PM Mukherjee K Almas

## Orthodontic considerations for gingival health during pregnancy: a review

#### Authors' affiliations:

Padma M. Mukherjee, Division of Orthodontics, Department of Craniofacial Sciences, University of Connecticut School of Dental Medicine, Farmington, CT, USA Khalid Almas, Division of Periodontology, University of Connecticut School of Dental Medicine, Farmington, CT, USA

#### Correspondence to:

Dr Padma M. Mukherjee Division of Orthodontics Department of Craniofacial Sciences University of Connecticut School of Dental Medicine 263 Farmington Ave Farmington, CT 06030, USA Tel.: +1 860 679 3625 Fax: +1 860 679 1920 E-mail: pmukherjee@uchc.edu

Dates: Accepted 11 February 2009

#### To cite this article:

*Int J Dent Hygiene* **8**, 2010; 3–9 DOI: 10.1111/j.1601-5037.2009.00383.x Mukherjee PM, Almas K. Orthodontic considerations for gingival health during pregnancy: a review.

© 2009 John Wiley & Sons A/S

Abstract: Gingivitis is caused by several known systemic and local factors. Among systemic factors, the role of hormonal changes during pregnancy is well established. While presence of fixed orthodontic appliances alone may not cause gingivitis, factors such as pregnancy and poor oral hygiene combined together could precipitate acute gingival inflammation that may progress to a periodontal condition in a patient receiving orthodontic therapy. There has been an increase in the number of adult patients who are receiving orthodontic treatment. Orthodontic appliances could act as a potential plaque retentive source and aggravate inflammatory reactions that are seen during pregnancy. There is a lack of awareness regarding oral healthcare issues among patients who are pregnant and choose to seek orthodontic treatment. In addition, there is a need in the literature to outline management guidelines for patients who want to receive orthodontic treatment during pregnancy, with or without preexisting gingival conditions. This review focuses on the aetiology of pregnancy gingivitis and the management of orthodontic patients during pregnancy. Our emphasis is on patient education, oral hygiene maintenance, preventive and treatment strategies for the management of gingival health in orthodontic patients during pregnancy. We also highlight some of the possible complications of initiating orthodontic treatment during pregnancy.

Key words: gingiva; oral hygiene; orthodontics; pregnancy

## Gingivitis

Gingivitis is one of the most common causes of periodontal disease. Aetiological factors of gingivitis can be broadly classified into local and systemic causes. Local causes may include microorganisms, food impaction, certain drugs and some iatrogenic factors like faulty restoration (rough surfaces or crowns, marginal overhangs) and orthodontic appliances. Most of these local factors act as plaque retentive areas and when coupled with poor oral hygiene maintenance leads to gingival inflammation. Systemic causes include disorders like diabetes, haematological disorders, nutritional imbalance and hormonal changes including pregnancy (1–5).

Local factors of gingival inflammation include calculus, defective restorative margins and orthodontic appliances. These factors act as plaque retentive factors causing constant gingival irritation and leading to inflammation. Here, we will discuss presence of orthodontic appliances and gingival inflammation in more detail. It is known that orthodontic appliances could compromise the maintenance of optimum oral hygiene even in the most conscientious patient (6). Although in most children undergoing orthodontic therapy, with no previous history of loss of attachment or periodontal disease, the only consequence of wearing orthodontic appliances is a transient mild gingivitis caused by plaque. After completion of orthodontic therapy, this problem usually resolves because of ease in the access of inter-dental cleaning. However, during pregnancy, because of the presence of established gingivitis in some patients, the condition usually can progress to an irreversible breakdown of the periodontium.

Systemic factors that cause gingival inflammation can be broadly classified into genetic, haematological, hormonal, metabolic and environmental factors. Gingivitis and gingival hyperplasia have been associated with hormonal changes as seen during puberty, pregnancy and menopause (1-3, 7, 8). This belief is also supported by research that report an increase gingival inflammation in women taking steroid hormones, oral contraceptives and other drugs that contain oestrogen and progesterone (9-12). Animal studies have also demonstrated that there is an increase in gingival inflammation in experimental animals that are treated with systemically administered male and female sex hormones (13-15). Studies have shown that pregnant women have an increased incidence of gingival inflammation compared with non-pregnant women (16, 17). Progesterone has been shown to increase gingival exudates, affect the gingival vascularity and integrity of the capillary endothelial cells (13, 14). Sex hormone-induced alterations in the subgingival microflora lead to an increase in periodontal inflammation (17, 18). During pregnancy, there could be immunosuppression where CD4:CD8 ratios may be decreased (19) and there could also be low lymphocyte responsiveness (20, 21). The presence of increased sex hormones during pregnancy may cause epithelial separation and an increase in vascular permeability (15).

