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Results of apicoectomy of maxillary canines, premolars and molars with special reference to oroantral communication as a prognostic factor

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ABSTRACT – A total of 276 patients with 314 apicoectomized canines, premolars and molars from the maxilla were reviewed. Oroantral communication (OAC) was noted in 41 (13 %) of the cases. All patients were followed-up clinically and radiographically. The results of the operation proved successful in 54 %, uncertain in 25 % and unsuccessful in 21 %. No difference was found between the results in the OAC group and the rest of the material. The best results were noted for the canines, while the frequency of success was lowest for the first premolars. Such factors as retrograde root filling, the quality of the orthograde root filling, preoperative root resorption and the extent of periapical destruction had no demonstrable effect on the later course. In the group where the periapical lesion was a radicular cyst, the frequency of success was 25 % higher. In four of 26 cases the tomograms showed no bony partition between the apical region and the maxillary sinus. In three of these cases the result was regarded as successful on the basis of conventional radiographs.

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Various factors presumably capable of influencing the outcome of apicoectomy have been analyzed. Such factors are, for example, age and sex of the patient, tooth group, quality of the orthograde root filling, time of root filling in relation to operation, retrograde root filling, periodontal status, size of the periapical destruction, experience of the oral surgeon, etc.[7,8,9,10,12,13,14,15,16,17,18]. However, oroantral communication (OAC) has not previously been studied for its effect on the prognosis. The results of apicoectomy of canines, premolars and molars in the maxilla were therefore studied with special reference to the effect of OAC on the prognosis. The effect of OAC on the status of the maxillary sinus was also studied.

Material and methods

NUMBER OF PATIENTS AND TEETH

A total of 293 patients underwent apicoectomy of one or more teeth in the canine region and

Table 1. Survey of the material according to tooth group

Tooth group	No. of teeth (percentage)		Total
	Without OAC	With OAC	
3 | 3	143 (92.3)	12 (7.7)	155 (100)
4 | 4	73 (91.3)	7 (8.8)	80 (100)
5 | 5	51 (73.9)	18 (26.1)	69 (100)
7 6 | 6 7	6 (60.0)	4 (40.0)	10 (100)
Total	273 (86.9)	41 (13.1)	314 (100)

distally in the maxilla at the Department of Oral Surgery, University of Umeå during the period 1958–1972. The series does not include reoperated cases. Seventeen patients had to be excluded because they could not be traced. This left 276 (97 men, 179 women) with 314 operated teeth. OAC was noted in 41 teeth (13%).

The ages of the patients at operation varied between 12 and 71 years (mean 38.3 years).

Table 1 gives the distribution of the material according to operated tooth and OAC. OAC is here to be understood as including not only those cases with distinct rupture of the sinus mucosa with communication between the apical region and the maxillary sinus ($n = 24$), but also patients where the mucosa was intact ($n=17$).

SURGICAL PROCEDURE

The operation was done in a conventional way[15, 16]. The retrograde root filling material consisted of silver amalgam ($n = 133$), guttapercha ($n = 11$) or Cavit® ($n = 8$).

FOLLOW-UP

Patients who have undergone apicoectomy are routinely examined 6, 12 and 36 months after the operation. But inspection of the files revealed that some of the patients had not been reexamined according to this time table. In some cases the interval between the operation and the review was more than 36 months. The follow-up thus varied between 6 months and 12 years. In only 10 % was the interval between the operation and the review limited to 6–12 months.

Patients with OAC underwent complete sinus radiography, including tomography, in association with collection of the material[4]. Tomography was done to obtain a more detailed picture of the regeneration of the bone in the region of the operation and of the relation between the borders of the maxillary sinus and the root of the operated tooth. Four tomographic sections were exposed at a distance of 2 mm. Altogether, 26 patients were examined in this way. The reasons why not all of the patients with OAC were examined ($n = 41$, see "Material") were: a) the patient had moved away from the area ($n = 3$) and b) the tooth had been reoperated or extracted ($n = 12$) and thus the periapical status at the review was not related to the primary apicoectomy.

CLASSIFICATION OF THE RESULTS OF APICOECTOMY

The asymptomatic teeth were classified on the basis of intraoral radiographs from the last follow-up as follows:

Successful, when the apical area showed complete bone regeneration with or without periodontal membrane;

Uncertain, when a certain degree of bone regeneration had occurred but a radiolucency was still demonstrable;

Unsuccessful, when there was no bone regeneration or an increased radiolucency and/or demonstrable resorption of the root.

The teeth were classified jointly by the authors before the sinus radiograph and tomogram were interpreted.

