



Odontogenic Infections in a Regional Hospital in Kuwait: 7 Years Retrospective Study

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Authors' contributions

This work was carried out in collaboration between both authors. Author PS designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors PS and MAA managed the data collection of the study. Both authors managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Objective: We review our experience with odontogenic infections requiring hospitalization, to identify etiological factors, the most frequently affected anatomical spaces, prognostic signs, bacterial pathogens and adequacy of initial empiric antibiotic therapy, surgical interventions, and the influence of these variables on the length of hospitalization.

Methods: A retrospective study of all patients hospitalized for management of odontogenic maxillofacial space infections from May 2013 to May 2020 was performed utilizing the admission database of the Oral & Maxillofacial Surgery Unit and computerized hospital information system of Al-Farwaniya Hospital in Kuwait. The databases were manually searched and the relevant data analyzed.

Results: The records of 95 (6.6% of all admitted) patients diagnosed with acute odontogenic infections were analyzed. They were 63 males and 32 females, M:F ratio 2:1. The age of patients ranged from 4 to 71 with a mean 32 and a median of 30 years. Twenty patients suffered from underlying medical conditions. The most frequently affected anatomical space was the submandibular one. In 85 patients the causative tooth was still present at the time of admission. Causative teeth were most frequently lower molars (n=72). An extraoral incision was performed in 74 patients, intraoral incision in 10 patients. All still present causative teeth were extracted in the

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same session. The length of hospital stays varied from 1 to 19 days with mean 4.5 days and modus 3 days.

Conclusions: No statistically significant relation was found between length of hospital stay and patient age, initial WBC value, CRP value, presence of diabetes, or adequacy of empiric antibiotic treatment. We believe that the overwhelming majority of hospital admissions for odontogenic infections could be prevented by timely and competent treatment including the extractions of causative teeth in outpatient settings.

Keywords: Odontogenic infection; tooth extraction; incision and drainage; antibiotics.

1. INTRODUCTION

Patients suffering from odontogenic infections are frequently seen in outpatient dental clinics. If not neglected, these infections are usually limited to the oral cavity or superficial anatomic spaces like the oral vestibule, hard palate, perimaxillary and perimandibular soft tissues at the time of the first visit of the patient. They can be controlled by the elimination of the etiological factor, antibiotics, and intraoral surgical incision and drainage if necessary. Nevertheless, late presentation, incorrect diagnosis, or ineffective initial treatment can lead to progression with the involvement of deep neck spaces that can even become life-threatening. Such conditions necessitate hospital admission and urgent surgical intervention [1-3].

Our study aims to review our experience with advanced odontogenic infections, to identify etiological factors, the most frequently affected anatomical spaces, prognostic signs, bacterial pathogens, and adequacy of initial empiric antibiotic therapy, surgical interventions, and the influence of these variables on the length of hospitalization.

2. MATERIALS AND METHODS

A retrospective study of all patients hospitalized for management of odontogenic maxillofacial space infections from May 2013 to May 2020 was performed utilizing the admission database of the Oral & Maxillofacial Surgery Unit and computerized hospital information system of Al-Farwaniya Hospital in Kuwait. The databases were manually searched and the relevant data were tabulated using Microsoft Excel® spreadsheet and analyzed using database and statistical functions.

3. RESULTS

Of 1414 patients admitted during the reviewed period 130 individuals were treated for maxillofacial infections. This corresponds to

approximately 9% of admitted cases. Thirty-five patients suffered from non-odontogenic diseases like infectious complications of maxillofacial trauma, infections of facial skin adnexa, sialoadenitis, lymphonoditis, and complications of facial tissue fillers. The records of 95 (6.6% of all admitted) patients diagnosed with acute odontogenic infections were analyzed. They were 63 males and 32 females, M:F ratio 2:1. The age of patients ranged from 4 to 71 with a mean 32 and a median of 30 years.

Twenty-nine patients visited the hospital casualty department 1-8 days earlier, some of them repeatedly. There were altogether 43 visits. Dental casualty service was visited 21x, general surgery 17x, ENT 3x, ophthalmology and internal medicine once each. One patient had even 6 visits between preadmission days 5 and 1: 2x dental casualty, 2x general surgery, and 2x ENT.

