Vol. 105 No. 2 February 2008

Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology

ENDODONTOLOGY

Editor: Larz S. W. Spångberg

Patient discomfort following periapical surgery

René Christiansen, DDS,[a] Lise-Lotte Kirkevang, DDS, PhD,[b] Preben Hørsted-Bindslev, DDS,[b] and Ann Wenzel, DDS, PhD, DrOdont,[c] Aarhus, Denmark UNIVERSITY OF AARHUS

Objective. The aim of the study was to assess patient discomfort following periapical surgery.
Study design. Forty-two patients with apical periodontitis were allocated to apicectomy with either smoothening of the gutta-percha root filling or a retrograde root filling with mineral trioxide aggregate (MTA).
Results. Pooling all patients, VAS score for pain peaked 3 hours postoperatively (mean VAS = 29). The VAS score for swelling peaked 1 day postoperatively (mean VAS = 41). Patients' overall perception of postoperative discomfort was induced by (questions asked at the day for suture removal): Oral awareness (36 yes, 6 no); swelling (30 yes, 12 no); compromised chewing ability (18 yes, 24 no); pain (15 yes, 27 no). There was no correlation between the operating time and VAS scores for pain and swelling ($r \leq .25$, $P > .11$).
Conclusions. Patients experienced little pain and moderate swelling after periapical surgery. Oral awareness was the most reported reason for postoperative discomfort. The operating time was not a decisive factor in relation to postoperative discomfort. **(Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:245-50)**

When a patient is to decide whether or not to have oral surgery, the dentist should be able to provide information on the expected discomfort during and after the operation. It has been demonstrated that pain following periapical surgery tends to peak on the operational day,[1-7] whereas swelling has been found to be most pronounced 1 to 2 days postoperatively.[1,4,7,8]

Postoperative discomfort was found in some studies to be associated with tooth group,[1,2,8] patient's expectations,[1] sex,[1] and age,[1] whereas other studies did not find a relationship between postoperative discomfort and sex[2,3,6-9] or age.[2,7,9] Other postoperative complications, such as a reduced mouth opening and difficulties with mastication and fulfilling the daily work have been shown to peak 1 to 2 days postoperatively.[7] Some studies have reported that absence from work was mainly due to swelling and discoloration of the skin,[4] whereas others have reported that no patients took days off work because of postoperative symptoms.[9]

Most studies have found that nonprescriptive analgesics were sufficient to control postoperative pain after apicectomy,[1-3,7] however some have suggested the use of steroids to minimize pain and swelling.[2,9] A few studies have assessed operating time in relation to postoperative discomfort and found that longer operating times induced more swelling,[8] but the same level of pain, than shorter operating times.[7,8] In one study, smoking was evaluated, and there was no relationship between smoking and pain or inflammation of the operation wound.[8]

The aim of this study was to assess patient discomfort following apicectomy with smoothening of the gutta-percha root filling or a retrograde root filling with mineral trioxide aggregate (MTA), and to evaluate the effect of the operating time on postoperative pain.

MATERIALS AND METHODS

Initially, patients with a periapical radiolucency on a root-filled tooth were examined. The inclusion criteria for the study were the following: an incisor, canine, or

Financial support was provided by a research stipend from the Faculty of Health Sciences, University of Aarhus, Denmark.
[a]PhD Student, Department of Oral Radiology, School of Dentistry, Faculty of Health Sciences, University of Aarhus, Denmark.
[b]Associate Professor, Department of Dental Pathology, Operative Dentistry & Endodontics, School of Dentistry, Faculty of Health Sciences, University of Aarhus, Denmark.
[c]Professor, Department of Oral Radiology, School of Dentistry, Faculty of Health Sciences, University of Aarhus, Demnark.
Received for publication Aug 16, 2007; accepted for publication Aug 21, 2007.
1079-2104/$ - see front matter

doi:10.1016/j.tripleo.2007.08.023

Table I. Description of patients in relation to sex, tooth group, smoking, and age related to treatment

	Sex		*Tooth group*			*Smoking*		*Age*	
	W	*M*	*I*	*P*	*CP*	*No*	*Yes*	*Mean*	*SD*
Gutta-percha	14	4	7	7	4	12	6	52.2	9.8
MTA	9	15	6	14	4	17	7	56.1	11.7
Total	23	19	13	21	8	29	13	54.4	11.0

W, Women; *M,* Men; *I,* Incisors upper jaw; *P,* Premolars upper jaw; *CP,* canines and premolars lower jaw.

premolar with a sufficient orthograde root filling regarding length and density and with a periapical lesion persisting for at least 2 years. A periapical lesion was defined as score 3, 4, or 5 on the periapical index (PAI).[10] Furthermore, the marginal bone level around the tooth in question should be reduced no more than 50%. All registrations were performed on a periapical radiograph taken with the paralleling technique and at a successive clinical examination.

