

# A Dentobronchial Syndrome. The Relationship between Productive Cough and Periodontitis Affecting Teeth near the Maxillary Sinuses

Christian O. Brøndum, Bjarne Klausen

Clinical observations and existing literature suggest that severe periodontal disease near the maxillary sinuses may contribute to sinusitis and subsequently to chronic productive cough. The aim of the present study was to test this hypothesis. Sixty-five individuals with severe periodontitis affecting upper molars and premolars were selected. Clinical and radiographic examinations included gingival bleeding, clinical probing depth, and alveolar bone loss. In addition, two consecutive questionnaires about smoking habits, productive cough and postnasal drip before and after periodontal treatment were used. The test population was compared to a periodontally healthy control group that was stratified and matched for age, gender and smoking habits. The prevalence of productive cough and postnasal drip was 22% in the test group compared to 6% in the control group ( $p < 0.05$ ). Among the patients who were positive for productive cough 29% also suffered from recurrent sinusitis as diagnosed by an otolaryngologist. After periodontal treatment 43% of the cases reported reduced airway symptoms, although smoking habits were unchanged. The findings support a previous study suggesting that periodontitis affecting teeth near the maxillary sinuses may increase the risk for productive cough. The high prevalence of postnasal drip and diagnosed sinusitis suggests chronic secretory sinusitis as a possible link in the dentobronchial syndrome.

**Key words:** periodontal disease, respiratory diseases, chronic productive cough, maxillary sinus, clinical study

In recent years several studies have suggested an association between periodontal infection and increased risk for cardiovascular diseases (Kuramitsu et al, 2001), preterm birth (Jeffcoat et al, 2001), and poor glycemic control in diabetes mellitus (Taylor, 2001). In addition, clinical evidence for an association between chronic inflammatory periodontal disease and productive cough (chronic bronchitis) has emerged (Scannapieco and Ho, 2001). Epidemiological studies also show similarities between these two diseases. Both are highly prevalent with a social gradient, and tobacco smoking plays a major role in their process of development (Albandar, 2002; Fletcher et al, 1976). Cooperation between dentistry and clinical medicine is needed to define the nature of a possible connection.

The potential mechanisms by which periodontitis may influence the lower airways remain obscure. Existing literature often focus on aspiration of oral pathogens (Scannapieco et al, 2001), but since 50% of healthy people aspirate oropharyngeal contents during sleep (Megran and Chow, 1986), other factors must be involved. Tobacco and alcohol as well as neurological disorders are often considered (Terpenning, 2001). However, it seems possible that two well-known syndromes affecting the upper airways may form a link between periodontitis and productive cough. The term *dental sinusitis syndrome* (endo-antral syndrome) was proposed in 1989 (Selden, 1989), but extension of periapical infections into the maxillary sinuses was described much earlier (Bauer, 1943). Today it is generally accepted that endodontic infections may give rise to sinusitis

(Hauman et al, 2002), and apical or pulpal affections are assumed to cause as much as 40% of all cases of chronic maxillary sinusitis (Selden, 1989). The spread of periodontal infection into the sinus has caused more sporadic attention (Cassel and Lindahl, 1981; Abrahams and Glassberg, 1996), although swelling of the sinus mucosa could be demonstrated in 79% of the sinuses in a group of patients with severe untreated periodontitis (Engström et al, 1988). Chronic sinusitis may go unnoticed by patients for years, and ordinary X-ray will only detect part of the cases. Chronic cough, however, may lead to diagnosis of unsuspected sinusitis (Baker, 1993).

The concept *postnasal drip syndrome* (Mello et al, 1996; Irwin et al, 1981) implies symptoms such as 'clearing of the throat' and more or less persistent coughing-up of swallowed and aspirated mucus. This is a major complaint of secretory sinusitis sufferers (Rosbe and Jones, 1998).