Twenty patients suffered from known underlying medical conditions, 2 patients were mentally retarded. The most frequent medical condition was type 2 diabetes mellitus (n=16), five times in combination with hypertension, twice with chronic renal failure and twice with a history of cerebral vascular accident. One patient was diagnosed with acute myeloid leukemia during the preoperative work-up.

The most frequently affected anatomical space was the submandibular one (Table 1).

One space was affected in 70 patients, two spaces in 17 patients, three spaces in 4 patients, and more spaces in 4 patients. Three patients fitted to the criteria of Ludwig's angina. One patient presented with a fully developed clinical picture of necrotizing fasciitis, and this was the only patient who died.

Initial WBC values were recorded for 86 patients. They varied in the range of 6.1 – 35.6 x 10⁹/L with a mean 14.7 and a standard deviation of 5.3.

CRP examination was done only in 11 patients and varied from 57 to 460 mg/l. Causative teeth were most frequently lower molars (n=72), most prominent of them wisdom teeth (n=40). Upper teeth were the source of infection only in 7 adults and 2 pediatric patients. In five pediatric patients, the causative teeth were deciduous (Fig. 1).

In 85 patients the causative tooth was still present at the time of admission, in 10 patients it was extracted earlier.

As a mode of surgical treatment, an extraoral incision was performed in 74 patients, intraoral

incision in 10 patients. More than one extraoral incision was necessary for 10 patients. The patient affected by necrotizing fasciitis received tooth extraction, incision of submandibular and parapharyngeal abscess, and extensive debridement (Fig. 2).

All still present causative teeth were extracted in the same session. In 10 patients the extraction of causative tooth was the only surgical intervention. Two patients, whose causative teeth were extracted before admission, received only antibiotics (Table 2).

Table 1. Distribution of affected spaces

Location	Cellulitis	Abscess	Σ
Submandibular	4	47	51
Submental	1	21	22
Perimandibular	8	12	20
Sublingual	4	12	16
Parapharyngeal	-	9	9
Buccal	-	8	8
Perimaxillary	1	5	6
Masticatory	1	4	5
Infratemporal	-	1	1
Total	19	119	138

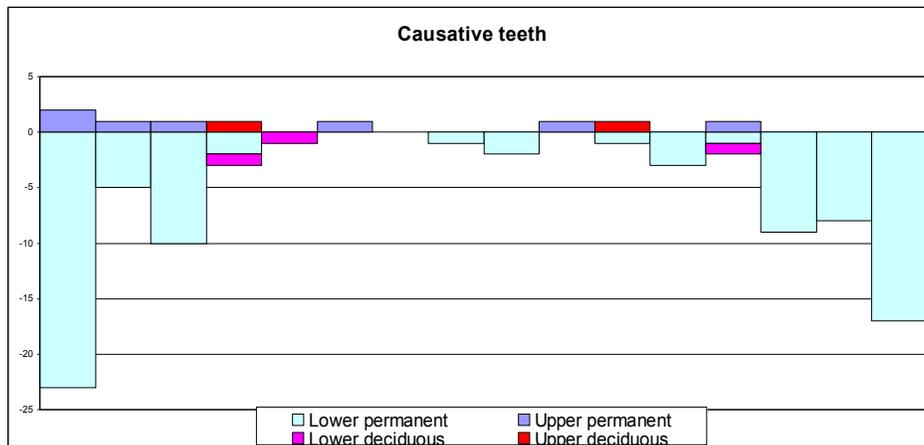


Fig. 1. Distribution of causative teeth

Table 2. Surgical interventions

Intraoral and extraoral incision + extraction	2
Extraoral incision + extraction	65
Extraoral incision and debridement + extraction	1
Intraoral incision + extraction	7
Extraoral incision	7
Intraoral incision	1
Extraction	10
No surgical intervention	2
Total	95



Fig. 2. The case of necrotising fasciitis: A. before debridement, B. after debridement

Thirty patients were operated on the day of admission, 54 patients on the following day, 5 patients on the second post-admission day. One patient, who was refusing indicated extraction and insisted on antibiotic treatment only, received finally extraction on the third post-admission day. One patient, whose causative tooth was extracted before admission, agreed to the extraoral incision only on the fourth post-admission day. In 2 patients the day of intervention (extraction) is missing.

