

Tooth Brushing and Oral Health: How Frequently and when should Tooth Brushing be Performed?

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Summary: This review shows that there is consensus in the literature that (meticulous) tooth brushing once per day is sufficient to maintain oral health and to prevent caries and periodontal diseases. Tooth brushing is also regarded as an important vehicle for application of anti-caries agents, such as fluorides. However, most patients are not able to achieve sufficient plaque removal by performing oral hygiene measures at home. Therefore, tooth brushing twice daily is recommended by most of the dentists in order to improve plaque control. This rule is followed by most of the patients taking care for their oral health and has shown to be effective in maintenance of oral health in numerous studies.

Study of the literature gives no clear evidence as to the optimal time-point of tooth brushing (before or after meals). However, in order to eliminate food impaction and to shorten the duration of sucrose impact by tooth cleaning after meals seems to be recommendable. Although – with our current knowledge of potential harm due to brushing of erosively altered and softened tooth surfaces – giving advice on a more individual basis is recommended for patients suffering from erosion.

Keywords: Tooth brushing, frequency, time point

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ASPECTS OF TOOTH BRUSHING AS A MEANS FOR ACHIEVING ORAL HEALTH

The bacterial biofilm (plaque) is commonly held responsible as one main reason for formation of both caries and inflammatory periodontal diseases. Studies have proved that onset of these diseases might be prevented by regularly meticulous plaque removal in form of primary prevention (Axelsson and Lindhe, 1978; Garmyn et al, 1998). Moreover, as an integral part of supportive therapy after periodontal treatment or management of dental carious (secondary prevention), efficient plaque

control may stop progression, recurrence or formation of new periodontal (Axelsson and Lindhe, 1981a; 1981b; 1981c; Axelsson et al, 1991; Garmyn et al, 1998) or carious lesions (Baca et al, 2003). Although, it should be noted that beside the presence of plaque other factors, such as systemic diseases (for example diabetes mellitus), genetic polymorphisms or tobacco consumption play an important role especially in the development of periodontitis (Page, 2002; Kinane and Hart, 2003; Verma and Bhat, 2004). Beside the professional preventive care performed by dentists or dental hygienists, the individual oral hygiene conducted at home is also of great importance. The individual daily oral hygiene necessitates the mechanical removal of the bacterial biofilm by tooth brushing and methods for cleaning of the interproximal areas by flossing or brushing with specially designed interdental brushes.

It has been shown that more plaque is removed when brushing time is increased from one to four minutes (Huber et al., 1985). However, even brush-

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ing for four minutes left the posterior teeth and lingual aspects of the teeth with higher plaque accumulation as compared to anterior teeth and buccal aspects. This underlines that not only brushing time but also brushing technique is important for maximum effectiveness. Data from five- to 15-year-olds have also indicated that little improvement in plaque removal is gained beyond 60 seconds of brushing, presumably because the patients are continually missing the same areas (Ashley, 2001). In this sense, a previous study showed that effectiveness in plaque removal was better in children of dentists having presumably received proper oral health care instructions, compared to children from other academic parents who were not so well-informed (Ainamo and Holmberg, 1974). Despite this interesting observation, a systematic review revealed that dental health education and intervention generally has only a small and temporary effect on plaque accumulation (Kay and Locker, 1996).

Tooth brushing is mostly recommended to be performed after meals to eliminate both bacterial plaque and food impaction. After meals, food remnants are especially retained for a longer period in interproximal niches compared to occlusal surfaces or cervical portions of teeth. A period of 30 seconds of tooth brushing after a meal is effective in eliminating food remnants nearly completely (Marthaler, 1978). Regular tooth brushing after a meal is accepted by many patients, as emphasised by a recent study performed in 77,845 employees in Japan (Kawamura and Iwamoto, 1999).

