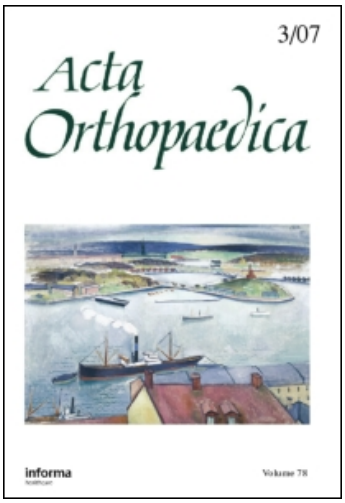

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No delayed bone healing in Swedish male oral snuffers operated on by the hemicallotasis technique: A cohort study of 175 patients

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No delayed bone healing in Swedish male oral snuffers operated on by the hemicallotasis technique

A cohort study of 175 patients

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Background and purpose **The effect of oral snuff on bone healing is virtually unknown. In vitro data have indicated that delay in bone healing in smokers may be the result of components of smoke other than nicotine. We compared the time for bone healing after high tibial osteotomy in snuffers, smokers, and in control subjects who did not use snuff or cigarettes.**

Patients and methods **175 male patients comprising 41 smokers, 21 oral snuff users, and 113 non-smokers/non-snuffers, all of whom were operated on for knee deformity by tibial osteotomy using the hemicallotasis technique (HCO) between 2000 and 2005, were included in a consecutive manner. Preoperative tobacco use, postoperative complications, and treatment time in external fixation were documented.**

Results **There was no delayed healing in the oral snuff users. The mean time in external fixation for all patients was 94 days (SD 20). Oral snuff users had the shortest time in external fixation (87 days (SD11)) compared to smokers (100 days (SD 25)) (p = 0.03) and non-smokers/non-snuffers (93 days (SD 14)). The risk ratio for smokers developing complications was 6.1 (95% CI: 1.2–36.4) compared with oral snuff users.**

Interpretation **Our findings indicate that the use of oral snuff does not delay bone healing or increase the risk of postoperative complications, which cigarette smoking does, in patients operated on by the hemicallotasis technique.**

The use of oral snuff has been paid scant attention compared to smoking. More than 20% of the male population and 3% of the female population of Sweden use oral snuff. Thus, the possible health effects of oral snuff may be important.

Nicotine is the foremost habit-forming component of oral snuff, but it also contains carcinogenic substances such as N-nitrosamines. The effects of oral snuff are thus mostly associated with the levels of nicotine and the specificity of tobacco N-nitrosamines. The method of production of Swedish snuff reduces the levels of carcinogenic nitrosamines compared to international oral snuff. International studies have not included a specific evaluation of Swedish snuff. Most of the studies on oral snuff have concentrated on the risk of cancer and heart disease (Cnattingius et al. 2005).

Smoking delays bone healing and increases the risk of complications in fracture healing (Kyro et al. 1993, Schmitz et al. 1999, Adams et al. 2001), ankle arthrodesis (Cobb et al. 1994), hip and knee replacement (Moller et al. 2002) and high tibial osteotomy (W-Dahl and Toksvig-Larsen 2004), but whether this is an effect of nicotine and/or other smoke components is debatable. In vitro data have indicated that nicotine acts as a direct stimulant of bone cell metabolic activity, and the delayed bone healing in smokers may in part be a result of components of smoke other than nicotine (Gullihorn et al. 2005). A recently published study has shown that nicotine does not reduce the strength of the healing fracture (Skott et al. 2006).

We investigated healing time, delayed healing, and other complications in a cohort study of male smokers, oral snuff users, and non-smokers/non

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Table 1. Patient characteristics (n = 175)

	Non-smoker/ non-snuffer n = 13	Snuffer n = 21	Smoker n = 41
Age (years), mean (SD)	54 (9)	50 (8)	51 (7)
BMI (kg/m^2), mean (SD)	29 (3.2)	29 (4.5)	28 (3.3)
OP indication			
Osteoarthritis (n)	108	17	38
Sequelae fracture (n)	2	2	2
Reconstruction (n)	2	2	0
Sequelae HTO [a] (n)	1	0	1
Bilateral surgery simultaneously (n)	17	4	4
Preoperative HKA angle, mean (SD)	170 (6.6)	174 (7)	171 (5.5)

BMI: Body mass index;
HTO: high tibial osteotomy;
HKA angle: radiographic hip-knee-ankle angle.
[a] severe overcorrection of close-wedge osteotomy.

snuffers who were operated on by tibial osteotomy using the hemicallotasis technique (HCO).

Methods

Patients

We studied 175 consecutive male patients (mean age 53 (21–75) years), 113 (65%) of whom were non-smokers or non-snuffers, 41 (23%) of whom were smokers, and 21 (12%) of whom were oral snuff users, and all of whom were operated on for knee deformity by HCO during the period 2000–2005 (Table 1). 25 patients had simultaneous bilateral surgery. The patients' smoking and oral snuff habits were documented preoperatively. The patients were defined as non-smokers/non-snuffers if, at the preoperative visit, they reported that they had never smoked or used snuff—or that they had stopped smoking or using snuff more than 6 months earlier.

Hemicallotasis osteotomy

4 conical pins were inserted, 2 hydroxyapatite-coated in the metaphyseal bone and 2 standard pins (Orthofix, Bussolengo, Italy) in the diaphyseal bone. The Orthofix T-garche was used. Patients were allowed free mobilization and full weight bearing after the operation.