If the patient complained of symptoms of pain, or if clinical examination revealed fistula-

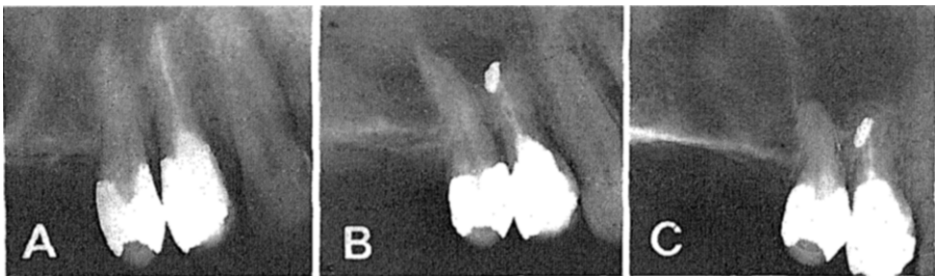

Fig. 1. Complete bone regeneration in a case of oroantral communication. A, condition immediately before and B immediately after operation and retrograde root filling with amalgam. C, 1 year postoperatively, complete bone regeneration.

tion, apical-marginal communication or tenderness to palpation or percussion, the case was classified as unsuccessful irrespective of the appearance of the radiograph.

Like PERSSON[15] the term uncertain was used at the 6-month follow-up even when the radiographic status was unchanged in comparison with that immediately after the operation.

CLASSIFICATION OF THE STATUS OF THE MAXILLARY SINUS

To find out whether the OAC had any effect on the prognosis or caused chronic changes in the maxillary sinus or postoperative defects in the bone, note was made of any local or general mucosal hyperplasia in the maxillary sinus, fluid level and defects of the bone between the border of the maxillary sinus and the root of the tooth operated upon. If the mucosa was less than 5 mm thick, the hyperplasia was regarded as moderate; if it was thicker it was regarded as severe.

Results

Examples of various postoperative results are given in Figs. 1–2.

The results regarding the outcome of the apicoectomy in the whole material, as judged from the clinical-radiographic findings at the last reexamination, are summarized in Table 2. No difference was found between the results obtained in the groups without and with OAC.

On the basis of clinical symptoms, 13 cases were assigned to the group unsuccessful, though the radiographic findings justified assignment to the group uncertain ($n = 11$) and successful, respectively ($n = 2$).

The results of the operation in the group with ruptured sinus mucosa did not differ from those in the group with intact mucosa.

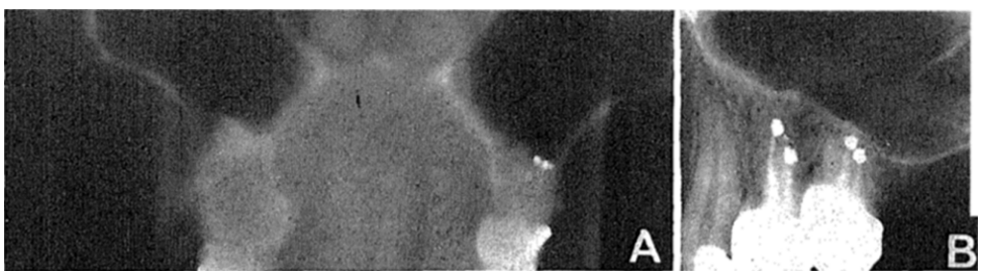

Fig. 2. A case of oroantral communication. Fifteen months postoperatively the tomogram shows no bony partition between apex of tooth and maxillary sinus (A), while apical radiograph was interpreted as complete bone regeneration (B).

Table. 2. Survey of results of apicoectomy as judged from clinical symptoms and radiographs obtained at last reexamination

Result	Percentage distribution (no. of teeth)		Total
	Without OAC	With OAC	
Successful	52.4 (143)	61.0 (25)	53.5 (168)
Uncertain	27.7 (73)	14.6 (6)	25.2 (79)
Unsuccessful	20.9 (57)	24.4 (10)	21.3 (67)
Total	100 (237)	100 (41)	100 (314)

The OAC group included five patients who had preoperative sinusitis judged as odontogenic and in whom periapical surgery was part of the treatment of sinusitis. In only one case did therapy result in early relief of symptoms, while the other four cases required continued treatment of their sinusitis. In two of these five cases the teeth involved were later extracted.

The results of the operation of different groups of teeth in the whole material are given in Table 3. The results of operation of the canines were better than those of the first and second premolars ($\chi^2 = 9.60$; d.f. = 2; $0.01 > P > 0.001$, respectively $\chi^2 = 8.54$; d.f. = 2; $0.02 > P > 0.01$).

No significant difference was found between the first and second premolars despite a relatively higher frequency of success in the second premolar group. The molar group was considered too small to warrant statistic analysis. Nothing suggested that OAC had affected the results of treatment in the groups of teeth.