Each patient fulfilling the inclusion criteria was given written and verbal information about the study, and a consent form was signed before participation. There was no financial inducement to participate, and patients were given the opportunity to withdraw from the study at any time. The study was approved by the regional Committee of Ethics.

Forty-two patients (23 women and 19 men), average age 54.4 years (range 30-68), participated in the study (Table I). Before surgery they were asked about their smoking habits (smoking yes/no).

Patient treatment

If the quality of the coronal restoration was insufficient, it was replaced before surgery. All patients were treated according to a protocol with a standardized set-up and by one operator (R.C.). Before surgery, local analgesics, Xyloplyin Dental Adrenalin (Dentsply, Addlestone, UK) (n = 35), or second choice, Citanest-Octapressin (Dentsply, Addlestone, UK) (n = 7), was administered (average 5.3 mL, range 2.7-8.1 mL). The patient rinsed with antiseptic mouthwash (0.2% Chlorhexidine Gluconate) and ingested 1 tablet 600 mg ibuprofen.

After a sulcular incision, a full buccal flap was elevated. The triangular flap design was the first choice (n = 37); a trapezoid flap design was preferred for incisors if there was poor accessibility (n = 5). Osteotomy was performed in the buccal bone using a round steel bur in a slow-speed hand piece with sterile saline coolant. In 16 cases a buccal fenestration already existed; this was extended if needed. Perpendicular root resection (2-4 mm) was performed with a 0.6-mm cone square cross-cut steel bur (Komet, Lemgo, Germany), and surface irregularities were trimmed with a fine flame-shaped diamond bur (Intensive SA, Grancia, Switzerland) in a slow-speed hand piece with sterile saline coolant. Periradicular granulomatous or cystic tissue was removed and hemostasis was obtained with adrenalin-impregnated gauze and compression force. The resection surface was inspected in a dental operating microscope (DOM, Opmi Pico Zeiss, Oberkochen, Germany), and photographed at magnification factors 0.4, 0.6, 1.0, 1.6, and. 2.5, with the camera body (Canon EOS-10D, Tokyo, Japan) mounted on the microscope. If no gaps were seen between the gutta-percha root filling and the dentin wall, the patients were randomly allocated (drawing a lot) to apicectomy with white MTA (Pro Root, Dentsply-Tusla Dental, Johnson City, TN) retrograde root filling (n = 18) or smoothening of the gutta-percha root filling (n = 18). If there were visible gaps between the root filling and dentin wall, the patient was allocated to MTA (n = 6). Patients were positioned with the buccal cortical bone surface aligned with the horizontal plane. The volume of the bone defect was measured, dispensing sterile water (Octavia, Halden, Norway) into the bony cavity with a single volume (10-μL) micro pipette. The MTA root cavities were prepared 3 mm in depth using diamond-coated ultrasonic retrotips (Satelec, Merignac, France) with an ultrasonic device (Satelec P5 Ultrasonic Booster, Merignac, France). MTA was applied with a MTA delivery gun (Dentsply Maillefer, Ballaigues, Switzerland). Smoothening of the gutta-percha root filling was performed with a heated droplet-shaped steel instrument. The resection surface was again inspected in the DOM and photographed. In 4 cases there was fenestration of bone to the maxillary sinus. The size of the buccal cortical bone cavity was measured with a slide caliper in the vertical and horizontal direction. The surgical wound bed was rinsed with sterile water and then sutured with 4-0 nylon suture (Ethicon, Johnson and Johnson, Dublin, Ireland). After surgery, the operating time (first incision to last suture) was registered.