The distraction started 7–10 days postoperatively. 8 weeks postoperatively, the fixation was dynamized to stimulate bone healing. 12 weeks postoperatively, control of bone healing was done by radiographic investigation and ultrasound. If the osteotomy healing was satisfactory, the patient did a weight-bearing test, i.e. walked for an extended period of time (varying from a few hours to some days) without the instrument but still with the pins in situ. If no symptoms arose, the pins were removed at the outpatient clinic. If the patient developed symptoms, fixation was resumed and the bone-healing control was repeated every second week until the healing of the osteotomy was satisfactory. Patients were not given NSAIDs during the treatment in external fixation.

Outcome

Time in external fixation (from surgery until the external pins were removed) and complications such as delayed healing (> 16 weeks in external fixation), nonunion, septic arthritis, deep venous thrombosis, interrupted treatment, and other complications (including replacement of pins and difficulties in correction) were compiled.

Statistics

ANOVA test, t-test, and Chi-square test were used for the statistical analysis. The influence of 3 potential predictor variables on time in external fixation, age, size of correction, and simultaneous bilateral surgery, was analyzed by multivariate regression analysis. Firstly, the influence of each potential predictor was assessed by simple regression analysis and was analyzed further in a multivariate regression analysis. A p-value of < 0.05 was considered statistically significant. StatView for Windows version 5.0 (SAS Institute Inc., Cary, NC) was used.

Results

There were no cases of delayed healing among the oral snuff users. A difference in delayed healing was seen between smokers (8/41) and oral snuff users (0/21) ($p = 0.03$) but not between smokers and the non-smokers/non-snuffers (10/113). The mean time in external fixation was 94 days (SD 20). There were

Table 2. Complications

	Non smoker/ non-snuffer n = 113	Snuffer n = 21	Smoker n = 41
Delayed healing	10	0	8
Nonunion	2	0	1
Septic arthritis	4	0	1
DVT	3	0	2
Interrupted treatment	0	0	0
Other [a]	6	1	0

[a] including replacement of pins and difficulties in correction.

differences in time in external fixation between the three groups (p = 0.01). The results were adjusted for age, size of correction, and simultaneous bilateral surgery. Differences were seen between oral snuff users and smokers (unadjusted 13 days, 95% CI: 1.4–25, p = 0.03; adjusted 12 days, CI: 0.004–25, p = 0.05) and also between smokers and non-smokers/non-snuffers (unadjusted 7 days, CI: 0.5–13, p = 0.03; adjusted 6 days, CI: -0.3–13, p = 0.05). There were no statistically significant differences between oral snuffers and non-smokers/non-snuffers (unadjusted -5.8 days, CI: -12.1–0.5, p = 0.07; adjusted -6.1 days, CI: -12.7–0.5, p = 0.07). Oral snuff users had the shortest time in external fixation (87 days (SD11)) compared to smokers (100 days (SD 25)) and non-smokers/non-snuffers (93 days (SD 14)). Smokers had more complications (12/41) than oral snuff users (1/21) (p = 0.03). The risk ratio for smokers developing complications was 6 (CI: 1.2–36) compared to oral snuff users (Table 2).

25 patients were operated on by bilateral HCO in one séance. There were no statistically significant differences regarding time in external fixation between unilateral and bilateral osteotomies (-2.4, 95% CI: -5.3–0.4, p = 0.3) or the size of the corrections (-0.2, 95% CI: -0.7–0.19, p = 0.1).

Discussion

None of the oral snuff users in our study had delayed healing. They had less complications and the shortest time in external fixation, almost 2 weeks shorter than smokers. These results confirm the findings in the in vitro study of Gullihorn et al. (2005), which suggested that delayed bone healing in smokers was the result of smoke components other than nicotine. Despite the positive indications for oral snuff users in our study, there were no advantages in using snuff compared to abstaining from cigarettes or oral snuff.

Only men were included in our study, as none of our female patients used snuff. The proportion of oral snuffers was lower and the proportion of smokers higher in our study than the proportion of male oral snuffers (22%) and smokers (15%) in Sweden in general (Cnattingius et al. 2005). This is probably due to the fact that the number of oral snuffers decreases with age and is highest in the 18–29-year age group, whereas the number of smokers increases with age and is highest in the 45–54-year age group.

Most studies in Sweden on the effects of oral snuff on health have concentrated on the risks of cancer and cardiovascular disease. Experimental and epidemiological studies have suggested that Swedish oral snuff is carcinogenic; however, there has been no evidence published. On the other hand, oral snuff may increase the risk of fatal cardiac arrhythmia (Cnattingius et al. 2005).

One explanation for the differences in the effects of smoking and oral snuff use on health may be that many of the harmful substances produced from the incineration of tobacco do not exist in oral snuff. Even so, the levels of nicotine are similar for smoking and oral snuff use (Cnattingius et al. 2005).

We did not document the number of packets of cigarettes smoked or the amount of oral snuff used per person per day; nor did we measure the nicotine levels in serum and urine. It may be argued that this was a weakness of our study design. However, such data were not obtained because of the results of previous studies showing that cessation of smoking—both preoperatively and postoperatively—reduces the risk of complications, whereas reduction in smoking is not sufficient to reduce the risk (Lavernia et al. 1999, Glassman et al. 2000, Moller et al. 2002, 2003).

The strength of our study was the uniform study group of healthy men (except for their knee deformity), who were operated on by a standardized procedure. We did not exclude smokers, but they were informed about the risk of complications associated with smoking.

Our findings indicate that the use of Swedish oral snuff does not have the negative effects—such as delayed bone healing and increased risk of postoperative complications—that cigarette smoking has, in patients operated on by the hemicallotasis technique. The clinical results of our study are also in line with those of in vitro studies suggesting that delayed bone healing may be the result of smoke components other than nicotine.

Contributions of authors

AWD: designed the study, collected and analyzed the data, and wrote the manuscript. STL: designed the study and revised the manuscript.

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