regions of residual plaque, however. The purpose of this study was to compare rates of plaque removal from the mesial and distal surfaces of the bilateral maxillary and mandibular premolars and molars among 3 types of interdental instrument: finger-winding-dental floss, holder-type dental floss, and an interdental brush. Prior to the experiment, the artificial teeth in a jaw model were removed for application of artificial plaque. The teeth were then replaced and the model attached to a phantom. An operator brushed the teeth in a posture close to that adopted in actual tooth brushing with each type of instrument, after which the plaque removal rate was compared among them. The rate of plaque removal using finger-winding floss was the highest, although this type of instrument is less easy to hold than the others. The rate with a handle-equipped interdental instrument showed a decrease in some regions, although it is easy to hold. The results of this study suggest that the type of interdental instrument used should differ depending on the region to be cleaned.

Key words: Interdental instrument — Plaque-removing effects — Molar region — Dental floss — Interdental brush

Introduction

Dental caries and periodontal disease are caused due to the formation of plaque by oral bacteria, so they can be prevented by appropriate plaque control¹. In Western countries, the use of toothbrushes and interdental instruments in combination has become widespread, and this has a highly preventive effect against dental caries and periodontal disease²⁵. Cleaning using a toothbrush alone has been reported to remove only approximately 65% of plaque from the entire tooth surface¹⁰. Toothbrush bristles are unlikely to reach interdental regions. This means that plaque is often left unreleased, which often
results in the development of gingival inflammation in these regions. Concomitantly using an interdental brush with a toothbrush, however, increases plaque removal 1.5-fold. Equally effective in increasing the rate of plaque removal is concomitant use of dental floss as an auxiliary instrument to prevent dental caries and periodontal disease. Therefore, it is highly important to use interdental instruments and toothbrushes in combination.

Due to increased interest in oral hygiene and periodontal disease, consciousness of plaque control has recently improved, and the market share of interdental instruments has expanded, along with that for toothbrushes. In Japan, many interdental instruments, such as dental floss and interdental brushes, are now easily purchased and are sold in large numbers. In the 2016 Survey of Dental diseases, 30.6% of people reported using dental floss and interdental brushes for oral care, and the percentage is increasing. Poor plaque control is still observed in some regions of the oral cavity, however, even though interdental instruments are in standard use in clinical practice.

Several studies have compared the effects of various types of interdental instrument on plaque control. Few studies have investigated the relationship between each type of interdental instrument and regions with residual plaque, however. In this study, artificial plaque was affixed to a dentition model equipped with artificial gums and attached to a mannequin. The adjacent tooth surfaces were then cleaned using 3 types of instrument: finger-winding dental floss, holder-type dental floss, or an interdental brush. The plaque removal rates on the mesial and distal surfaces of the bilateral maxillary and mandibular premolars and molars were measured to determine the plaque-removing effects of each type of interdental instrument.

Materials and Methods

1. Operators

Tooth cleaning was performed by 5 right-handed 3rd-year students of the Tokyo Dental College School of Dental Hygiene familiar with the use of interdental instruments.

2. Experimental object

A jaw model with artificial gums, epoxy resin artificial teeth (NISSIN Dental Products Inc.), and buccal mucosa (NISSIN Dental Products Inc.) was attached to a mannequin (J. MORITA Corp.).

3. Regions tested

The distal surfaces of teeth #14, 16, 24, 26, 34, 36, 44, and 46, and the mesial surfaces of teeth #15, 17, 25, 27, 35, 37, 45, and 47 were targeted. A 5 × 3-mm rectangular area 2.5 mm to the buccal-side, 2.5 mm to the tongue/palatal-side, and 3 mm to the tooth cervical-side from the contact point was set as the test region on each tooth.

4. Interdental instruments

Three types of interdental instrument used by operators in routine clinical practice were investigated (Fig. 1): finger-winding-type dental floss (RUSCELLO FLOSS®, GC) (hereafter, finger-winding floss); Y-shaped holder-type dental floss (DENT. EX ULTRA FLOSS®, LION Dental Products Company Ltd.) (hereafter, holder floss); and an interdental brush (SSS) fit to the lower embrasure (DENT. EX Interdental Brush®, LION Dental Products Company Ltd.) (hereafter, interdental brush).