As in the sinobronchial syndrome there are conflicting conceptions of mechanisms and etiologies, but aspiration of mucus from hypersecreting mucosa in the sinuses is recognized as a contributing factor (Sanders, 1964; Singleton, 1971; Irwin and Pratter, 1980; McBride and Brooks, 1984; Leupold, 1993).

The possible connection between these two silent and incompletely explained syndromes was supported by an investigation in patients seeking periodontal treatment. It was found that productive cough was more prevalent in patients affected by periodontitis in the upper jaw than in patients with periodontitis confined to the lower jaw. Half of these cases stopped coughing after effective dental treatment, irrespective of smoking habits (Brøndum, 1992). One of the aims of the present study was to reduce the confounding from smoking that disturbed this previous study. In earlier studies on the relation between respiratory and periodontal diseases the respiratory disease investigated was often chronic obstructive pulmonary disease (Hayes et al, 1998; Scannapieco et al, 2001). Besides cough this concept includes obstructive symptoms due to chronic bronchitis and emphysema.

However, there is no correlation between the prevalence of productive cough and the obstructive symptoms. The majority of subjects with air-flow limitation do not report productive cough, but both symptoms are associated with smoking. In

Denmark 5–8% of the population below 60 years of age has chronic bronchitis, the prevalence being higher among men and in urban areas (Lange et al, 1989). The term *chronic bronchitis* usually refers to bronchial hypersecretion (Fletcher et al, 1976). Because the predominant mechanism of slime production in the present study is considered more complicated than simply bronchial hypersecretion, we prefer the term *chronic productive cough*. Using a two-stage prospective epidemiological method including stratification for tobacco smoking, the aims of the present study were to study: 1) to what extent periodontal disease affecting teeth near maxillary sinuses was related to productive cough and postnasal drip; 2) the possible changes in these symptoms after periodontal treatment; and 3) the possible relationship between the type of periodontal treatment and the reported change of cough/phlegm.

## MATERIALS AND METHODS

The protocol was approved by The Research Ethical Committee of Ribe County (Approval no. 1296/94). The collection of data took five years.

### *Investigation for the Prevalence of Cough/phlegm*

Using interviews the study was a prospective follow up of a cohort with severe chronic inflammatory periodontal disease in close vicinity of the sinus maxillaris matched to a control group with normal periodontal conditions. The total sample population consisted of 130 individuals, aged 30 to 65 years, attending a dental clinic in the town of Esbjerg, Denmark. Individuals with asthma, diabetes mellitus and conditions contra-indicating dental surgery were excluded (Wennström et al, 2003). In addition, patients with cough that could be associated with antihypertensive medication (ACE-inhibitors) were excluded. Nobody refused to participate in the study.

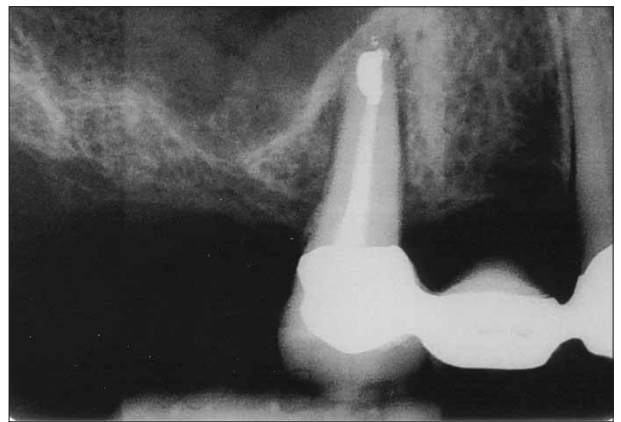
The test population consisted of 65 consecutive patients with severe chronic periodontitis who attended the dental clinic. Inclusion criteria were periodontal probing depths above 5 mm and profound intraosseous defect of at least one maxillary molar or premolar and radiographically verified close proximity of the periodontal defect to the

**Fig. 1a and b** Examples of teeth with profound periodontal involvement and close relation to the maxillary sinus.

**Fig. 1a** 51-year-old female patient, non-smoker with productive cough. The second premolar had 10 mm pockets distally and orally and responded normally to electrometric pulp vitality testing. After surgical treatment the pocket depth was reduced to maximally 5 mm, the periapical lesion healed with osseous regeneration, and the cough and phlegm disappeared.