In 4 patients treated initially by extraoral incision and tooth extraction, it was necessary to perform revision surgery in the following days.

All patients received intravenous antibiotics since admission. Clindamycin was administered in 63 patients, Ampicillin-Clavulanate in 8 patients, Clindamycin plus Ceftriaxone in 5 patients, and Ceftriaxone in 1 patient. In 18 patients the kind of antibiotic treatment was not retrievable from the information system.

Microbiology examination results were available for 66 patients. In 19 cultures there was no

growth. The culture was positive in 47 samples. Twenty different species were isolated, 1 species in 31 patients, 2 species in 13 patients, and 3 species in 2 patients. The most frequent isolate was *Streptococcus anginosus* gr. (n=25) and *Prevotella* spp. (n=14).

Matching information on antibiotic treatment and antibiotic sensitivity was available for 37 patients. In 25 cases isolated microorganisms were sensitive to initial empiric treatment, in 12 cases they were resistant.

The length of hospital stays varied from 1 to 19 days with mean 4.5 days and modus 3 days (Fig. 3).

3.1 Statistical Analysis

Pearson Correlation Coefficients were calculated for relations between length of hospital stay and age, initial WBC value, CRP value, presence of diabetes, adequacy of empiric antibiotic treatment, and the day of the surgery (Tables 3,4). No statistically significant relation was found.

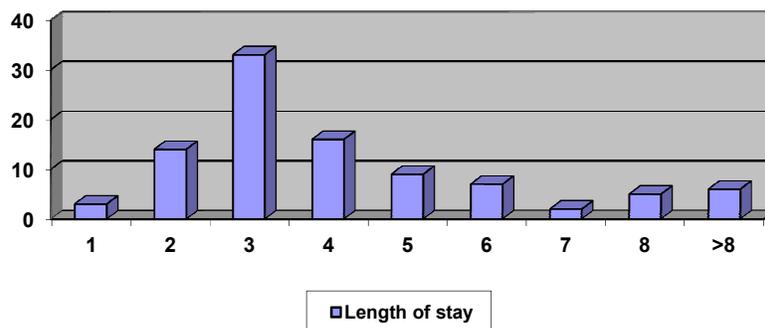


Fig. 3. The length of hospitalization

Table 3. Descriptive statistics of evaluated variables

Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Age	95	32.00000	15.13907	3040	4	71
WBC	86	14.73605	5.30125	1267	6.1	35.6
CRP	11	222.09091	147.62280	2443	57	460
Diabetes	95	1.83158	0.37623	174	1	2
Day of surgery	91	0.82417	0.58866	75	0	4
Antibiotic sensitivity	37	1.32432	0.47458	49	1	2
Length of stay	95	4.48421	3.29688	426	1	19

Diabetes 1=yes 2=no

Antibiotic sensitivity 1=yes 2=no

Table 4. Correlation between the length of hospitalization and other variables

	Number of observations	Pearson coefficient	P
Age	95	0.25321	0.0133
WBC	86	0.18753	0.0838
CRP	11	0.03215	0.9252
Diabetes	95	-0.03647	0.7257
Day of surgery	91	0.23910	0.0225
Antibiotic sensitivity	37	-0.19274	0.2531

4. DISCUSSION

To our best knowledge, there is no previous study available that evaluates maxillofacial space infections in Kuwait. The demographic data of our study are in some aspects different from the other studies published in English literature. While many authors, in accordance with our findings, reported a predominance of males, the mean age of our patients was 32 years, considerably lower than found in some similar studies [3-7]. This can be explained by poor dental status and difficulties in obtaining preventive and primary dental care, poor self-care habits, dental fear, and belief that visiting a dentist is necessary only for pain relief [8-10]. Recently, the situation was aggravated by the introduction of fees for visits to health care facilities, imaging, surgical procedures, and prescription drugs that must be paid by expatriates, who constitute a majority (nearly 70%) of Kuwait's population [11].