Table 3. Result of apicoectomy grouped according to tooth group and OAC

Tooth group	OAC	Result			Total
		Percentage (no. of teeth)			
		Successful	Uncertain	Unsuccessful	
3 | 3	No	55.2 (79)	30.8 (44)	14.0 (20)	100 (143)
	Yes	58.3 (7)	25 (3)	16.7 (2)	100 (12)
	No + Yes	55.5 (86)	30.3 (47)	14.2 (22)	100 (155)
4 | 4	No	42.5 (31)	27.4 (20)	30.1 (22)	100 (73)
	Yes	57.1 (4)	(–)	42.9 (3)	100 (7)
	No + Yes	43.8 (35)	25.0 (20)	31.3 (25)	100 (80)
5 | 5	No	54.9 (28)	17.6 (9)	27.5 (14)	100 (51)
	Yes	61.1 (11)	11.1 (2)	27.8 (5)	100 (18)
	No + Yes	56.5 (39)	15.9 (11)	27.5 (19)	100 (69)
7 6 | 6 7	No	(5)	(–)	(1)	100 (6)
	Yes	(3)	(1)	(–)	100 (4)
	No + Yes	(8)	(1)	(1)	100 (10)
Total		53.5 (168)	25.2 (79)	21.3 (67)	100 (314)

Table 4. Results of apicoectomy in the whole material without and with retrograde root filling

Treatment	Result			Total
	Percentage (no. of teeth)			
	Successful	Uncertain	Unsuccessful	
Apicoectomy	54.3 (88)	22.8 (37)	22.8 (37)	100 (162)
Apicoectomy + retrograde root filling	52.6 (80)	27.6 (42)	19.7 (30)	100 (152)
Total	53.5 (168)	25.2 (79)	21.3 (67)	100 (314)

Table 5. Classification of the result in relation to the quality of canal obliteration

Space between orthograde and retrograde root filling	Frequency distribution (no. of teeth)			Total
	Successful	Uncertain	Unsuccessful	
Yes	57.4 (27)	29.8 (14)	12.8 (6)	(47)
No	50.5 (53)	26.7 (28)	22.9 (24)	(105)
	$\chi^2 = 2.03$; d.f. $= 2$; $P > 0.05$			
Total	52.6 (80)	25.2 (72)	21.3 (30)	(152)

Table 6. The results of apicoectomy in relation to the diameter of the periapical destruction

Diameter of the periapical destruction	Result			Total
	Percentage (no. of teeth)			
	Successful	Uncertain	Unsuccessful	
$\leq$ 5 mm	53.2 (124)	24.9 (58)	21.9 (51)	100 (233)
$>$ 5 mm	48.4 (30)	25.8 (16)	25.8 (16)	100 (62)
Total	52.2 (154)	25.1 (74)	22.7 (67)	100 (295)

There was no difference in the results between cases without and with retrograde root-filling (Table 4). OAC had no effect on this result. Cases with retrograde root filling were divided into two groups according to the quality of the orthograde root filling (appraised radiographically). No difference could be demonstrated between the postoperative results (Table 5).

Preoperative root resorption occurred in 46 cases. The results of surgery in these cases did not differ from those in the rest of the material.

Cases with a periapical destruction of more than 5 mm showed the same result as cases with a destruction of less than 5 mm (Table 6). The analysis did not include cases in which the destruction had involved more than one tooth, and the cases were classified according to their extent on the apical radiographs.

Nineteen teeth were involved in periapi-

Table 7. Classification of the postoperative result in relation to the microscopic picture of the periapical lesion. Only cases with one tooth involved in the lesions are included

Microscopic picture	Result			Total
	Percentage (no. of teeth)			
	Successful	Uncertain	Unsuccessful	
Cyst	65.0 (13)	25.0 (5)	10.0 (2)	100 (20)
Granuloma	41.4 (12)	34.5 (10)	24.1 (7)	100 (29)

cal destructions affecting more than one tooth. Of these 14 were judged as successful, five as uncertain.

Histologic examination of the periapical destruction (one tooth/destruction) was done in 49 cases. Though the statistical analysis revealed no significant difference ($\chi^2=2.97$; d.f. = 2), the frequency of success was almost 25 % higher when the lesion proved to be a cyst than when it was a granuloma (Table 7). The postoperative result was assessed without knowledge of the microscopic findings.

In 15 % ($n = 4$) of the 26 cases of OAC examined with tomography the bony partition between the apical area and the maxillary sinus was missing. In three of these four cases the apical radiograph (see Fig. 2) was judged as successful and in the fourth as uncertain. This evaluation was done without knowledge of the appearance of the tomogram.

