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ORIGINAL ARTICLE

Changing clinical features of odontogenic maxillofacial infections

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Abstract Odontogenic maxillofacial infections occasionally require hospital care. Our aim was to study whether the number and the clinical features of patients hospitalized due to odontogenic abscesses in a large hospital district in Finland had changed in one decade. A retrospective analysis of two 12-month study cohorts one decade apart from the same population base was conducted. The first cohort comprised 71 patients and the second cohort comprised 101 patients. The incidence of odontogenic infections requiring hospital care increased from 5.3 to 7.2 per 100,000 inhabitants. The need for intensive care increased significantly from 15% to 32%, and the maximal C-reactive protein levels were significantly higher in the latter cohort, 127 mg/L, compared to the first cohort, 104 mg/L. The proportion of previously healthy patients decreased significantly from 83% to 65%. Odontogenic maxillofacial infections have become more prevalent and more severe during the decade in our hospital district. An increasing proportion of patients had underlying diseases.

Keywords Odontogenic maxillofacial infection · Space infection · C-reactive protein · Intensive care · Cardiovascular disease

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Introduction

Odontogenic infections generally respond well to dental care, antimicrobial therapy, and surgical intervention [1, 2]. However, they occasionally spread, causing maxillofacial infections that require hospital care [3–7]. A few studies have been published on the course and outcome of these infections. Admission temperature and underlying medical conditions have been shown to correlate with increased length of stay (LOS) [6]. LOS can also be predicted by the number of infected spaces and the duration of operation [8], and children seem to require shorter LOS than adults [2]. Recognition of airway compromise, surgical intervention, and administration of appropriate antibiotics are essential for the rapid resolution of infection [9]. Patients requiring intensive care have been shown to have higher admission C-reactive protein (CRP) values as well as higher maximal CRP values than patients without need for intensive care [10]. CRP has also been shown to be a good indicator of severe infection and sepsis, and the follow-up of maximum daily variation has been found to be a useful marker of infection prediction [11–14].

It has been reported that the majority of complications requiring hospitalization result from diseased third molars or their removal [15]. An equal distribution between males and females has been shown to be associated to multispace infections, but a prominence of males seem to be linked to single-space infections [16]. Two patient cohorts, one from the 1980s and one from the 1990s, have been reviewed for differences in patient characteristics; but, in this study, no clinically significant changes could be found [17]. Recently, an epidemic of admissions for surgical treatment of dental abscesses has been reported from the United Kingdom [18]. An opposite trend has been reported from Germany [19]. In Finland, we also have noticed a change in the course of infection towards more severe events in patients with locally invasive odontogenic infections. The purpose of the present work was to see if the incidence of odontogenic maxillofacial infections requiring hospital care had increased and if the clinical features of the infections had become more severe between two 12-month study cohorts over a 10-year period in the same hospital district.

Materials and methods

Study design

This study material consists of two 12-month study cohorts a decade apart (years 1994–1995 and 2004) of consecutive patients admitted because of a locally invasive odontogenic infection to the Department of Oral and Maxillofacial Diseases, Helsinki University Central Hospital (HUCH) in the Hospital District of Helsinki and Uusimaa (HUS) in Finland. This department was the only referral center for both public and private sectors in the 1.4 million-inhabitant hospital district, covering 27% of the population in Finland for both study cohorts.

Patients in both cohorts were identified in the hospital district database using the following WHO ICD-10 diagnoses: K04.7 (periapical abscess without sinus), K05.2 (acute periodontitis), K12.2 (cellulitis and abscess of mouth), K14.0 (glossitis), J36 (peritonsillar abscess), and J39.1 (other abscess of the pharynx). Patients with the need for hospital care due to a locally invasive odontogenic infection for at least one hospital day were included. The analyses were performed without patient identifiers according to our research protocol approved by the hospital district.

Patient numbers and characteristics of the two cohorts were compared. The characteristics reviewed were age, gender, health status, occupation, body temperature, white blood cell (WBC) counts, CRP levels, source of infection, fascial spaces involved, LOS, need for intensive care, and length of intensive care.