Postoperative course

After surgery, patients were instructed to avoid physical exercise, chewing, and tooth brushing in the operation field and to rinse 2 times daily with antiseptic mouthwash (0.2% Chlorhexidine Gluconat) for 1 week. Each patient received written instructions regarding the use of antiseptic mouthwash and in case of swelling to use application of cold. Patients were supplied with 5 tablets 600 mg Ibuprofen, to take if they experienced postoperative pain (dose: 1 tablet each 8 hours) and to continue with nonprescriptive (over-the-counter) pain

Table II. Operating time in minutes and patients' VAS scores for pain and swelling (mean and standard deviation) after surgery in relation to treatment

	Operating time		*3 h po*		*Day 1*				*Day 2*				*Day 3*			
			Pain		*Pain*		*Swell*		*Pain*		*Swell*		*Pain*		*Swell*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Gutta-percha	108	19	30	21	21	22	51	27	9	10	31	24	9	9	28	25
MTA	140	21	29	24	17	19	35	24	11	17	41	24	14	21	34	26
Total	126	26	29	23	19	20	41	26	10	14	37	24	12	17	31	25

po, postoperative.

relievers if needed. In case of perforation to the maxillary sinus, patients were subscribed 20 tablets of 800 mg phenoxymethylpenicillin (dose: 1 tablet each 6 hours for 5 days). In case of complications or questions, the patients were told to contact the surgeon.

The patients were given a questionnaire with questions about the postoperative course from 3 hours postoperatively until the day of suture removal (5 to 7 days after surgery). The patients registered on a 100-mm visual analogue scale (VAS) with extreme end points (no and intense pain; no and severe swelling)[11]; the intensity of postoperative pain after cessation of the local analgesics before taking additional tablets; the intensity of pain 1, 2, and 3 days after surgery; and the severity of swelling 1, 2, and 3 days after surgery. Furthermore, patients were asked about the number of consumed analgesic tablets, days off work, whether they had sought advice due to surgery, and if they had been treated for complications due to surgery.

Patients had their sutures removed 5 to 7 days after surgery. The questionnaires were collected at that time. The patients were asked whether their overall perception of postoperative discomfort had been caused by pain, swelling, compromised chewing ability, oral awareness, or other reasons (all yes/no).

RESULTS

The distribution of patients in relation to sex, tooth group, smoking, age, and treatment method is shown in Table I. More women had been allocated to smoothening of the gutta-percha root filling (n = 14) than to MTA treatment (n = 9), and fewer men had been allocated to smoothening of the gutta-percha root filling (n = 4) than to MTA treatment (n = 15). This difference was significant ($P = .01$, chi-square test) (Table I). There was an equal distribution in the tooth groups with regard to treatment with either smoothening of the gutta-percha root filling or MTA, except for premolars in the upper jaw where 7 received smoothening of the gutta-percha root filling treatment and 14 received MTA treatment.

Pooling all patients, the VAS score for pain peaked 3 hours postoperatively (mean VAS = 29). Patients reported more pain 3 hours postoperatively than 1 day (mean VAS = 19), 2 days (mean VAS = 10), and 3 days (mean VAS = 12) postoperatively ($P < .011$, paired *t*-tests). There was also a statistically significant difference between VAS score for pain 1 day postoperatively compared with 2 days and 3 days postoperatively ($P < .011$, paired *t*-tests). The VAS score for swelling peaked 1 day postoperatively (mean VAS = 41). No significant differences were observed between VAS score for swelling 1 day, 2 days (mean VAS = 37), and 3 days (mean VAS = 31) postoperatively (Table II).

For 16 patients the periapical infection had fenestrated the buccal cortical bone; for 26 patients the buccal cortical bone was intact. There were no significant differences between VAS scores for pain and swelling for the fenestration group and the nonfenestration group ($P > .13$, grouped *t*-test).

The buccal cortical bone cavity after apicectomy was on average 5.6 mm in the vertical direction (range 4.0 to 11.0 mm) and 4.6 mm in the horizontal direction (range 3.0 to 9.0 mm). There was no significant correlation between the size of the vertical or horizontal dimensions of the buccal cortical bone cavity and VAS scores for pain and swelling ($r \leq 0.2$, $P > .22$, Pearson's correlation analysis). The volume of the periapical bone defect after apicectomy was on average 69 μL (n = 31). There was no significant correlation between the volume of the periapical bone defect and VAS scores for pain and swelling ($r \leq .19$, $P > .31$, Pearson's correlation analysis).