5. Experimental methods

Prior to the experiment, the artificial teeth were removed from the jaw model. Artificial plaque (NISSIN Dental Products Inc.) was then applied homogenously to the teeth, avoiding uneven coating, after which they were allowed to dry naturally for 30 min. The artificial plaque was then applied again and allowed to dry naturally for 30 min. The artificial teeth were then returned to the jaw model, which was then attached, together with the buccal mucosa, to the mannequin, setting the Frankfort plane parallel to the floor. The operator stood behind the manne-
quin and brushed the teeth using each type of interdental instrument in a posture close to that adopted in actual brushing. During brushing, the finger-winding floss, holder floss, or interdental brush was inserted between each pair of teeth targeted (#14 and 15, 16 and 17, 24 and 25, 26 and 27, 34 and 35, 36 and 37, 44 and 45, and 46 and 47). The instrument was moved reciprocally in the buccolingual direction 10 times to remove artificial plaque. The artificial teeth were then removed from the jaw model and their adjacent surfaces photographed using a digital camera. Each operator performed this procedure 5 times, after practicing prior to commencement under the guidance of a dentist. The contact point and a 5-mm scale were marked on the artificial teeth beforehand.

6. Analytical method

The images acquired using the digital camera were magnified on a computer screen. The 5×3-mm test area (Fig. 2) was equally divided into 240 squares, and the squares from which the artificial plaque had been completely removed counted. The plaque removal rate was calculated according to the following equation: the number of squares/240×100 (%).

7. Statistical analysis

A 2-way layout analysis of variance followed by Tukey’s multiple comparison were used to analyze the relationships between the plaque removal rates on the mesial and distal surfaces of the bilateral maxillary and mandibular premolars and molars and each type of interdental instrument. A p-value of 5% was considered to indicate statistical significance.

Results

1. Rates of plaque removal with each type of interdental instrument in maxilla and mandible

In the maxilla, the rates of plaque removal with finger-winding floss and an interdental brush were 44% and 41%, respectively, which was significantly higher than that with holder floss (26%).

In the mandible, the rates of removal with finger-winding floss and an interdental brush were 51% and 42%, respectively, which was significantly higher than that with holder floss (32%) (Fig. 3).

2. Rates of bilateral plaque removal with each type of interdental instrument

On the non-dominant side —that is, the left side here, as all the operators were right-handed— the rates of plaque removal with holder floss and an interdental brush were 27% and 38%, respectively, which was significantly lower than that with finger-winding floss (50%).

On the right side, the rates of removal with finger-winding floss and an interdental brush were 45% and 45%, respectively, which was significantly higher than that with holder floss.
3. Rates of plaque removal from mesial and distal surfaces with each type of interdental instrument

From the mesial surface, the rates of plaque removal with finger-winding floss and an interdental brush were 53% and 46%, respectively, which was significantly higher than that with holder floss (28%).

From the distal surface, the rate with finger-winding floss was 43%, which was significantly higher than that with holder floss (30%) (Fig. 5).

4. Rates of plaque removal from premolars and molars with each type of interdental instrument

From the premolars, the rate of plaque removal with finger-winding floss was 49%, which was significantly higher than that with holder floss (36%).

From the molars, the rates of plaque removal with finger-winding floss and an interdental brush were 47% and 37%, respectively, which was significantly higher than that with holder floss (22%).

In addition, the rates of plaque removal from the premolars and molars with holder floss were 36% and 22%, respectively, demonstrating a significantly higher rate than that from the premolars (Fig. 6).

Discussion

The rates of plaque removal with finger-winding floss in the maxilla and mandible were significantly higher than those with holder floss. This may have been because finger-winding floss allows greater freedom in direction of movement. On the other hand, the direction of brushing in interdental
regions with holder floss is likely to be limited, which may result in plaque being left unre¬moved in specific regions, although this type of instrument has an advantage over finger¬winding floss in terms of ease of holding.