**Fig. 1b** 50-year-old female patient, moderate smoker (<10 cigarettes/day) with productive cough. The second premolar had a 10 mm pocket distally and the only combined periodontal-endodontal lesion found among the 14 periodontal patients with productive cough. Surgical intervention revealed direct communication between the lesion and maxillary sinus. After combined antibiotic and surgical treatment the pocket depth was reduced to maximally 7 mm, and the cough and phlegm diminished.



maxillary sinus (Fig. 1). Combined periodontal-endodontal lesions were not excluded.

The control group comprised 65 individuals without periodontitis who attended the same clinic. Inclusion criteria were absence of clinical probing depth above 4 mm and bleeding on probing in less than 16% of the teeth. Each person in this group was selected to match a person from the test group with respect to age, gender, and smoking habits (non-smoker/moderate smoking/heavy smoking).

The first interview included the following variables: gender, age, coughing up of slime from the throat for more than 3 months a year, corresponding to BMRC criteria, postnasal drip, current smoking status (non-smoker, moderate smoking=less than 10 cigarettes/day, heavy smoking=at least 10 cigarettes/day). The dentist interviewed all individuals in the two groups for productive cough and post-

nasal drip and filled out the questionnaires. Individuals with both of these symptoms were registered as 'cases'. Fourteen cases were found (Table 1).

#### *Treatment of Patients with Periodontal Disease*

One patient with chronic periodontitis and productive cough refrained from proposed periodontal treatment, whereas the remaining 13 underwent treatment according to individual needs. This included extraction of all periodontally involved maxillary teeth in 2 cases, combination of extractions and surgery in 3 cases, surgical treatment without extractions in 7 cases, and non-surgical treatment in 1 case. In 4 cases (1 non-surgical, 3 surgical) treatment was supplemented with systemic antibiotic treatment (amoxicillin and/or metronidazole) for 7–11 days.

**Table 1** The different prevalences of cough/phlegm in test population (n = 65) and control group (n = 65) after matching for age, gender, and smoking, stratified in 3 groups according to smoking habits (cigarettes/day)

Smoking Habits		Cough/phlegm in test population with periodontitis	Cough/phlegm in control group without periodontitis
Non-smokers	(n = 46)	2	1
Less than 10/day	(n = 16)	3	0
More than 10/day	(n = 68)	9	3
		14	4

#### *Investigation for the Possible Effect of Periodontal Treatment*

One year after the first interview, the fourteen patients considered as 'cases' were telephoned by a physician for a second interview. Two cases could not be contacted. The patients were asked questions on: the character of cough and phlegm after periodontal treatment using the same criteria as in the first interview (the productive cough at the time for first interview had lasted for 3 months a year for at least two years to meet the BMRC definition of chronic bronchitis); postnasal drip (again chosen as a chief complaint of secretory sinusitis); and contacts with general practitioners or otolaryngologists concerning sinusitis during the last five years. In addition patients were asked if they felt any quantitative change in respiratory symptoms (the same, less or no cough/drip) after the periodontal treatment, and if/how they had changed their smoking habits. Information from the clinic's routine patient-questionnaire was also used. A control group consisting of untreated chronic inflammatory periodontal disease-patients was not included because we considered it unethical not to treat patients seeking a dentist and suffering from severe periodontal disease.

#### *Statistical Analysis*

The analysis of the first part of the study was performed as a prospective investigation (follow-up) of two cohorts with and without periodontitis in the

vicinity of the maxillary sinuses. The cases with chronic cough were grouped according to smoking habits and a chi-square test and RR test was performed between coughing cases in the test population and in the control group. Because of the absence of a control group, no statistical analysis was performed concerning the second part of the study.