The operation time for the gutta-percha group (mean = 108 min) was significantly shorter than for the MTA group (mean = 140 min) ($P < .001$, grouped *t*-test). The VAS score for swelling 1 day postoperatively was higher for the gutta-percha group (mean VAS = 51) than for the MTA group (mean VAS = 35) ($P = .043$, grouped *t*-test). No other significant differences were observed between the gutta-percha and the MTA group (Table II). Including both groups, there was no significant correlation between the operating time and VAS scores for pain and swelling ($r \leq .25$, $P > .11$, Pearson's correlation analysis).

Table III. Operating time in minutes and patients' VAS scores for pain and swelling (mean and standard deviation) after surgery in relation to sex

	Operating time		*3 h po*		*Day 1*				*Day 2*				*Day 3*			
			Pain		*Pain*		*Swell*		*Pain*		*Swell*		*Pain*		*Swell*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Women	120	26	37	24	21	21	50	21	10	11	39	23	12	16	33	24
Men	134	24	20	18	16	19	33	29	10	18	34	26	11	18	30	28

po, postoperative.

VAS score for pain 3 hours postoperatively was significantly higher for women (mean VAS = 37) than for men (mean VAS = 20) ($P = .018$, grouped *t*-test). VAS score for swelling 1 day postoperatively was significantly higher for women (mean VAS = 50) than for men (mean VAS = 33) ($P = .038$, grouped *t*-test). No other differences were observed between women and men (Table III).

More nonsmokers (n = 29) participated in the study than smokers (n = 13), but there was no significant difference between the distribution of smokers and nonsmokers in the gutta-percha and the MTA groups ($P > .05$, chi-square test) (Table IV), and there was no significant difference between postoperative pain and swelling between smokers and nonsmokers ($P > .11$) (Table IV).

Four patients were prescribed 20 tablets of 800 mg phenoxymethylpenicillin (dose: 1 tablet each 6 hours for 5 days) due to perforation to the maxillary sinus. During the period from surgery to suture removal, 4 patients called the surgeon for advice; however, there were no postoperative complications that needed treatment. Patients ingested on average (the first 4 days postoperatively) 2.3 tablets of 600 mg Ibuprofen. Two patients took 1 day off work, and 5 patients took 2 to 4 days off work because of the surgery.

Patients' overall perception of postoperative discomfort was induced by (questions asked at the day for suture removal) oral awareness (36 yes, 6 no); swelling (30 yes, 12 no); compromised chewing ability (18 yes, 24 no); pain (15 yes, 27 no); and other reasons such as irritating sutures, and difficulty with mouth opening (9 yes, 33 no).

DISCUSSION

In the present study the VAS score was used to assess pain and swelling, which in previous studies has been found to be a valid recording scale.[12,13] Compared with the verbal rating scale (VRS), where patients have to choose a categorical descriptor, the VAS offers a continuum of choices, which allows the patient to report small changes over time.[13] Previous studies have found a good correspondence between VAS and VRS in patients' pain assessment and studies using VAS and VRS may therefore be mutually compared.[14-16]

There was no significant correlation between the operating time and postoperative pain or swelling in the present study. Despite the shorter operating time for the gutta-percha group, this group reported more swelling 1 day postoperatively than the MTA group. An explanation for this may be that there was an overrepresentation of women in the gutta-percha group and that women in the present study reported more swelling 1 day postoperatively than men. Most other studies have found no differences in the way men and women report discomfort in connection with periapical surgery,[2,3,6-9] and we cannot explain the sex difference found in the present study. Pooling all patients the mean operating time (126 min) in the present study was long compared with a mean operating time of 35 minutes in a previous study,[6] but the VAS scores for pain was lower in our study than in the study by Seymour et al.[6] (Fig. 1). This may indicate that the operating time is not a decisive factor in relation to postoperative discomfort.

In the present study, DOM was used to inspect and photograph the surgical site. A previous study found that when DOM was used during surgery, patients had to stay in an uncomfortable position for a longer time. This was suggested to have caused differences in postoperative discomfort between 2 patient groups.[7]

In the present study, patients' VAS scores for pain peaked on the day of surgery. The distribution of these VAS scores was skewed to the right: 25% of the patients scored 0-12 on the VAS; 50% scored 0-25; and 75% scored 0-45. There is a good correspondence between the present findings for pain intensity and previous studies that have used VAS scores, even though these studies were conducted in 5 countries over a period of 20 years (Fig. 1).[1,2,4,6] This may be interpreted as pain intensity perceived by patients after periapical surgery being low to moderate according to a previous study in which VAS scores ranging from 30-54 mm were defined to equal moderate pain.[17] Furthermore, it suggests that pain may not be the main factor for postoperative discomfort.