This above-mentioned recommendation to brush teeth after meals essentially dates from a classical study in which caries increment in 946 students was monitored (Fosdick, 1950). The control group of students continued customary oral hygiene habits (tooth brushing before and after bedtime), the test group undertook tooth brushing thoroughly within 10 minutes after eating or, when brushing was impossible, rinsed their mouth thoroughly with water. A significant lower caries increment was reported for the test group (1.49 DS) compared to the control subjects (2.53 DS). However, deficiencies in the design of the study (eg. lack of randomisation) complicate an overall assessment of the results. Nevertheless, tooth brushing at regular intervals also has the benefit of being regarded by the patient as routine behaviour. However, tooth brushing must be performed effectively whilst minimising the risks to the dental hard tissues. This is

especially true when tooth brushing is performed almost immediately after an erosive attack by acidic dietary components. There is evidence that erosively altered and softened surface of both enamel and dentine can be easily removed by the tooth brushing action (Jaeggi and Lussi, 1999; Attin et al., 2001; Eisenburger et al, 2001; Eisenburger et al, 2003; Attin et al, 2004). In-situ-studies on this topic have shown that a minimum of 60 min is needed to re-establish abrasion resistance of previously eroded enamel and dentin (Jaeggi and Lussi, 1999; Attin et al, 2001; 2004) This period could not be shortened by rinsing with fluoride solutions as shown in in-vitro-studies (Attin, 1997; Attin et al., 1998). Therefore, patients suffering from erosion should be advised to brush their teeth not before a time lapse of about 60 minutes after an erosive attack. It was also shown, that frequency of daily tooth brushing is positively correlated with the occurrence of erosive/abrasive non-carious root lesions (Kalsbeek et al, 1997). The opinion that tooth brushing is also associated with gingival recession is not supported by the literature (Addy and Hunter, 2003). With regard to the best time for tooth brushing, it should also be taken into consideration that a meticulous and, if possible, complete plaque removal before meals would create clean tooth surfaces before consuming substrates that are fermentable for bacteria.

Having enough time for tooth brushing seems to be an important prerequisite for optimal tooth cleaning. A study performed with 471 Brazilian workers showed a significant relationship between flexibility of the working time schedule and tooth cleaning frequency, range of oral hygiene aids used and level of dental plaque (Abegg et al, 1999; 2000). Moreover, schoolchildren and young adults with a later bedtime showed a trend towards decreased tooth brushing frequency (Macgregor and Balding, 1987; Macgregor et al, 1996).

In some studies the impact of lifestyle and behavioural factors on tooth brushing frequency were evaluated. Frequency of tooth brushing was shown to correlate with healthy life style and the frequency of dental visits (Sakki et al, 1998; Suominen-Taipale et al, 2000; Tada and Matsukubo, 2003). However, occupational status and individual socioeconomic situation did not generally have an influence on tooth brushing behaviour (Sakki et al, 1998; Abegg et al, 1999; Christensen et al, 2003). The majority of studies indicate that women brush their teeth more often than men. A recent survey

showed that 88% of the interviewed females compared to 63% of males brushed their teeth twice or more per day (Tada and Hanada, 2004).

THE IMPACT OF TOOTH BRUSHING ON PERIODONTAL HEALTH

Classical clinical studies have proved that in patients with healthy periodontal conditions, meticulous and complete removal of supragingival bacterial plaque every 24-48 hours is sufficient to prevent gingivitis (Lang et al, 1973; Kelner et al, 1974). In these studies, plaque control was performed in a dental practice by trained personnel. Conversely, plaque accumulation for about 72 hours will induce gingival inflammation. These findings were underlined in further studies which revealed that the frequency of daily tooth brushing is associated with a reduction or lower incidence and prevalence in gingivitis (Barenie et al, 1976; Hugoson et al, 1998; Taani et al, 2003). It is not completely understood whether the onset of periodontitis might also be prevented by prevention of gingivitis (Sheiham, 1997). Periodontal destruction does not result from supragingival plaque deposits alone but necessitates interaction of other local and host-related factors. Tooth brushing frequency is therefore not strongly correlated with reduction or absence of severe and destructive periodontitis (Baelum et al, 1997; Shizukuishi et al, 1998; Merchant et al, 2002). Clearly, it is the efficacy rather than the frequency of tooth brushing that is important for the quality of plaque removal (Jepsen, 1998; Kinane, 1998).