## RESULTS

**Demographic and Clinical Characteristics of the Test Population**  
The average age was 50 years in the total test population and 48 years in the case group. The majority was female (70%). One patient complained of heart disease, and two were allergic to medicine (Iodine and penicillin). No neurological diseases were found. Intraoral radiographic examination indicated endodontic involvement in one case (Fig. 1).

#### *Findings Resulting from the Interviews*

Results from the first interview are shown in Table 1. Fourteen cases in the test population and 4 in the control group were coughing. The chi-square test was significant:  $p < 0.05$  with Yates correction. RR adjusted for tobacco was  $14/4 = 3.5$  (2.6–4.6). In the second interview, all cases matched the BMRC criteria for chronic bronchitis. The productive cough was typically starting and most intensive in the morning and early hours of the day. No

unusual seasonal changes were reported during the five years. Six individuals (43%) with cough and phlegm at first interview reported less or no symptoms at second interview. All of these patients with improved health had undergone periodontal surgery and three of the cases also underwent extractions of teeth near sinus. None of the smokers had stopped smoking, but four individuals reported that they had reduced tobacco consumption. One non-smoker answered that cough and phlegm almost disappeared after periodontal treatment (Fig. 1). Four of the cases had recurrently during the previous 5 years suffered from sinusitis verified and treated by an otolaryngologist. None had been hospitalized or referred to a dentist.

## DISCUSSION

The present study indicated a strong relation between productive cough, postnasal drip, and periodontitis affecting teeth near the maxillary sinuses. The prevalence of productive cough in the tested population was threefold that in the general population after reducing confounding from tobacco. All the smokers in the study had smoked for several years, the majority having smoked 10 or more cigarettes a day. As seen in Table 1, the prevalence of cough increased with quantity of cigarettes smoked. The confounding from smoking is not totally eliminated, as there was no upper limit of tobacco consumption in the interview. The prevalence of 22% is very high for a population with an average age of 48 years. At this age the prevalence of cough related to smoking is less than 6% (Langhammer, 1997).

The revelation that all cases reported postnasal drip supports the theory of aspiration of phlegm (McBride and Brooks, 1984). Development of progressive lung disease by this route also requires an unrecognized defect in tracheobronchial clearance. The findings in this study highly suggest influence from tobacco, and the low RR in the non-smoker group indicates that smoking is an important co-factor in the development of chronic cough for patients with periodontal disease (Garcia et al, 2001).

The present study did not control for confounding from social class. However, because of high consumer costs for dental treatment in Denmark, it is

unlikely that clients in a private clinic for periodontal surgery would represent a lower socio-economic group. If the test population had originated from a group with a higher percentage of men and poor social conditions, the prevalence of cough and phlegm most likely would be even higher (Lange et al, 1989). In general, the number of women seeking periodontal treatment in the clinic in Esbjerg is approximately twice the number of men, which explains the predominance of women featured in the material.

One third of the cases reported that their otolaryngologist had diagnosed episodes of chronic sinusitis, a condition so difficult to diagnose, that CT scanning is often required (Sanders, 1964; Rosbe and Jones, 1998; Cousin et al, 2000). Three persons claimed to have encountered very little interest in their dental problems from the otolaryngologists.

The recollection of feeling postnasal drip and its variation through a year was in general weaker than the recollection of cough. The majority of the cases regarded cough, but not postnasal drip, as a 'real disease'. Although the value of detailed history taking in diagnosing the cause of cough may be doubtful (Mello et al, 1996), it is interesting that the cough would start predominantly in the morning at the normal change from supine to upright position, which is consistent with postnasal drip (Dirksen and Rasmussen, 1999).

The patients who most convincingly reported fewer symptoms after treatment were those who had received the most radical dental treatment (extraction and surgical intervention). Previously it was found that the swelling of the sinus mucosa that occurred in 79% of the sinuses in severe untreated periodontitis was reduced to 17% after treatment (Engström et al, 1988).