Table IV. Operating time in minutes and patients' VAS scores for pain and swelling (mean and standard deviation) after surgery related to smoking

	Operating time		*3 h po*		*Day 1*				*Day 2*				*Day 3*			
			Pain		*Pain*		*Swell*		*Pain*		*Swell*		*Pain*		*Swell*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Nonsmoker	128	24	27	22	15	14	45	24	9	9	38	21	11	15	32	24
Smoker	123	29	34	25	26	29	36	31	12	22	34	30	13	21	30	29

po, postoperative.

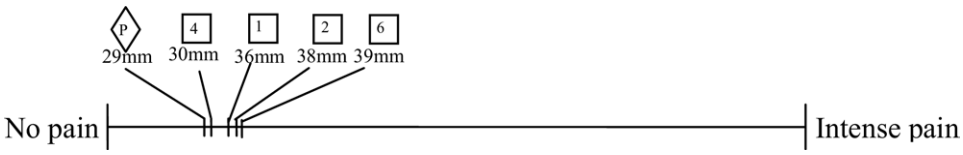

Fig. 1. Patients' scores (mean) for pain on the day of surgery (100 mm VAS) in the present (= ◇) and in previous studies (= □; see reference list).

In the present study, patients' VAS scores for swelling peaked 1 day postoperatively. The distribution of VAS scores was also skewed to the right: 25% of the patients scored 2-17 on the VAS; 50% scored 2-43; and 75% scored 2-53. In previous studies using VAS, the severity of swelling also peaked 1 day postoperatively.[1,4] Again, there was a good correspondence between the severity of swelling reported in the present and previous studies. Using VRS, 1 study found that pain peaked on the day of surgery and swelling peaked 1 day postoperatively[7] while another study found that pain and swelling peaked 2 days postoperatively.[8]

In the present study, the surgeon used sterile water and a pipette to measure the volume of the periapical defect after apicectomy. The bone cavity was filled with sterile water. This method has not been used in previous studies or been described in the literature, but seemed a handy method of measuring defect volume.

In the present study, patients were premedicated with a nonsteroidal anti-inflammatory drug (NSAID) (1 tablet 600 mg Ibuprofen). In studies on periapical surgery, different drug administration strategies have been suggested. Premedication with NSAID has been used by some,[1-3] whereas others did not use premedication.[2,4,7-9] Some studies used NSAID both pre- and postoperatively[1] whereas others only used NSAID postoperatively, and furthermore covered patients with amoxicillin for 7 days.[8] In another study patients were covered with oral dexamethason preoperatively and the first 2 days postoperatively, and antibiotics were prescribed on indication.[9] A previous study compared the effect of NSAID, steroids, and placebo given pre- and postoperatively and found that NSAID and steroids had similar effects and that both were more effective in reducing postoperative pain than placebo.[2] Because of different drug administration and study designs, it is difficult to conclude from previous studies if NSAID taken preoperatively reduces postoperative discomfort in relation to periapical surgery. However, in a study concerning surgical removal of third molars it was found that preoperative administration of NSAID reduced pain 2-4 hours postoperatively compared to placebo tablets.[18]

Antibiotics were prescribed on indication in the present study as in the majority of previous studies.[1-4,9] In one study, patients received antibiotics for 7 days. In that study, patients' levels of pain and swelling tended to peak 1 day later than in studies using antibiotics only on indication.[8] However, another study found no correlation between postoperative symptoms for patients who took antibiotics on indication compared with patients who did not take antibiotics.[9] Whether or not patients were covered with antibiotics may be due to different strategies for prescribing antibiotics between countries. The literature provides no evidence that antibiotics should be used routinely in connection with periapical surgery.