Stratification of occupational social class

The socioeconomic status was defined by the patient's occupation according to the UK Registrar General's classification. The occupational social class was based on the patient's current or most recent occupation. Patients were classified into five categories: professionals, e.g., doctors and lawyers (I) or intermediate occupations, e.g., managers and teachers (II), non-manual skilled occupations, e.g., office workers (III non-manual), manual skilled occupations, e.g., carpenters and bricklayers (III manual), and partly skilled occupations or unskilled occupations, e.g., salespersons and warehouse workers (IV, V). Social classes IV and V were combined as earlier described by Skapinakis [20]. A sixth category was added for patients whose social class was indeterminable (children, full-time students, pensioners, patients who had never worked) or if the occupation was inadequately described, corresponding to the missing data of this variable.

Statistical analysis

Data were analyzed by using Graph Pad Prism version 4.0 (Graph Pad Inc. San Diego, CA, USA). Data were compared by the Mann–Whitney U test or the unpaired two-tailed t test and the chi-square test or the Fisher's exact test [21]. Data are presented as mean (±standard deviation), median (range), or number (%). A p-value less than 0.05 was considered statistically significant.

Results

Over the two study periods, a total of 172 patients were identified by the defined search criteria and included in the study. The first 12-month cohort comprised of 71 patients and the second 12-month cohort a decade later from the same geographical area (HUS) comprised of 101 patients. The incidence of odontogenic maxillofacial infections requiring hospital care increased from 5.3 to 7.2 per 100,000 inhabitants in 10 years in the Helsinki and Uusimaa Hospital District. The 1994–1995 and 2004 cohorts did not statistically differ in age (mean 37.2±13.4 and 41.5±16.9 years, respectively) or gender (59% and 63% males, respectively).

The patient characteristics of the two cohorts are presented in Table 1. The proportion of patients in need for intensive care increased significantly in one decade (p= 0.0158). Maximal CRP levels were significantly higher in 2004 when compared to 10 years earlier (p=0.0236). However, LOS was significantly shorter in the latter study period (p<0.0001). Concomitantly, the CRP levels and WBC counts were significantly higher at discharge in 2004 (p=0.0017 and p=0.0378, respectively).

The proportion of patients who were previously healthy and did not have any underlying diseases or continuous medications decreased significantly between the cohorts (p=0.0101). The most common underlying diseases of the

Table 1 Patient characteristics during hospital stay in the two 12-month study cohorts. Data are presented as number (%) or median (range)

	Cohort		p values
	1994–1995 (n=71)	2004 (n=101)	
Need for intensive care	11 (15)	32 (32)	0.0158[a]
LOS (days)	5 (2–16)	3 (1–26)	<0.0001[b]
Length of intensive care (days)	2 (1–6)	3 (1–22)	ns[b]
CRP (mg/L) on admission	84 (1–372)	104 (5–516)	ns[b]
CRP (mg/L) at maximum	104 (9–372)	127 (11–516)	0.0236[b]
CRP (mg/L) at discharge	31 (1–117)	42 (5–146)	0.0017[b]
WBC (10^3/μL) on admission	12.3 (2.9–24.6)	11.7 (6.3–24.4)	ns[b]
WBC (10^3/μL) at maximum	13.0 (6.4–24.6)	12.2 (6.3–27.9)	ns[b]
WBC (10^3/μL) at discharge	7.0 (3.7–15.5)	7.7 (3.9–16.6)	0.0378[b]
Body temperature ≥ 37.5°C on admission	23 (32.4)	33 (33.0)	ns[a]
Body temperature ≥ 38.0°C at maximum	25 (35.2)	30 (32.6)	ns[a]

LOS length of stay, *ns* not significant, *CRP* C-reactive protein, *WBC* white blood cell

[a] Chi-square test

[b] Mann–Whitney *U* test

patients are presented in Table 2. The proportion of patients with cardiovascular diseases (CVD) and hypertension was significantly higher in 2004 when compared to 10 years earlier (p=0.0406 and p=0.0160, respectively). In addition, the proportion of mental disorders increased significantly between the study periods (p=0.0008). The characteristics of the patients with mental disorders in 2004 are shown in Table 3.

