

Effects of Snuff on the Oral Health Status of Adolescent Males: A Comparative Study

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Purpose: The purpose of this study was to investigate effects of snuff on the oral health status of adolescent males.

Materials and Methods: The participants consisted of 80 adolescent males between 16-25 years, 40 snuff users and 40 non-users. The snuff users and non-users were matched with reference to their age. Data were collected using a questionnaire containing questions on general and oral health, daily oral hygiene and tobacco habits. The clinical examination was carried out in a dental office by two experienced dental hygienists. Snuff lesions were clinically classified on a four-point scale and documented on colour slides. The examination also assessed the number of teeth, restored tooth surfaces, plaque index and gingival index, probing pocket depth and gingival recessions.

Results: Out of 40 snuff users, 35 showed snuff included lesions. The clinical diagnosis of snuff users' mucosa showed snuff lesions of different severity clinically classified as degree 1, 2 and 3. When explaining snuff lesions of degree 2 and 3, hours of daily snuff use and package form (portion-bag snuff versus loose snuff) was statistically significant. There were no statistical differences between snuff users and non-users regarding restored tooth surfaces, presence of plaque, gingival inflammation and probing pocket depth. Seventeen percent of the cases showed loss of periodontal attachment as gingival recessions.

Conclusion: In spite of mucosal lesions caused by snuff there were no statistical differences in prevalence in plaque and gingivitis between snuff users and non-users. However, some cases showed loss of periodontal attachment as gingival recessions.

Key words: adolescent, oral health, tobacco habits, snuff lesions

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There is extensive literature on the medically damaging effects of tobacco (for review see Doll et al, 1994). The World Health Organization (WHO) estimates that smoking causes 3.5 million premature deaths worldwide each year.

Regarding the specific impact of snuff on general health there is still a lack of knowledge. It has, however, been shown that snuff-users are at risk of heart disease and that they have a higher pulse rate and higher blood pressure compared to those who do not use tobacco. It is probable that the pulse rate and blood pressure effects are related to nicotine exposure (Bolinder et al, 1994; Bolinder and de Faire, 1998). However, other studies have not been able to show a higher risk of myocardial infarction among snuff-users (Huhtasaari et al, 1992; Huhtasaari et al, 1999).

Oral mucosal changes due to snuff usage are well documented in literature (Axell et al, 1976; Robertsson et al, 1990; Creath et al, 1991; Pindborg, 1992; Tomar et al, 1997; Merne et al, 2002; Taybos, 2003). These changes appear less when using

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portion bags compared to loose snuff (Andersson et al, 1989). Tissue changes caused by Swedish moist snuff have shown to be reversible as soon as the snuff use has ended (Larsson et al, 1991).

Gingival recessions and loss of periodontal attachment appears to a higher degree in connection with mucosal lesions caused by snuff (Robertson et al, 1990; Hart et al, 1995). It has also been shown that snuff users – compared to non-users – in addition to more exposed root surfaces also have a higher level of cervical caries and abrasion (for review see Robertson et al, 1997). Axell (1993) reported that gingival recessions are much more frequently found among users of loose snuff than among users of portion bag snuff, and these seem to be irreversible. Occlusal attrition and discolouration have also occurred more frequently in snuff users than in non-users (Robertson et al, 1997).

Regarding prevalence of plaque, gingivitis, pocket depth and missing teeth, no significant differences have been shown between users and non-users of snuff (Robertson et al, 1997).

Offenbacher and Weathers (1985) reported in a study among males with a mean age of 13.8 years that, in these adolescents with clean mouths free from gingivitis, the use of smokeless tobacco was not associated with a change in the prevalence of gingival recession, mucosal pathology or in the mean DMF score. On the other hand, a connection between tobacco usage and increased caries prevalence has been found by Hirsch et al, (1991) in a study among teenagers ranging from 14 to 19 years of age. However, the authors point out that the influence of eating habits and oral hygiene in these teenagers must be evaluated before the effect of tobacco on caries development can be determined.

It is difficult to attain detailed information on the contents of Swedish snuff (smokeless tobacco in the shape of moist snuff, called 'snus' in Swedish), since consumer information is not required by law. The declaration of contents on the snuffbox reveals that the snuff contains water, tobacco, moist preservatives (E 422, E 1520), taste enhancers (salt), acidifiers (E 500) and aromas, including smoke aroma. At the same time it must be pointed out that around 2,500 chemical components have been identified in tobacco, where the most common component is nicotine (Ahlbom et al, 1997). Other components are sodium carbonate, sodium chloride, TSNA (tobacco-specific nitrosamines) and PAH (polycyclic aromatic hydrocarbons) (Bolinder, 1997).