4 Int J Dent Hygiene 8, 2010; 3-9

Vascular and hormonal changes may increase the gingival crevicular fluid and aggravate response to plaque (8, 11).

## Oral health care during pregnancy

It has been reported that in the United States, over 6 million women get pregnant each year (22). Less than a quarter of these women receive any dental care during pregnancy (23, 24). Studies have also reported that an important factor that determines if pregnant women seek dental care is their socioeconomic status and subsequently the type of oral hygiene methods used (25). Women with lower socio-economic strata tend to avoid visiting dental offices during pregnancy. In addition, there is a lack of awareness among women about the potential risk of poor pregnancy outcomes and periodontal disease (24, 26, 27). Thus dental care visits are reduced during pregnancy and some choose to wait until after delivery to address any oral healthcare needs (28). Studies have shown a correlation between periodontal disease and increased risk of preterm low birth weight babies. In addition, there is research to support that treatment of periodontal disease could reduce preterm births (29-33). There have been reports that support the association of periodontal disease with pre-eclampsia during pregnancy (34).

It is therefore not surprising that several studies have been conducted to investigate dental care seeking behaviour during pregnancy. Most of them show that at the most only 35-50% of women visit the dentist during pregnancy (23, 35). Another interesting area to discuss at this point is the behavioural aspects of pregnant patients. There appears to be a tendency towards self-negligence and maintenance of poor oral hygiene habits during pregnancy (36). For many years, education campaigns have followed the Knowledge-Attitude-Behaviour (K-A-B) Model. The K-A-B model asserts that education leads to greater awareness and attitude change and this leads to responsible behaviour. Behaviour is also affected by social contexts and social norms that may contribute towards changing behaviour, as well as personal motivations, religious and cultural beliefs, and knowledge about the consequences of actions (6, 37). Thus, being cognizant of these important issues is critical for the dental profession who could play a major role in patient education and oral health awareness.

# Periodontal health during orthodontic treatment

Some professionals believe that long-term periodontal health benefits from orthodontic care, while others believe that it does not (38-40). Orthodontic therapy can provide benefits to adult periodontal health in several cases such that crowding where improvement in the alignment allows better access to oral hygiene maintenance. In addition, opening embrasures in some cases could help regain lost papilla and obvious aesthetic improvement caused by adjusting gingival margin especially in the anterior region (41). However, especially during pregnancy, in cases that have pre-existing gingival inflammation, presence of orthodontic appliances could increase the demand of rigorous oral hygiene maintenance and in patients who lack that self-motivation, the periodontal condition may get aggravated when orthodontic appliances are present in the oral cavity. It is known that fixed appliances can act as plaque-retaining devices. However, when coupled with pre-existing gingival inflammation that may be present in a pregnant patient, there could be fast progression towards periodontal disease. Ideally, tooth movement should not be done during active gingival inflammation because of increased risk of periodontal abscess formation. According to some reports, the prevalence of periodontal disease in pregnancy is around 35-100% (22). There is also an additional factor of self-neglect among pregnant women as we have discussed earlier (36). Also postpartum, women's oral health condition has been shown to deteriorate further. While there is literature to support that oral health of women is not optimal during pregnancy and after childbirth, there have been three case-control cohort and cross-sectional studies that have demonstrated that periodontal disease may be a potential independent risk factor for preterm low-birth-weight babies (29, 30, 42). Thus, it is of paramount importance to create awareness in the dental profession and also to educate women about the importance of oral health care during orthodontic therapy especially if they are pregnant.