The involvement of fascial spaces is presented in Table 4. The odontogenic infection complications were mainly single-space infections in both cohorts [51 (72%) patients and 75 (74%) patients, respectively]. In the first cohort, the most common location of a single-space infection was the buccal space [32 (63%) patients], whereas in the latter cohort it was the submandibular space [35 (47%) patients]. The incidence of buccal space as a single-space infection was found to be significantly higher in the first cohort (p=0.0011). The incidence of submandibular space as a single-space infection did not change over one decade. The submandibular space was the most common fascial space involved in multiple-space infections in both study periods [19 (95%) patients and 22 (85%) patients, respectively]. Mandibular molars were the most common sources of infection in both cohorts [57 (80%) patients and 83 (82%) patients, respectively]. There was no statistically significant difference in the incidence of left- and right-side mandibular molar involvement. Of the 13 patients with mental disorders, a mandibular molar was the source of infection in 12 cases (92%). All five patients who were in the need for ICU treatment had either submandibular or sublingual space involvement.

The primary antibiotics prescribed prior to hospital admission and the primary antibiotics administered during hospital stay are shown in Tables 5 and 6. There was no change in the proportion of patients who were prescribed antibiotics prior to hospital admission between the two cohorts (59% and 60%, respectively). The usage of penicillin V alone decreased significantly from 31% to 17% (1994–1995 and 2004) (p=0.0291). Other groups of antibiotics, e.g., macrolides, were used increasingly instead. The spectrum of primary antibiotics administered during hospital stay did not change significantly.

Table 2 Health status and the underlying diseases of the patients in the two 12-month study cohorts

Underlying condition	Cohort		p values
	1994–1995 (n=71)	2004 (n=101)	
Cardiovascular diseases	3 (4)	14 (14)	0.0406[a]
Hypertension	1 (1)	11 (11)	0.0160[a]
Coronary heart disease	0 (0)	4 (4)	ns[a]
Cardiac arrhythmia	0 (0)	4 (4)	ns[a]
Cardiac insufficiency	0 (0)	1 (1)	ns[a]
Congenital heart defect	2 (3)	0 (0)	ns[a]
Mental disorders	0 (0)	13 (13)	0.0008[a]
Diabetes mellitus	0 (0)	5 (5)	ns[a]
Pregnancy	1 (1)	4 (4)	ns[a]
Previously healthy patients	59 (83)	66 (65)	0.0101[b]

Data are presented as number (%)

ns not significant

[a] Fisher's exact test

[b] Chi-square test

Table 3 Characteristics of the patients with mental disorders in year 2004

Patient number	Age (years)	Sex	Mental disease	Underlying disease	Location of the infection	Focus of the infection	ICU treatment
1	38	F	Schizophrenia	–	Buccal	LI1-LP1	−
2	64	F	Depression	Cardiac arrhythmia	Buccal and submandibular	LM1-2	+
3	39	M	Schizophrenia	–	Sublingual	LM1	−
4	30	F	Panic disorder	–	Masseter	UM3, LM1-2	−
5	49	M	Depression	Discus prolapsis, spondylosis	Sublingual and submandibular	LM1	+
6	42	M	Schizophrenia	–	Sublingual	LM2	+
7	48	F	Depression	–	Submandibular	LP2-LM2	+
8	35	M	Depression	–	Buccal and submandibular	LM3	−
9	29	M	Panic disorder	–	Submandibular	LM1-2	−
10	31	F	Bipolar affective disorder	Kidney dysfunction	Submandibular	LM1	−
11	45	F	Schizophrenia	–	Buccal	LP2-LM1	−
12	87	F	Paranoid psychosis	Chronic heart flimmer	Buccal	LP1, LM1	−
13	49	F	Depression	–	Submandibular	LM1	+

ICU intensive care unit, *F* female, *M* male, *L* lower, *U* upper, *I* incisor, *P* premolar, *M* molar

Patients with partly skilled or unskilled occupations, such as salespersons and warehouse workers belonging to social class IV/V, were significantly more common in the first study cohort when compared to the latter study cohort (p=0.0242). Data was available for 57 (80%) patients in the first study cohort and 54 (53%) patients in the second study cohort. In all other patient groups (occupational social classes I–III), the proportion of patients increased over the decade. The proportion of patients belonging to professionals (class I) increased from none (0%) to four (7%) patients, intermediate occupations (class II) from ten (14%) to nine (17%) patients, non-manual skilled occupations (class III non-manual) from 11 (15%) to 11 (20%) patients, and manual skilled occupations (class III manual) increased from six (8%) to 13 (24%) patients from the first to the latter study cohort.