When Swedish snuff is produced in Sweden, it is exposed to a heat treatment process that creates an almost sterile product with a high level of moisture – about 50% water. Since snuff is a basic substance with a pH level of 7.5 – 8.5, the absorption of nicotine through the mucosa is facilitated, while at the same time there is a risk of erosion (Borg et al, 2000).

In a study among Swedish snuff users, Andersson and Warfvinge (2003) examined the effect of the pH level and nicotine concentration for changes in mucosa and in pH levels in the saliva. Andersson and Warfvinge concluded that the results point to a synergetic effect between nicotine concentration and pH level, and that the nicotine is one of the substances in snuff that has a biological effect on the mucosa.

The Swedish tobacco law was sharpened on January 1, 1997, which among other things meant that anyone under 18 years of age is not allowed to buy tobacco. In a report aiming to describe young people's possibilities to buy tobacco, one of the conclusions was that it was easier to buy snuff than cigarettes for adolescents under the age of 18, and it was also reported that the boys who participated in the study were more often allowed to buy tobacco than the girls (Sundh et al, 2003).

In a follow-up study by Rolandsson and Hugoson (2003) among ice-hockey playing adolescents it was shown that snuff use was increasing in spite of good knowledge about its negative effects, which could mean that different preventive actions carried out by society for these adolescents did not achieve the desired effect to prevent, decrease or persuade the adolescents to give up their tobacco use.

Since only a few international and national studies have been published that produce a more general picture of the effects of snuff on oral health among children and adolescents, it has been found important to conduct the study presented here.

The purpose of this comparative study was to investigate effects of snuff on oral health status of adolescent males.

MATERIALS AND METHODS

Participants

The participants consisted of 80 adolescent males aged between 16 – 25 years – 40 snuff users and

Table 1 Distribution of adolescent males according to age (n = 80)

	Age in years										Total
	16	17	18	19	20	21	22	23	24	25	
Snuff users	2	1	2	6	4	3	10	5	2	5	40
Non-users	2	1	2	6	4	3	10	5	2	5	40
Total	4	2	4	12	8	6	20	10	4	10	80

40 non-users. A snuff user was defined as an individual who used snuff every day or almost every day. The snuff users and non-users were matched with reference to their age. The participants were selected among ice-hockey players in the Värmland region of Sweden and among students in Karlstad, the main town in Värmland. Sixty-five of the participants were active, or had been active, as ice-hockey players and several of them had participated in earlier studies by Rolandsson and Hugoson (2000, 2001, 2003). One hundred and seventy adolescent males were asked to participate before the estimated number of participants was reached. Out of those who declined participation in the study most claimed that they did not have time to participate, while a smaller number said they were not interested in participating in the study. The distribution of the participants according to age is presented in Table 1.

Questionnaire survey

The examination started with a questionnaire containing 27 questions, where the participants' medical and oral health history, daily oral hygiene and tobacco habits were recorded.

Regarding tobacco habits, questions were asked about snuff habits, snuff brand, package form (portion-bag snuff or loose snuff), at which age the respondent started using snuff, the daily amount of snuff use expressed as number of boxes per day (one box = 50 grams of snuff), hours of daily snuff use and number of years with snuff habits. The questionnaire also contained questions regarding smoking habits. These data were collected by the researcher who did not carry out the clinical examinations.

Clinical examination

The clinical examinations were carried out in a dental office by two experienced dental hygienists. After the mucosa was clinically examined for snuff-induced lesions, photos were taken of the snuff-carrying part of the mucosa, often buccally in the front upper jaw, region 13 – 11 and 21 – 23. In cases where the snuff lesions extended to the entire region 13 – 23, photos were also taken of the mucosa buccally in the front lower jaw in order to document healthy mucosa in snuff users. The corresponding areas were photographed on non-users of snuff.

Diagnostic criteria

Snuff lesions

The presences of snuff lesions were clinically noted and classified according to Axéll (1976).