## Orthodontic considerations and management

## Medical, dental and psycho-social history

Like any other form of dental care, before starting orthodontic therapy, a thorough and detailed medical history is critical. However, in case of pregnancy, it is important to get the opinion of the gynaecologist if any known complications are to be expected. A history of current medications is also valuable because various drugs have oral side effects and may influence the course of the orthodontic therapy. Drugs such as bisphosphonates and vitamin D metabolites could probably cause a reduction in tooth movement during orthodontic therapy, while non-steroidal anti-inflammatory drugs have also been shown to reduce bone resorption. Any previous medical conditions such as diabetes mellitus or previous pregnancy complications are important to know in advance before starting orthodontic treatment (14, 33). The patient's perception of their own health is considered to be an important aspect of their psychosocial make up and potential compliance. If the patient has suffered previously from certain complications during her pregnancy and is at a risk as per her medical care provider, it may be best to wait until postpartum to start orthodontic therapy.

A complete dental history provides the orthodontist knowledge about the patient's attitude towards dental care and patient's priorities. A patient who does not receive routine dental care and is negligent about oral care is unlikely to be compliant during orthodontic treatment. A record for the cause of tooth loss if any is also important. History of trauma and sensitivity with previously traumatized teeth is extremely important to know prior to commencement of orthodontic treatment. As the number of adult patients seeking orthodontic treatment is on an increase, it is important that the orthodontists must be more active and capable of diagnosing gingival and periodontal problems. If the patient already has signs such as gingival inflammation, bleeding on probing, presence of pockets and poor oral hygiene, it may be wise to start orthodontic therapy after the pregnancy. However, there are no obvious contraindications to orthodontic therapy in a healthy pregnant patient. However, it may be advisable to limit the visits to shorter appointments to avoid the patient being in extreme supine position especially during the later stages of the pregnancy. Radiographic imaging such as a panoramic film and periapical films are routinely used to assess periodontal health and root inclinations. According to American Dental Association (ADA), every precaution should be taken to minimize radiation during pregnancy. However, if there is an acute dental infection, it must be addressed and radiographs can be taken. In addition, the radiation caused by oral radiography is minimal. It is advisable to coordinate the orthodontic treatment plan with the obstetric care provider to establish guidelines that will benefit maternal oral health and perinatal outcomes.

It is important for the orthodontist to know if the patient is self motivated and enthusiastic about receiving orthodontic treatment. It is especially important to take into account the hormonal and physiological changes that will be anticipated during the course of pregnancy and the patient must be mentally prepared to visit the orthodontist for regular adjustments. It is critical to discuss in depth about the entire course of the treatment, the expected number of visits and the level of cooperation that will be required for successful completion of orthodontic treatment to achieve ideal function and aesthetics.

#### Orthodontic treatment plan

It is of utmost importance to plan a simple and realistic treatment plan in patients who are pregnant. A good communication between the orthodontist and the patient is a key for successful results. If the patient wants to undergo orthodontic therapy primarily for frontal aesthetics and is not willing to be compliant for a 2-year treatment plan and comprehensive therapy, this needs to be established at the beginning. In such patients, limited treatment should only be performed. As an alternative in some patients, it may be advisable to wait until after the pregnancy to start orthodontic treatment.

#### Oral hygiene maintenance during orthodontic treatment

Before starting orthodontic treatment, any pre-existing periodontal condition must be addressed. Because of pre-existing hormonal changes during pregnancy, the gingival tissues may be already inflamed in pregnancy women. Thus, a more rigorous oral hygiene routine will be required to maintain optimal oral health. Frequent dental prophylaxis will be helpful and meticulous home-care regimens will need to be employed to ensure success. In addition to tooth brushing, a detailed instruction in the manipulation of dental floss will enable the patient to floss when the braces are in the mouth. Many interdental cleaning aids such as tooth picks or miniature bottle brushes can be attached to handles for the convenience of manipulation around teeth (8), Thus oral hygiene regimen maintained at home and coupled with professional dental cleaning will ensure successful oral health and keep orthodontic patients during pregnancy free of gingival and periodontal disease during active treatment.