Table 4 Frequency of fascial space(s) involved in the two 12-month study cohorts

	Cohort	
	1994–1995 (n=71)	2004 (n=101)
Single-space involvement		
Number of patients (%)	51 (72)	75 (74)
Submandibular space	16 (31)	35 (47)
Buccal space	32[a] (63)	25[a] (33)
Submental space	0 (0)	1 (1)
Sublingual space	2 (4)	9 (12)
Retropharyngeal space	1 (2)	0 (0)
Peritonsillar space	0 (0)	1 (1)
Masseteric space	0 (0)	4 (5)
Multiple-space involvement		
Number of patients (%)	20 (28)	26 (26)
Submandibular space	19 (95)	22 (85)
Lateral pharyngeal space	1 (5)	3 (12)
Buccal space	11 (55)	12 (46)
Submental space	2 (10)	3 (12)
Sublingual space	6 (30)	10 (38)
Retropharyngeal space	0 (0)	1 (4)
Medial pterygoid space	1 (5)	0 (0)
Masseteric space	0 (0)	1 (4)
Base of the skull	0 (0)	1 (4)
Neck	0 (0)	1 (4)

Data are presented as number (%) [17]

[a] Chi-square test p=0.0011

Discussion

This study shows that the clinical characteristics of patients hospitalized due to odontogenic maxillofacial infections have changed over a 10-year period. Patients were significantly more often in need of intensive care in 2004 compared to 10 years earlier. Maximal CRP levels were significantly higher in the latter cohort, suggesting a more severe course of infection. The incidence of patients with odontogenic maxillofacial infections requiring hospital care also increased between the study cohorts. In our hospital district, odontogenic maxillofacial infections appear to have

Table 5 Primary antibiotics prescribed prior to hospital admission in the two 12-month study cohorts

Cohort	1994–1995 (n=71)	2004 (n=101)
No antibiotic therapy	29 (41%)	40 (40%)
Penicillin V	22 (31%)[a]	17 (17%)[a]
Penicillin V + metronidazole	13 (18%)	22 (22%)
Penicillin A + metronidazole	0	1 (1%)
Cephalexin	1 (1%)	2 (2%)
Cephalexin + metronidazole	1 (1%)	1 (1%)
Erythromycin	2 (3%)	0
Erythromycin + metronidazole	1 (1%)	0
Roxythromycin	0	9 (9%)
Roxythromycin + metronidazole	0	4 (4%)
Clindamycin	1 (1%)	2 (2%)
Doxycycline	0	1 (1%)
Doxycycline + metronidazole	0	1 (1%)
Metronidazole	0	1 (1%)
Antimicrobial therapy with inadequate documentation	1 (1%)	0

Data are presented as number (%)

[a] Chi-square test p=0.0290

become more severe over a 10-year period, which is in accordance with a recent UK study [18].

However, we found that in 2004 the median LOS was significantly shorter than a decade earlier and had decreased from 5 to 3 days. In previous studies, LOS due to odontogenic maxillofacial infections has ranged from 4 to 8.3 days [2, 6, 8–10, 15, 16]. We also found that at discharge the CRP levels and WBC counts were found to be significantly higher in the latter cohort. In our opinion, this suggests that the LOS has shortened because of a change in hospital policies concerning earlier discharge rather than faster recovery, which may reflect emphasized cost-effectiveness and concern for hospital-acquired infections.