- Degree 1. A superficial lesion with a colour similar to the surrounding mucosa, and with slight wrinkling. No obvious mucosal thickening.
- Degree 2. A superficial, whitish or yellowish lesion with wrinkling. No obvious thickening.
- Degree 3. A whitish-yellowish to brown wrinkled lesion with intervening furrows of normal mucosal colour. Obvious thickening.
- Degree 4. A marked, white-yellowish to brown and heavily wrinkled lesion with intervening, deep and reddened furrows and/or a heavy thickening.

Number of teeth

The number of teeth was recorded. Third molars were excluded from the analysis.

Restorations

The number of restored tooth surfaces was recorded.

Plaque

The presence of visible plaque was recorded for all tooth surfaces after drying with air according to the criteria for the Plaque Index (PLI) system scores 2 and 3 (Silness and Loe, 1964). A PLI score of 2 and 3 was considered to be a positive indication of plaque, and the surface was registered as positive.

Periodontal status

Gingival inflammation

The occurrence of gingival inflammation was assessed at four sites around each tooth, using the criteria of Gingival Index (GI) system scores 2 and 3 (Loe and Silness, 1963). A GI score of 2 or 3 was considered to be a positive indication of gingivitis, and the surface was registered as positive.

Probing pocket depth

The presence of probing pocket depths equal to or exceeding 4 mm was recorded in mm at four sites around each tooth.

Gingival recessions

The presence of gingival recessions was recorded in mm from the cemento-enamel junction.

Statistical analyses

Before beginning the study the researchers calibrated the diagnostic criteria. Calibrations of the clinical variables plaque index, gingival index, probing pocket depth and recessions were carried out on two occasions by the clinical examiners and a specialist in the area.

Regarding the different degrees of snuff lesions, the inter-rater agreement between the two observers was calculated using Cohen's Kappa. The inter-examiner agreement was 0.57 (simple kappa) 95% CI 0.28 – 0.86; (weighted kappa) 0.70, 95% CI 0.48 – 0.91, which means moderate to good strength of agreement (Landis and Koch, 1977).

A power calculation was carried out in order to calculate the number of individuals necessary to find a significant difference of five percentage points between the groups snuff users and non-users regarding gingivitis. A difference of five percent points was deemed clinically interesting. The result

of the statistical calculation at the 0.05 level of significance, power 0.80 and standard deviation = 0.12, was that 40 snuff users and non-users respectively was the number of participants which would secure this level.

Statistical analysis was conducted using the SPSS software package. After having shown that the difference between 'matched pairs' was normally distributed (Kolmogorov-Smirnov Test), tests of significance for differences between users and non-users of snuff, depending on the proportion of plaque and gingivitis present, were carried out using the Students' *t*-test.

The degree of association between snuff-induced lesions and explanatory variables was investigated using multivariate logistic regression. Information on the odds ratios (OR), together with corresponding 95% confidence intervals (CI) is presented. Results were considered statistically significant when $p < 0.05$.

Ethics

The Ethical Committee at Karlstad University approved the study.

RESULTS

General health

All participants claimed to feel healthy. At the same time 23 participants reported allergies: four reported pharmaceutical allergies and nineteen reported other allergies, e.g. to furred animals. Five participants took medications.

Tobacco habits

Twenty-eight of the snuff using participants reported that they had started using snuff at the age of 13 – 15. Seven said they started at age 13 and four answered age 18 – 20 (Fig 1).

The choice of snuff brand and snuff types, loose snuff or portion-bag snuff varied. All snuff brands offered both loose snuff and portion-bag snuff. The brand General was preferred by 22 of the snuff users: 10 preferred loose snuff and 12 used portion bags. Other brands and snuff kinds are presented in Table 2. Thirty-one of the participants reported

Table 2 Number of clinically classified oral snuff lesions according to choice of brand and type of snuff

Clinical Degree	Ia	Ib	IIa	IIb	IIIa	IIIb	IVa	IVb	Va	Vb	Total
0		1		1		1				2	5
1	2	6				2				1	11
2	5	5	2	1	3			2			18
3	3		3								6
4											0
Total	10	12	5	2	3	3		2		3	40

Brand I = General; II = Ettan; III = Grovsnus; IV = Göteborgs Rapé; V = Mixed brand use
a = loose snuff; b = portion-bag snuff

that they used less than one box per day. Seven participants said they used one box per day and two reported using more than one box per day. The number of hours per day the snuff users claimed to use snuff varied between one to 18 hours. Eighteen participants used snuff between 10 – 18 hours per day, six used it between one to three hours and three used it between 15 – 18 hours per day.