The partial disappearance of cough and postnasal drip in half of the cases after periodontal treatment might be accidental or due to reduced smoking. Even after repeated explanation to the patients of the possible relationship between periodontal disease and cough, it seemed difficult for most of them to imagine any connection.

The reliability of subjective reporting by interviews concerning changes in cough can be questioned. Some smokers accept considerable coughing as a part of normal life. It thus seems noteworthy that one non-smoker also stopped coughing after periodontal treatment (Fig. 1).

Reservations about reliability also apply to questions about smoking. This is not an area where hard scientific data is readily available. However, in both parts of this study intra-observer variation was absent. All the cases were also questioned twice about their cough and smoking using the same criteria. Furthermore, patients' recollection of disappeared symptoms can be doubted, but it was remarkably clear that persons who still felt the postnasal drip easily described this at the second interview.

The relationship between periodontal disease and chronic productive cough found in this study might indicate that periodontitis provoked mucosa in the maxillary sinuses to hypersecretion through an unknown mechanism. Slime may be aspirated during sleep and later coughed up. One important condition might be that patients with sinusitis, attempting to reduce the feeling of pressure, often prefer a sleeping position with elevated head, allowing sinus secretion to drain to the pharynx (Brøndum, personal observation). The finding that not one patient was hospitalized for respiratory diseases indicates that, in this age group, patients with chronic cough will most probably circulate among therapists in the primary sector.

Further evaluation of the possible effect of periodontal treatment requires a study performed in the primary healthcare sector, including a large number of treated patients compared to a control group and a more detailed control for changes in smoking habits.

## ACKNOWLEDGEMENTS

The Research Foundation for Community Medicine in Ribe and Ringkøbing Counties supported the project financially. Thanks to Dr. Jens Georg Hansen for valued manuscript suggestions.

## REFERENCES

- Abrahams JJ, Glassberg RM: Dental Disease: A frequently unrecognized cause of maxillary sinus abnormality. *Am J Roentgenol* 1996; 5: 1219–1223.
- Albandar JM: Global risk factors and risk indicators for periodontal diseases. *Periodontology* 2000 2002; 29: 177–206.
- Baker HL: The many faces of atypical sinusitis. *J Nat Med Assoc* 1993; 85: 773–776.
- Bauer WH: Maxillary sinusitis of dental origin. *Am J Orthodont Oral Surg* 1943; 29: 131–155.
- Brøndum CO: Dentobronkialt syndrom. Kan vedvarende produktiv hoste skyldes parodontitis? En enqueteundersøgelse. *Ugeskr Laeg* 1992; 154: 1502–1505.
- Cassel T, Lindahl L: Oral utredning på patienter med kronisk sinusit. *Tandläkaretidningen* 1981; 7: 336–338.
- Cousin JN, Har-El G, Li J: Is there a correlation between radiographic and histologic findings in chronic sinusitis? *J Otolaryngol* 2000; 29: 170–173.
- Dirksen A, Rasmussen FV: In: Lorenzen I (ed). *Medicinsk Kompendium* 15. udg. Bind 1. Copenhagen: Nyt Nordisk Forlag Busck 1999: 1434.
- Engström H, Chamberlain D, Kiger R, Egelberg J: Radiographic evaluation of the effect of initial periodontal therapy on thickness of the maxillary sinus mucosa. *J Periodontol* 1988; 59: 604–608.
- Fletcher CM, Peto R, Tinker CM, Speizer FE: *The Natural History of Chronic Bronchitis and Emphysema*. Oxford: Oxford University Press 1976; 143–150.
- Garcia RI, Nunn ME, Vokonas PS: Epidemiologic associations between periodontal disease and chronic obstructive pulmonary disease. *Ann Periodontol* 2001; 6: 71–77.
- Hauman CHJ, Chandler NP, Tong DC: Endodontic implications of the maxillary sinus: a review. *Int Endodont J* 2002; 35: 127–141.
- Hayes C, Sparrow D, Cohen M, Vokonas PS, Garcia RI: The association between alveolar bone loss and pulmonary function: the VA dental longitudinal study. *Ann Periodontol* 1998; 3: 257–261.
- Irwin RS, Pratter MR: Postnasal drip and cough. *Clin Notes Resp Dis* 1980; 18: 11–12.
- Irwin RS, Corrao WM, Pratter MR: Chronic persistent cough in the adult: the spectrum and frequency of causes and successful outcome of specific therapy. *Am Rev Resp Dis* 1981; 123: 413–417.
- Jeffcoat ML, 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.
- Kuramitsu HK, Qi M, Kang I, Chen W: Role for periodontal bacteria in cardiovascular diseases. *Ann Periodontol* 2001; 6: 41–47.
- Lange P, Groth S, Nyboe J, Appleyard M, Mortensen J, Jensen G, Schnor P: Chronic obstructive lung disease in Copenhagen: cross-sectional epidemiological aspects. *J Internal Med* 1989; 226: 25–32.
- Langhammer A: Kronisk obstruktiv lungesygdom. In: Hunskaar S (ed). *Allmenmedicin, Klinisk arbejde* 1. ed. Oslo: AdNotam Gyldendal AS 1997; 398–399.