THE IMPACT OF TOOTH BRUSHING ON CARIES

It is not completely clear how plaque thickness is related to development of caries. Mature interproximal plaque, as compared to smooth surface plaque, has a lower content of calcium, phosphate and fluoride, which might provide the bacterial aggregate with a higher cariogenic potential (Wilson and Ashley, 1988). Conversely, an intermediate plaque thickness (0.5 mm) is able to reach the critical pH-value for enamel dissolution more quickly than a thin (0.1 mm) or thick plaque (Dawes and Dibdin, 1986). However, the thicker the plaque, the more time is required to reach neutral pH after a drop in pH (Dawes and Dibdin, 1986). This sug-

gests that in order to prevent caries, bacterial accumulation should not reach a critical thickness. This hypothesis is supported by the majority of studies which show that a higher frequency of tooth brushing correlates with a lower prevalence and incidence of caries, although very often results do not reach clinical significance (Leske et al, 1976; Stecksen-Blicks and Gustafsson, 1986; Chesters et al, 1992; Pine et al, 2000; Stecksen-Blicks et al, 2004). Thus, tooth brushing frequency and oral hygiene, among other factors, act as risk indicators for the development of carious lesions (Mascarenhas, 1998; Harris et al, 2004). This finding is corroborated by the observations that the earlier children start to brush their teeth, the lower the caries experience in seven-year-olds compared to controls (Vanobbergen et al, 2001) and the lower the level of detectable *S. mutans* (Habibian et al, 2002).

However, there are also studies that demonstrate only weak or no association between tooth brushing frequency with caries (Dale, 1969; Town, 1979; Ety et al, 1994; Sutcliffe, 1996). Frequent tooth brushing does not necessarily lead to elimination of plaque if the brushing is ineffective – thus the importance of efficacy of tooth cleaning compared to frequency. It should also be noted that those who brush their teeth more frequently are likely to be more concerned with other aspects of oral health. It is also important to consider that tooth brushing is usually performed using fluoridated dentifrices; the higher the tooth brushing frequency the more frequently fluoride is applied. It is, therefore, not tooth brushing per se, but tooth brushing with a fluoridated dentifrice which is largely responsible as the caries-preventive measure (Bibby, 1966; Petersson and Bratthall, 1996; Bratthall et al, 1996; Sutcliffe, 1996). Intra-oral retention of fluoride after brushing with a fluoridated dentifrice depends on the mode of post-brushing mouthrinsing (Attin and Hellwig, 1996). Studies investigating the impact of mouthrinsing procedures after tooth brushing with fluoridated dentifrices clearly show that when less fluoride is expectorated after the brushing the caries incidence is lower (Sjögren and Birkhed, 1993; O'Mullane et al, 1997; Chestnutt et al, 1998; Ashley et al, 1999).

CONCLUSIONS

- Toothbrushing (especially with fluoridated dentifrices) is effective in the reduction of caries.

- Toothbrushing is effective in reduction of gingivitis, but not of aggressive periodontitis.
- Rather the quality of toothcleaning than the frequency is important for maintenance of oral health.
- Despite lack of evidence in literature as to the optimal time-point of tooth brushing (before or after meals), it is recommendable to perform toothcleaning after meals in order to eliminate food impaction and to shorten the duration of sucrose impact.
- On the basis of the knowledge of potential harm due to brushing of erosively altered and softened tooth surfaces, patients suffering from erosion should be instructed on a more individual basis giving the advice to brush their teeth not before a time lapse of 60 min after an erosive attack.

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