Oral health problems

The questionnaire contained questions regarding whether the participants experienced oral health problems. Sixteen snuff users and non-users respectively reported that they sometimes had oral health problems. Twelve respondents reported that their gingiva sometimes bled when they cleaned their teeth. Eight of these were non-users of snuff. Seven of the participants reported problems such as soreness or blisters – five of these were non-users of snuff. Five snuff users and one non-user claimed to have problems with sensitive root surfaces.

Oral health care

Seventy-seven participants reported that they brushed their teeth more than once a day. Three reported that they brushed once a day. When asked what kind of toothbrush the participants used, 67 answered that they used a regular toothbrush and 13 said they used an electrical one. Fifty-one participants used dental floss and one used toothpicks.

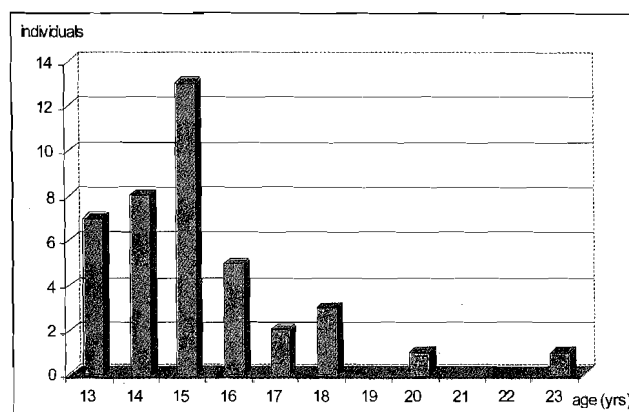


Fig 1 Age distribution among snuff users regarding snuffing debut (n = 40).

Number of teeth

The mean number of existing teeth among the snuff users and non-users was 27.3 and 26.9 respectively.

Restorations

Thirty participants (37.5%) had no filled teeth. Among the 50 participants who had filled teeth, 28 (56.0%) were snuff users and 22 (44.0%) were non-users. Among snuff users the number of filled teeth varied between one and 13 and among the non-users between one and seven. Six of the snuff users had more than seven filled teeth. The *t*-test showed that, at the 5% level, there was not a sig-

Table 3 Snuff habits related to clinical classification of oral snuff lesions

Clinical degree	N	Age (\bar{x})	Portion-bag snuff	Loose snuff	Amount of snuff/day			Duration hours/day (\bar{x})	Duration years (\bar{x})
					< 50g	50g	> 50g		
0	5	18.8	5		5			2.0	3.4
1	11	21.0	9	2	9	1	1	7.2	4.8
2	18	21.6	8	10	14	4		9.6	6.7
3	6	22.5		6	3	2	1	12.3	8.7
4									
Total	40	21.9	22	18	31	7	2	8.0	6.1

Table 4 Results of the multivariate logistic regression analysis

Dependent variables	Explanatory variables	OR	95% CI	p-values
Snuff lesions degree 1 – 3/0	Number of hours snuff was used per day	4.115	1.09 – 15.55	0.037
Snuff lesions degree 2 – 3/0 or 1	Number of hours snuff was used per day	1.284	1.03 – 1.60	0.025
	Type of snuff portion-bag/loose	0.121	0.02 – 0.08	0.023

nificant difference in the number of restored tooth surfaces between snuff users and non-users.

Oral mucosal lesions/snuff lesions

Out of the 40 participants who used snuff, 35 individuals had oral mucosal lesions in connection with the snuff's placement. The degree of the lesions varied between one and three. None of the snuff users presented degree 4 snuff lesions. Among the non-users of snuff, no oral mucosal lesions could be found.

Of the 22 snuff users who preferred the brand General, eight users showed degree 1 lesions and 10 showed degree 2 lesions. The five participants who did not show any mucosal change all used snuff in portion bags with the brands General, Ettan and Grovsnus. Two users mixed brands (Table 2).

Risk indicators for snuff lesions

In Table 3 the snuffing habits of the participants are presented in relation to degree of snuff lesion.