## Patient education and awareness

To increase the use of dental care services among pregnant women, it will be beneficial for dental care professionals to work in conjunction with prenatal healthcare professionals and other dental specialties. It is important that medical professionals dealing with prenatal care be educated the importance of dental care to their patients. In addition, the dental healthcare providers must be aware of the importance of dental care during pregnancy and effects of poor periodontal health on pregnancy and the baby. It is also important for social care services to identify and eliminate barriers such as low educational and socio-economic status that may interfere and prevent pregnant women from obtaining dental care. Various behavioural modification techniques could be employed. The K-A-B model has been

such associated. Especially during orthodontic treatment, which is over a period of a couple of years, constant reinforcement and periodic monitoring and occasional discussions with the patient are extremely crucial. Most importantly, there needs to be a psychological change and motivation in the patient that will make them conscious about their oral hygiene status. It is important to emphasize that professional tooth cleaning alone is not sufficient for preventing gingival and periodontal issues and conscientious oral home care is also of paramount importance. Thus, a combination of professional tooth cleaning and educational reinforcement of oral hygiene will prove to be successful. The model in Fig. 1 depicts steps for successful orthodontic treatment during pregnancy and also highlights causes of failure.
Patient summary (A)
Figure 2(a) are the initial intra-oral pictures of an 18-year-old patient presented to the Orthodontic Resident Clinics at the

patient presented to the Orthodontic Resident Clinics at the University of Connecticut Health centre with a chief complaint 'I do not like my teeth'. Patient was diagnosed with a class I malocclusion with 0% overbite and 4 mm overjet. Patient had retained primary maxillary canines, buccally erupting maxillary left canine and a transposed maxillary right canine. During the initial consultation, it was noted that the patient was 6 weeks pregnant. Apart from the pregnancy, there was no other significant medical history. Her oral hygiene status was fair. The patient was advised to obtain physician's

shown to be successful to motivate patients in improving their

oral hygiene. Knowledge about this technique will enable the

clinicians to provide the necessary information to their patients

to improve their level of understanding of their oral health

issues. Thus, constant motivation of the patient could help

improve patient compliance during orthodontic treatment. It is

critical for the dental care provider to focus on changing the

individual's perceived need towards oral health and/or values



*Fig. 1.* Proposed model for success and/or failure for orthodontic treatment during pregnancy.





approval prior to the start of her orthodontic therapy. Some of the major concerns during her orthodontic treatment were gingival inflammation and bleeding exacerbated with poor oral hygiene. Figure 2(b and c) demonstrate the gingival inflammation around brackets in 3 and 6 months after initiating orthodontic treatment. Although the orthodontic treatment in this case was not difficult, the management of this case became more complex because of inflammatory reaction seen during pregnancy and lack of patient compliance to maintain good oral hygiene.

## Patient summary (B)

Figure 3(a) are the initial intra-oral pictures of a 19-year-old patient with the chief complaint 'I do not like the gap in the front'. Patient was diagnosed with class II malocclusion with anterior open bite caused by thumb sucking habit. She was 3 months pregnant at the start of treatment. Lower right first molar was extracted 2 years ago because of caries. Lower left

(a)

first molar was endodontically treated and had a periapical lesion. It was scheduled for extraction by her general dentist. Patient's thumb sucking habit was addressed with positive reinforcement and orthodontically, she was to be treated with upper bicuspid extraction and using an extrusion arch, we planned to close the open bite. Patient wanted to get implants in the future to replace her mandibular first molars. Figure 3(b and c) illustrate progress pictures 3 and 6 months later. There was improvement with the open bite and there were no clinically visible signs of gingivitis around the orthodontic brackets. The patient's oral hygiene was maintained by educating the patient, motivation and good home-care regimen.

## Conclusions

#### Professional knowledge

From literature review and case report, it has been found that orthodontic treatment during pregnancy may aggravate

*Fig. 3.* (a) Pretreatment intra-oral photographs of patient B (0 months). Patient is end-on class II with 5 mm anterior open bite and 3 mm overjet. Lower left first molar had been extracted 2 years ago because of decay. (b) Progress intraoral pictures after 3 months of orthodontic treatment. Patient's oral hygiene is good and no clinical signs of gingival inflammation around orthodontic brackets. (c) Progress at 6 months. Improvement with the open bite and patient's oral hygiene is well maintained.



gingivitis caused by local and systemic factors. Periodontitis during pregnancy may lead to complications during pregnancy and preterm low-birth-weight babies. Awareness among oral and prenatal healthcare professionals is critical for optimal patient care.