When recording the number of ingested analgesic tablets, we did not discriminate between patients' self-prescribed tablets and the NSAID tablets supplied to each patient pre- and postoperatively. Some patients might have taken tablets because of other pain problems. In general, patients reported to have ingested few tablets during the first postoperative days. A previous study found that if analgesics were needed postoperatively, then self-prescribed tablets were adequate and effective.[3] In the present study, oral awareness was the

most frequently reported reason for postoperative discomfort followed by swelling, compromised chewing ability, and pain. In the present and in previous studies, which used VAS[1,4] and VRS,[7-9] the mean scores for swelling were at a higher level compared with the mean scores for pain. It may therefore be concluded that pain is not a main reason for postoperative discomfort in connection with periapical surgery, and that studies should focus more on swelling and patients' oral awareness.

CONCLUSIONS

Patients experienced little pain and moderate swelling after periapical surgery. Oral awareness was the most reported reason for postoperative discomfort followed by swelling, compromised chewing ability, and pain. The operating time was not a decisive factor in relation to postoperative discomfort.

REFERENCES

1. Iqbal MK, Kratchman SI, Guess GM, Karabucak B, Kim S. Microscopic periradicular surgery: perioperative predictors for postoperative clinical outcomes and quality of life assessment. J Endod 2007;33:239-44.
2. Lin S, Levin L, Emodi O, El-Naaj IA, Peled M. Etodolac versus dexamethasone effect in reduction of postoperative symptoms following surgical endodontic treatment: a double-blind study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;101: 814-7.
3. Chong BS, Pitt Ford TR. Postoperative pain after root-end resection and filling. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005;100:762-6.
4. Kvist T, Reit C. Postoperative discomfort associated with surgical and nonsurgical endodontic retreatment. Endod Dent Traumatol 2000;16:71-4.
5. Meechan JG, Blair GS. The effect of two different local anesthetic solutions on pain experience following apicectomy. Br Dent J 1993;175:410-3.
6. Seymour RA, Meechan JG, Blair GS. Postoperative pain after apicectomy. A clinical investigation. Int Endod 1986;19:242-7.
7. Tsesis I, Shoshani Y, Givol N, Yahalom R, Fuss Z, Taicher S. Comparison of quality of life after surgical endodontic treatment using two techniques: a prospective study. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005;99:367-71.
8. Penarrocha M, Garcia B, Marti E, Balaguer J. Pain and inflammation after periapical surgery in 60 patients. J Oral Maxillofac Surg 2006;64:429-33.
9. Tsesis I, Fuss Z, Lin S, Tilinger G, Peled M. Analysis of postoperative symptoms following surgical endodontic treatment. Quintessence Int 2003;34:756-60.
10. Ørstavik D, Kerekes K, Eriksen HM. The periapical index: a scoring system for radiographic assessment of apical periodontitis. Endod Dent Traumatol 1986;2:20-34.
11. Seymour RA, Simpson JM, Charlton JE, Phillips ME. An evaluation of length and end-phrase of visual analogue scales in dental pain. Pain 1985;21:177-85.
12. Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. Pain 1983;17:45-56.
13. Seymour RA. The use of pain scales in assessing the efficacy of analgesics in post-operative dental pain. Eur J Clin Pharmacol 1982;23:441-4.
14. Averbuch M, Katzper M. Assessment of visual analog versus categorical scale for measurement of osteoarthritis pain. J Clin Pharmacol 2004;44:368-72.
15. Littman GS, Walker BR, Schneider BE. Reassessment of verbal and visual analog ratings in analgesic studies. Clin Pharmacol Ther 1985;38:16-23.
16. Wallenstein SL, Heidrich G III, Kaiko R, Houde RW. Clinical evaluation of mild analgesics: the measurement of clinical pain. Br J Clin Pharmacol 1980;10:319-27.
17. Collins SL, Moore RA, McQuay HJ. The visual analogue pain intensity scale: what is moderate pain in millimetres? Pain 1997;72:95-7.
18. Dionne RA, Campbell RA, Cooper SA, Hall DL, Buckingham B. Suppression of postoperative pain by preoperative administration of ibuprofen in comparison to placebo, acetaminophen, and acetaminophen plus codeine. J Clin Pharmacol 1983;23:37-43.

Reprint requests:

René Christiansen, DDS, PhD student
School of Dentistry
Department of Oral Radiology
Faculty of Health Sciences
University of Aarhus
Vennelyst Boulevard 9
DK-8000 Aarhus C, Denmark
RChristiansen@odont.au.dk