- Leupold W, Wunderlich P: Sinobronchial syndrome – a meaningful diagnosis? *Kinderärztliche Praxis* 1993; 61: 129–133.
- Mello CJ, Irwin RS, Curley FJ: Predictive values of the character, timing and complications of chronic cough in diagnosing its cause. *Arch Internal Med* 1996; 156: 997–1003.
- McBride JT, Brooks JG: Sinobronchial syndrome. *Ear Nose Throat J* 1984; 63: 177–179.
- Megran DW, Chow AW: Bacterial aspiration and anaerobic pleuropulmonary infections. In: Sande MA, Hudson LD, Root RK (eds). *Respiratory Infections*. New York: Churchill Livingstone 1986; 269–292.
- Page RC: Periodontitis and respiratory diseases: Discussion, conclusions and recommendations. *Ann Periodontol* 2001; 6: 87–90.
- Rosbe KW, Jones KR: Usefulness of patient symptoms and nasal endoscopy in the diagnosis of chronic sinusitis. *Am J Rhinol* 1998; 12: 167–171.
- Sanders SH: The confused problems of sinus disease in today's practice of otolaryngology. *Transactions Am Acad Ophthalmol Otol* 1964; 68: 456–469.
- Scannapieco FA, Ho AW: Potential associations between chronic respiratory disease and periodontal disease: Analysis of National Health and Nutrition Examination Survey III. *J Periodontol* 2001; 72: 50–56.
- Scannapieco FA, Bingyan W, Harlan JS: Oral bacteria and respiratory Infection: Effects on Respiratory Pathogen Adhesion and Epithelial Cell Proinflammatory Cytokine Production. *Ann Periodontol* 2001; 6: 78–86.
- Selden HS: The endo-antral syndrome: an endodontic complication. *J Am Dent Assoc* 1989; 119: 397–402.
- Singleton AM: Sinobronchial syndrome, an old-fashioned modern day entity. *Southern Med J* 1971; 64: 754–755.
- Taylor GW: Bidirectional interrelationships between diabetes and periodontal disease: An epidemiologic perspective. *Ann Periodontol* 2001; 6: 99–112.
- Terpenning MS: The relationship between infections and chronic respiratory diseases: an overview. *Ann Periodontol* 2001; 6: 66–70.
- Wennström J, Heijl L, Lindhe J: Periodontal surgery: Access therapy. In: Lindhe J (ed). *Clinical Periodontology and Implant Dentistry*. Oxford: Blackwell Munksgaard 2003; 519–560.

**Reprint requests:**

Christian O. Brøndum, MD, MPH  
Egemosevej 7  
DK-9492 Blokhus, Denmark  
cbrondum@dadlnet.dk