The OAC group included four cases with a basal thickening of the sinus mucosa (three cases of moderate and one with pronounced thickening) on the operated side. In two of these cases there was no bony partition (see above) and the apical radiograph in these cases was judged as successful and uncertain, respectively.

The apical radiographs of the other two cases were also interpreted as successful and uncertain, respectively.

In one of the cases with mucosal thickening the change was so extensive that it suggested chronic sinusitis, but the patient had no clinical symptoms of sinutitis.

Discussion

The number of patients not reviewed was small (6 %) and must be regarded as acceptable in a retrospective study. This small loss presumably had no effect on the evaluation of the results.

Reoperations were not included because the prognosis is worse than after primary apicoectomy[15]. Inclusion of reoperations would have meant underestimation of the average result of such primary operations.

It is debatable whether cases with a follow-up of less than 1 year should not be excluded. Our material included 33 such cases, 8 of which were classified as successful, 11 as uncertain and 14 as unsuccessful. Earlier investigations have shown that results which are successful or unsuccessful after such a short follow-up do not change during further follow-up, while uncertain cases may equally often later prove to be successful or unsuccessful[15,16]. We therefore considered it appropiate to include cases with a short follow-up in order to obtain a more correct appraisal of the average results.

The distribution of OAC among different groups of teeth agreed well with what had been found for tooth extractions[1]. Even though the OAC *per se* does not appear to affect the outcome of the apicoectomy,

our material showed that apicoectomy often (on average 13 %) interferes with maxillary sinus in the lateral parts of the maxilla. At such operations foreign bodies (e.g. bone chips, root filling concrements) are apt to be displaced into the maxillary sinus. Such complications may be the cause of the observed thickening of the sinus mucosa and symptoms of sinusitis. On the other hand, ERICSON & WELANDER[2,3] found that periapical infection gave rise to inflammatory changes in the antral mucosa but subsided after extraction of the infected teeth. One might thus also imagine that the mucosal thickening found by us was due to persistent periapical infection. Further support of this assumption may be the small number of cases where the apical radiographs and the tomograms did not agree with the status of the apical bone.

Our findings suggest that one should consider whether extraction might not be preferable to periapical surgery in cases of odontogenic sinusitis.

The average result achieved in the present material agrees well with what we have found in other investigations of operations performed with the same indications[14,16]. But the frequency of success was about 10–30 % lower than that reported by other authors[6,13,17]. This may be explained by differences between the indications used for surgical interference and minor differences in the evaluation of the radiographs. If we, like RUD, ANDREASEN & JENSEN[17], whose frequency of success differed most from ours, judged the results exclusively on the basis of the radiographs, the average frequency of success in our material would be slightly higher.

The results of treatment of the premolars were worse than those of the canines. This is probably because the premolars are technically more difficult to treat and the anatomy of the root of these teeth makes it difficult to obliterate the canal. The probable significance of these factors is underlined by the fact that the results of operation on the first premolar (which often has two roots) seem to be less favorable than those on the second premolar.

Like many other authors[7,13,14], we found that the retrograde method is not inferior to the orthograde technique.

That we obviously achieved good sealing with retrograde root filling is reflected in our finding that the quality of the orthograde root filling had no influence on the results of the operation.

The findings in Table 5 also probably suggest that the quality of orthograde root filling is difficult to assess from single apical radiographs. We have expected a poorer result when there was a lumen between the orthograde and the retrograde root filling rather than a tendency in the opposite direction. We therefore nearly always use retrograde amalgam root filling because not even after the region of the apex has been surgically exposed is it always easy to decide the quality of orthograde root filling.

Root resorption has been described as impairing the prognosis of conventional endodontic treatment[10] and is regarded as an indication for periapical surgical intervention of those cases where we found preoperative root resorption ($n = 44$). This condition was rarely the only indication for the surgical operation. But, as in an earlier study[16], the present investigation did not suggest that root resorption impairs the prognosis of apicoectomy.

In contrast with what has been found in earlier investigations[5,8,11,13,14,15,18], we did not find that the results of operation varied with the extent of the destruction at the time of the operation. In evaluating this discrepancy it should be borne in mind, first, that though we were able to divide the destructions into two size groups, the differences between the average diameter

of the lesions in the two groups was small, and, second, that the cases with destructions > 5 mm did not consist of patients with perforation of the palatal cortical as well as of the buccal bone plate, which may sometimes be seen at operation of the maxillary lateral incisor, for example.

As reported previously[14,15,16] and observed by other authors[10] it is difficult to explain why radicular cysts seem to have a better prognosis in periapical surgery than granulomas. But it is interesting to know that histologic examination of the periapical tissues is meaningful because the result of the examination can be used, among other things, in appraisal of the prognosis.

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