#### Role of professionals

For successful completion of orthodontic treatment, a good communication must be established between the patient and the orthodontist from the beginning. Detailed history, oral examination and assessment of patient compliance and expectations will enable the orthodontist to develop practical goals for successful treatment. It is important for orthodontists to be aware of the limitations that may be inherent in such cases. In addition to reinforcing oral hygiene, it is important that the patient be sent for professional cleaning at regular intervals. Good communication among healthcare professionals will benefit the patient and improve their quality of life.

#### **Role of patients**

It is important for women to be aware of the importance of oral health care especially during pregnancy. We have therefore described in detail the known associations between periodontal disease and complications during pregnancy. Simple and effective home-care measures described earlier and professional dental care will enable women to prevent any gingival and/or periodontal issues during the course of their orthodontic treatment.

## References

- 1 Loe H. Periodontal changes in pregnancy. J Periodontol 1965; 36: 209–217.
- Arafat AH. Periodontal status during pregnancy. J Periodontol 1974;
   45: 641–643.
- 3 Hugoson A. Gingivitis during pregnancy. *Med Hyg (Geneve)* 1970; **28**: 1791.
- 4 Soory M. Hormonal factors in periodontal disease. *Dent Update* 2000; **27:** 380–383.
- 5 Tilakaratne A, Soory M, Ranasinghe AW, Corea SM, Ekanayake SL, de Silva M. Periodontal disease status during pregnancy and 3 months post-partum, in a rural population of Sri-Lankan women. *J Clin Periodontol* 2000; **27:** 787–792.
- 6 Pender N. Aspects of oral health in orthodontic patients. *Br J Orthod* 1986; **13**: 95–103.
- 7 Amar S, Chung KM. Influence of hormonal variation on the periodontium in women. *Periodontol* 1994; 6: 79–87.
- 8 Suomi JD, Greene JC, Vermillion JR, Doyle J, Chang JJ, Leatherwood EC. The effect of controlled oral hygiene procedures on the

progression of periodontal disease in adults: results after third and final year. J Periodontol 1971; 42: 152-160.

- 9 Lindhe J, Sonesson B. Effect of sex hormones on inflammation. J Periodontal Res 1967; 2: 7–12.
- 10 Lindhe J, Branemark PI. Changes in vascular permeability after local application of sex hormones. J Periodontal Res 1967; 2: 259– 265.
- Lindhe J, Branemark PI, Lundskog J. Changes in vascular proliferation after local application of sex hormones. *J Periodontal Res* 1967; 2: 266–272.
- 12 Pankhurst CL, Waite IM, Hicks KA, Allen Y, Harkness RD. The influence of oral contraceptive therapy on the periodontium – duration of drug therapy. *J Periodontol* 1981; **52:** 617–620.
- 13 Lindhe J, Lundgren D, Nyman S. Considerations on prevention of periodontal disease. *Periodontal Abstr* 1970; 18: 50–57.
- 14 Tyrovola JB, Spyropoulos MN. Effects of drugs and systemic factors on orthodontic treatment. *Quintessence Int* 2001; **32:** 365–371.
- 15 Vittek J, Gordon GG, Rappaport SC, Munnangi PR, Southren AL. Phenytoin effect on the proliferation of rat oral epithelium is mediated by a hormonal mechanism. *Cell Differ* 1983; **12**: 335–339.
- 16 Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontol Scand 1963; 21: 533–551.
- 17 Jensen J, Liljemark W, Bloomquist C. The effect of female sex hormones on subgingival plaque. J Periodontol 1981; 52: 599–602.
- 18 Kornman KS, Loesche WJ. The subgingival microbial flora during pregnancy. J Periodontal Res 1980; 15: 111–122.
- 19 Sridama V, Pacini F, Yang SL, Moawad A, Reilly M, DeGroot LJ. Decreased levels of helper T cells: a possible cause of immunodeficiency in pregnancy. *N Engl J Med* 1982; **307**: 352–356.
- 20 O'Neil TC. Maternal T-lymphocyte response and gingivitis in pregnancy. J Periodontol 1979; 50: 178–184.
- 21 O'Neil TC. Plasma female sex-hormone levels and gingivitis in pregnancy. J Periodontol 1979; 50: 279–282.
- 22 Ventura SJ, Abma JC, Mosher WD, Henshaw S. Revised pregnancy rates, 1990–97, and new rates for 1998–99: United States. *Natl Vital Stat Rep* 2003; **52**: 1–14.
- 23 Mangskau KA, Arrindell B. Pregnancy and oral health: utilization of the oral health care system by pregnant women in North Dakota. *Northwest Dent* 1996; **75:** 23–28.
- 24 Al Habashneh R, Guthmiller JM, Levy S *et al.* Factors related to utilization of dental services during pregnancy. *J Clin Periodontol* 2005; **32:** 815–821.
- 25 Nuamah I, Annan BD. Periodontal status and oral hygiene practices of pregnant and non-pregnant women. *East Afr Med J* 1998; 75: 712–714.
- 26 Michalowicz BS, DiAngelis AJ, Novak MJ et al. Examining the safety of dental treatment in pregnant women. J Am Dent Assoc 2008; 139: 685–695.
- 27 Michalowicz BS, Hodges JS, DiAngelis AJ et al. Treatment of periodontal disease and the risk of preterm birth. N Engl J Med 2006; 355: 1885–1894.
- 28 Lindow SW, Nixon C, Hill N, Pullan AM. The incidence of maternal dental treatment during pregnancy. J Obstet Gynaecol 1999; 19: 130–131.
- 29 Offenbacher S, Katz V, Fertik G *et al.* Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol* 1996; 67: 1103–1113.
- 30 Marin C, Segura-Egea JJ, Martinez-Sahuquillo A, Bullon P. Correlation between infant birth weight and mother's periodontal status. *J Clin Periodontol* 2005; 32: 299–304.