On the non-dominant side, the rates of plaque removal with holder floss and an inter¬dental brush were significantly lower than that with finger-winding floss. This may have been due to limitations in the direction of interdental brushing: the operators were all right-handed, which meant that the work had to be carried out with weaker, contralateral hand. On the right side, the rates of plaque removal with finger-winding floss and an interdental brush were significantly higher than that with holder floss, because the move¬ment of interdental brushing with holder floss is likely to be limited compared with that with finger-winding floss or an interdental brush.

From the mesial surface, the rates of plaque removal with finger-winding floss and an interdental brush were higher than that with holder floss. This may have been due to limitations in the direction of interdental brushing with holder floss, as it is difficult to control movement in the mesial direction from behind. From the distal surface, the rate of plaque removal with finger-winding floss was significantly higher than that with holder floss. This may have been due to the greater degree of freedom of movement with finger¬winding floss, whereas the direction of inter¬dental brushing with holder floss is likely more limited.

From the premolars, the rate of plaque removal with finger-winding floss was signifi¬cantly higher than that with holder floss. This may have been due to the greater degree of freedom of movement with finger¬winding floss, whereas the direction of inter¬dental brushing with holder floss is likely more limited. From the molars, the rates of plaque removal with finger-winding floss and an interdental brush were significantly higher than that with holder floss, which may have been due to a limitation in the direction of interdental brushing with holder floss. In addition, the rate of plaque removal with holder floss was significantly lower from the molars than from the premolars. This may have been because the direction of insertion with holder floss is much more limited in a more posterior tooth location. This would have resulted in poorer contact between the tooth surface and the holder floss in many regions.

The rate of plaque removal with finger¬winding floss was significantly higher than that with holder floss in all regions. This sug¬gests that the direction of interdental brush¬ing with holder floss is more limited, which would result in plaque being left unre¬moved in specific regions, even though this type of instrument can be easily held.

The rate of plaque removal with the inter¬dental brush was slightly higher than that with holder floss. The degree of freedom of direction of movement with both devices is likely more limited than that with the finger-wind¬ing type due to their having a handle. The tooth surface area touched by an interdental brush is greater than that touched when using holder floss, however, as an interdental brush has many bristles and the core is made of wire. This enables the bristles to be firmly inserted into the interdental regions, which may have resulted in the higher plaque removal rate observed here.

No significant difference was noted in the plaque removal rate between the finger-wind¬ing floss and the interdental brush in most regions. Finger-winding floss offers freedom of movement in all directions, which means that its plaque-removing effects may be comparable to those with an interdental brush when properly used.

On the non-dominant side, the rates of plaque removal with the interdental brush and holder floss were significantly lower than that with finger-winding floss. Both hands are used when employing finger-winding floss, so this may have obviated any inconvenience on the non-dominant side in comparison with the other two types of instrument. In contrast, only one hand is needed to use an interdental brush or holder floss; therefore, when used
on the non-dominant side, insertion into the interdental region is more difficult due to limitations in the direction of brushing.

These results suggest that it is important to instruct patients on how to properly use interdental instruments with an understanding of the advantages and disadvantages inherent in each type.

**Conclusion**

1. The rate of plaque removal with finger-winding floss was significantly higher than that with holder floss in all regions.
2. The rate of plaque removal with an interdental brush was slightly higher than that with holder floss.
3. No significant difference was noted in the rate of plaque removal between the finger-winding floss and interdental brush in most regions.
4. On the non-dominant side, the rates of plaque removal with an interdental brush and holder floss were significantly lower than that with finger-winding floss.
5. The rate of plaque removal with holder floss was significantly lower from the molars than from the premolars.

Although finger-winding floss has a disadvantage in terms of ease of holding, the plaque removal rate was high. On the other hand, although interdental instruments with a handle are easier to hold, the plaque removal rate was lower in some regions. This suggests that choice of interdental instrument should depend on the region to which it is to be applied.

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