In the present study, medically compromised patients appear to constitute a notable proportion of the patients with locally invasive odontogenic infections. The proportion of patients who had an underlying disease increased significantly in a decade from 17% to 35%. This is of particular interest as the mean age of the patients in 2004 was only 41.5 years and did not significantly change over the 10-year period. CVD were the most common underlying disease in 2004 and the number of patients with CVD increased significantly over the 10-year period. The relationship between cardiovascular and oral diseases has been the focus of many studies [7]. Although the etiology of CVD is multifactorial, there is strong evidence that chronic infections such as dental infections contribute to atherosclerosis [22, 23]. The number of patients with mental disorders increased significantly from zero to 13 patients between the study cohorts. We suggest that the significantly increased proportion of patients with mental disorders in this study material reflects the unbalanced health status of these patients and the possible neglect of this patient group in our health care system [24].

The same proportion of patients had been prescribed antibiotics prior to hospital admission in both cohorts although the proportion of medically compromised patients had increased. It is possible that dentists are unaware of the increased infection complication risk in some patient groups or they fear of drug-to-drug interactions in these medicated patients. The spectrum of primary antibiotics

Table 6 Primary antibiotics administered during hospital stay in the two 12-month study cohorts

Cohort	1994–1995 (n=71)	2004 (n=101)
Penicillin G	3 (4%)	0
Penicillin V	0	1 (1%)
Penicillin G + metronidazole	56 (79%)	80 (80%)
Penicillin A + metronidazole	1 (1%)	0
Cefuroxime + metronidazole	6 (8%)	7 (7%)
Ceftazidime + ciprofloxacin + fluconazole	0	1 (1%)
Erythromycin + metronidazole	3 (4%)	0
Clindamycin	2 (3%)	7 (7%)
Clindamycin + metronidazole	0	5 (5%)

Data are presented as number (%)

prescribed prior to hospital admission changed markedly. The usage of penicillin V decreased significantly and other groups of antibiotics were used increasingly. This could be due to more patients reporting allergy to penicillin. However, this should have affected the primary antibiotics during hospital stay, which was not the case. The findings of our study support the efficacy of penicillin in the treatment of odontogenic infections and confirm the perceived emerging resistance of streptococci and anaerobes to macrolides and clindamycin in Finland.

Mandibular molars have been identified as the most common source of infection from the mouth in several reports, which can be seen also in the present study [8, 17]. The odontogenic infection complications were mainly single-space infections in both cohorts. Fascial spaces involved in this work were mainly submandibular and buccal spaces, which is in accordance with previous studies [2, 8, 17]. The buccal space was significantly more often involved in single-space infections in the first cohort when compared to the second at 10 years later. However, no plausible explanation can be found for this observation. There were no major changes regarding the involvement of fascial spaces of the neck and other deep structures between the study cohorts and these were very rare in both. Therefore, the involvement of these structures or number of spaces involved does not explain the more severe course of the infections in the latter study period.

We acknowledge some limitations in this work. Firstly, the occupation of the patients is not recorded routinely in the patient records, and due to the retrospective study design the classification of occupational social class is incomplete. Therefore, no definite conclusions can be drawn regarding the impact of the socioeconomic status on our findings. However, a high incidence of dental abscesses has recently been reported amongst poorer people in the UK, which is in accordance with our data [25]. Secondly, since the general medical records of the patients were not available, the interesting subgroup of patients with mental disorders could not be studied further. The admission criteria were essentially the same for the two cohorts, including threat to airways or vital structures, need for general anesthesia, septic fever, marked swelling, and/or need for inpatient control of a concomitant systemic disease. In addition, the criteria for intensive care have remained the same. However, it is recognized that small changes may take place over a 10-year period. Our results suggest that the admission criteria may have become more stringent as the infection parameters were higher on admission in the latter cohort. Therefore, the true increase in the number of cases could be even greater than the data indicate. The population or rate of immigration has not increased significantly over the study period in our hospital district, and that could explain the increase of these severe infections. However, the dentist–population ratio has slightly decreased, supporting the possibility of increased delay in accessing medical treatment and leading to a more severe infection course.

In conclusion, based on this study, odontogenic maxillofacial infections requiring hospital care became more prevalent and severe in our hospital district. The number of patients requiring intensive care increased and the maximal CRP levels were significantly higher in the latter cohort. Concomitantly, the number of previously healthy patients decreased and the proportion of patients with underlying diseases increased in the 10-year period.

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Conflict of interest The authors declare that they have no conflict of interest.

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