Potential risk variables tested were: age started to use snuff; number of years used snuff; number of hours used snuff per day; amount of snuff used each day; type of snuff (portion-bag or loose) and snuff brand. In a multivariate regression analysis a statistically significant relationship was found between snuff-induced oral mucosal lesions and the number of hours per day the snuff was used as well as the type of snuff used. When the number of hours a participant used snuff increased by one, the odds of having a snuff-induced oral mucosal lesion increased by a factor of 4.1. The other explanatory variables included in the model were not significant predictors of snuff lesions (Table 4).

Plaque and gingivitis

The mean value for the number of tooth surfaces with plaque and gingivitis was 12.0% and 12.4% respectively for snuff users, and 12.3% and 13.1% respectively for non-users. The mean value for plaque and gingivitis, for approximal tooth surfaces only, was for the snuff users 12.9% and 12.9% respectively and for the non-users 14.4% and

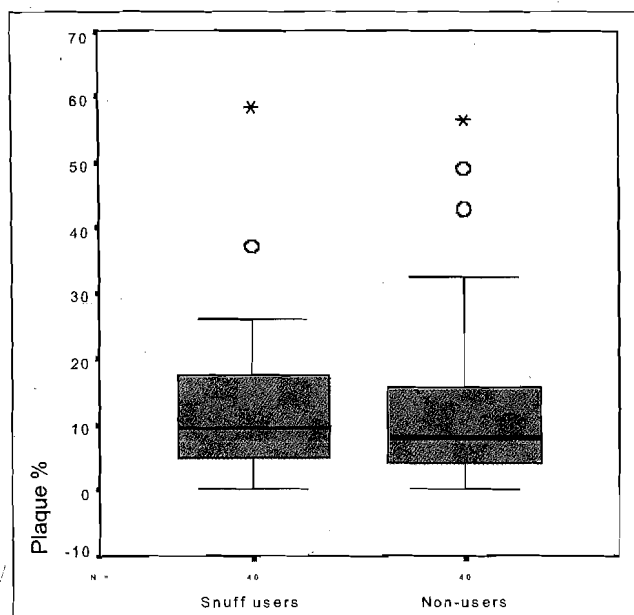


Fig 2 Boxplots showing the percentage of tooth surfaces/sites with plaque among snuff users and non-users. Box shows upper and lower quartiles. The central line is the median. The symbols O/* indicates an outlier/extreme value.

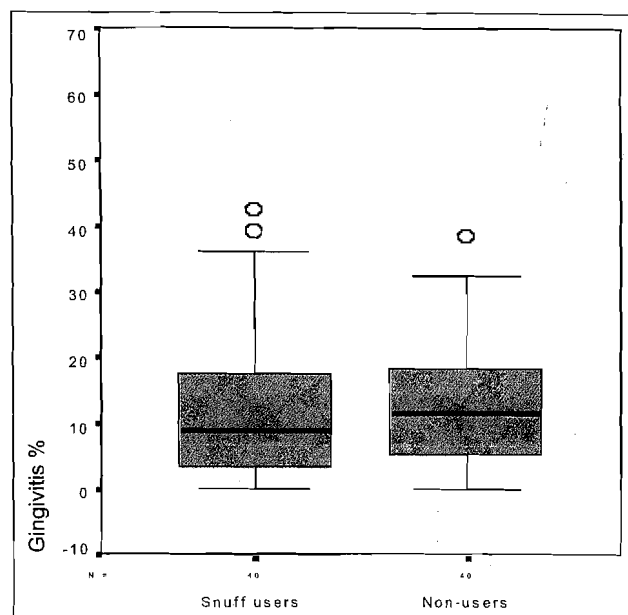


Fig 3 Gingivitis respectively among snuff users and non-users. Box shows upper and lower quartiles. The central line is the median. The symbols O/* indicates an outlier/extreme value.

14.2% respectively. The mean value for plaque and gingivitis for tooth surface regions 13-23 was among snuff users 4.0% and 5.8% respectively and among non-users 5.1% and 8.1% respectively. In Table 5 all mean values with standard deviations are presented. In the box plots, variations are shown regarding plaque and gingivitis among snuff users and non-users (Figs 2 and 3). The differences between snuff users and non-users regarding plaque and gingivitis were tried using a Student's *t*-test. No statistical differences could be found regarding the presence of plaque and gingivitis in the two groups.

Probing pocket depth and gingival recession

No deepened periodontal pockets could be found. Recessions between 1-5 mm were measured in seven snuff users and these were situated in connection with a mucosal lesion. One participant had three recessions, two participants had five recessions, and five participants had one recession.