- 31 Jeffcoat MK, Geurs NC, Reddy MS, Goldenberg RL, Hauth JC. Current evidence regarding periodontal disease as a risk factor in preterm birth. *Ann Periodontol* 2001; 6: 183–188.
- 32 Jeffcoat MK, Geurs NC, Reddy MS, Cliver SP, Goldenberg RL, Hauth JC. Periodontal infection and preterm birth: results of a prospective study. J Am Dent Assoc 2001; 132: 875–880.
- 33 Gameiro GH, Pereira-Neto JS, Magnani MB, Nouer DF. The influence of drugs and systemic factors on orthodontic tooth movement. *J Clin Orthod* 2007; 41: 73–78 (quiz 71).
- 34 Boggess KA, Lieff S, Murtha AP, Moss K, Beck J, Offenbacher S. Maternal periodontal disease is associated with an increased risk for precelampsia. *Obstet Gynecol* 2003; **101**: 227–231.
- 35 Murtomaa H, Holttinen T, Meurman JH. Conceptions of dental amalgam and oral health aspects during pregnancy in Finnish women. Scand J Dent Res 1991; 99: 522–526.
- 36 Pender NJ, Pender AR. Attitudes, subjective norms, and intentions to engage in health behaviors. *Nurs Res* 1986; **35**: 15–18.
- 37 Sarlati F, Akhondi N, Jahanbakhsh N. Effect of general health and sociocultural variables on periodontal status of pregnant women. *J Int Acad Periodontol* 2004; 6: 95–100.

- 38 Mathews DP, Kokich VG. Managing treatment for the orthodontic patient with periodontal problems. *Semin Orthod* 1997; 3: 21–38.
- 39 Ingervall B, Jacobsson U, Nyman S. A clinical study of the relationship between crowding of teeth, plaque and gingival condition. *J Clin Periodontol* 1977; 4: 214–222.
- 40 Machuca G, Khoshfeiz O, Lacalle JR, Machuca C, Bullon P. The influence of general health and socio-cultural variables on the periodontal condition of pregnant women. *J Periodontol* 1999; 70: 779– 785.
- 41 Bergenholtz A, Bjorne A, Vikstrom B. The plaque-removing ability of some common interdental aids. An intraindividual study. J Clin Periodontol 1974; 1: 160–165.
- 42 Yalcin F, Eskinazi E, Soydinc M *et al.* The effect of sociocultural status on periodontal conditions in pregnancy. *J Periodontol* 2002; 73: 178–182.
- 43 Prichard JF. The effect of bicuspid extraction orthodontics on the periodontium. Findings in 100 consecutive cases. J Periodontol 1975; 46: 534–542.
- 44 Kim J, Amar S. Periodontal disease and systemic conditions: a bidirectional relationship. *Odontology* 2006; **94:** 10–21.

Copyright of International Journal of Dental Hygiene is the property of Blackwell Publishing Limited and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.