Table 5 Means (\bar{x}) and Std. Deviation (SD) of tooth surfaces with plaque/gingivitis (total, proximal, region (13 - 23) in the different groups snuff users/non-users

		Snuff users		Non-users	
		\bar{x}	SD	\bar{x}	SD
Plaque	total	12.0	11.3	12.3	13.1
	proximal	12.9	14.8	14.4	13.2
	13 - 23	4.0	8.4	5.1	10.7
		\bar{x}	SD	\bar{x}	SD
Gingivitis	total	12.4	11.6	13.1	9.5
	proximal	12.9	13.3	14.2	16.6
	13 - 23	5.8	11.7	8.1	10.2

DISCUSSION

In this study, with the aim to investigate the effect of snuff on oral health, 80 adolescent males aged 16-25 years participated. These age groups are

interesting to study from a number of aspects, not least regarding the Swedish national goals for public health (SOU, 2000). One of the goals is that the number of adolescents under 18 who start to use tobacco should be decreased by half by the year 2014.

Today, snuff use is an established and accepted phenomenon in Swedish society and also in connection with certain sports. In a study, Rolandsson and Hugoson (2000) showed that snuff use was more common than smoking among ice-hockey playing adolescents. The association between snuff use and ice-hockey has also been shown in another study by Rolandsson and Hugoson (2003) where a statistically significant difference was found between snuff-using and non-using boys regarding whether they took part in other sport activities besides ice-hockey. Thus snuff usage was more frequent among the boys who did not take part in another sport than ice-hockey.

It has been previously known that snuff causes damage in the oral cavity in such a way that the mucosa in the area where the snuff is placed becomes thick and wrinkled and changes colour. In these areas, gingival recessions also appear, exposing the root surfaces of the tooth. These damages have mostly been observed in older individuals, but already among the younger participants in the present study, established mucosa changes and loss of periodontal attachment in the form of gingival recessions were diagnosed.

Thirty-five out of the 40 snuff users in the present study showed snuff induced lesions, while none of those who did not use snuff showed similar mucosal changes. Gingival recessions were found in seven of the 40 snuff users. Out of the 18 snuff users in this study using loose snuff, 16 showed snuff lesions grade 2-3. Out of the 22 snuff users taking portion bag snuff, eight showed snuff lesions degree 2, none had lesions of degree 3.

These results correspond to results found by Andersson et al (1989). Loose snuff caused more changes in oral mucosa than portion bag snuff. Another factor for developing lesions and gingival recessions was the number of hours per day that the participants used snuff. Those who used snuff for a large part of the day showed a higher degree of mucosal lesions and recessions than those who used it for a shorter period of time. This is probably also the reason why five snuff users did not show any mucosal lesions.

While the snuff users as opposed to the non-users showed mucosal changes and exposed root surfaces, there were no differences between the groups regarding plaque, gingivitis and probing pocket depth. These results are similar to those presented by Robertson et al (1990). Those results also showed that there was no between snuff usage and periodontal disease, and also no differences regarding plaque and gingivitis. However, there was a between gingival recessions and mucosal lesions. The participants of both studies can be regarded as relatively similar, since they represent a group of comparatively young men with regular self-care as well as professional dental care.

The lack of differences in plaque and gingivitis between snuff users and non-users may not be interpreted to say that snuff could not cause future periodontal tissue damage. The participants of the present study are members of a youth group who for many years have received preventive dental care of modern standards. As a result of this care, the participants showed few restored tooth surfaces and very good oral hygiene regardless of group, with an average of about 12% of the tooth surfaces covered in visible plaque and hence also low rates of gingival inflammation (13%). This state in itself promotes good oral health and means that it is not possible, using current clinical examination methods, to find initial damage on periodontal tissues caused by snuff.

Adult periodontitis is a chronic disease that develop over several years. Only rarely does more severe periodontal damage appear before the age of 40 – 50 years. The impact of smoking on periodontal disease is, however, indisputable (Norderyd and Hugoson, 1999; Bergström et al, 2000; Jansson and Lavstedt 2002; Paulander et al, 2004). When it comes to the long-term effects of snuff, clinical follow-up studies need to be carried out in order to achieve a better understanding of possible negative effects of snuff, apart from gingival recessions, which affect the periodontal tissues.

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