We believe that many, if not most, of admissions analyzed in our study, could have been prevented by the timely extraction of a causative tooth in an outpatient setting. Unfortunately, general dental practitioners in Kuwait, like in other Middle East countries, are reluctant to extract teeth in a presence of inflammation and they treat odontogenic infections only by antibiotics [12,13]. Even in a recent study from Finland two-thirds of the patients had had

previous visits for their current infection and half of the treatment provided was exclusively antibiotics [14].

Most of our patients experienced repeated visits to dental offices during days or even weeks before presentation in our clinic, but due to the lack of documentation, we could not include this aspect into our study. Patients who sought medical attention in the casualty department of our hospital were frequently either misdiagnosed or given inadequate treatment. Twenty-nine patients visited the hospital casualty department 1-8 days before admission, some of them repeatedly. Dental casualty service was visited 21x, general surgery 17x, ENT 3x, ophthalmology and internal medicine once each. One patient had even 6 visits between preadmission days 5 and 1: twice dental casualty, twice general surgery, and twice ENT. It attests to ineffective triaging and a lack of diagnostic abilities among casualty medical staff [15]. A maxillofacial surgeon is not on in-house duty outside working hours and it is up to the judgment of casualty department staff to ask for his consultation. Resulting delay of the adequate treatment of odontogenic infection can reasonably be considered malpractice [13].

Initial evaluation of the seriousness of the patient's condition and urgency of surgical intervention is assisted by some laboratory examinations, namely WBC and CRP

[3,4,6]. Patients that show CRP values above 200 mg/l and white blood cell count greater than $19 \times 10^9/L$ on admission require special attention [3].

There is no general consensus regarding a need for CT or MRI imaging at the time of hospital admission. The attempts were made to establish criteria for initial CT examination including blunting at the mandibular inferior border, a mouth opening smaller than 25 mm, voice change, the elevated floor of the mouth, periorbital edema, dyspnea, dysphagia or odynophagia [16,17]. However, blunting of mandibular inferior border, elevated floor of the mouth, and trismus are present in almost all odontogenic infections originating from mandibular teeth and requiring hospital admission. In our patients, CT examination on admission was indicated only in cases of Ludwig angina and necrotizing fasciitis. Later CT examination was performed in 4 patients who did not respond to initial surgical treatment and required the second operation. We believe that in cases of isolated submandibular or submental abscesses in patients without complete trismus, whose floor of mouth and oropharynx can be visualized, CT examination is not necessary.

CT use is constantly increasing and an estimated 2% of all cancers are attributable to medical imaging [18]. A recent study documented an elevated risk of thyroid cancer and leukemia in association with medical CT. Increased risks for non-Hodgkin lymphoma was found in patients aged 45 years or younger. A clear dose-response relationship was observed in patients 45 years or younger for all three cancers [19].

In agreement with the literature lower molars were the most frequent infection source [4, 20-23]. In all patients, the extraction of a causative tooth (if still present) was done as a part of surgical treatment. The question of whether or not to extract teeth immediately in the presence of acute infection remains to be controversial for many dentists who still believe that the extraction of teeth in such a situation can cause life-threatening complications [24]. The current opinion holds that odontogenic infection treatment should include the elimination of odontogenic foci. Early extraction results in faster resolution of the infection, decreased pain, and earlier return of function and can decrease the length of hospital stay [3,5,23,25,26]. The risk of seeding the infection into deeper spaces is low [24].

In addition to the removal of the offending tooth, timely and aggressive incision and drainage are the mainstays of space infection management [1,3,4,20]. Minimal attention is paid to the surgical technique of extraoral incision in recent literature, perhaps except discussion about the usefulness of irrigation drainage [3, 27]. Four of our patients required re-operation due to worsening clinical course and all of them had been primarily managed by a small extraoral incision that was in hindsight considered inadequate for a proper exploration of affected spaces. Three of them developed homolateral parapharyngeal abscess and one of them developed a contralateral submandibular abscess. It is important to emphasize that incision should be long enough to allow finger dissection and exploration of affected spaces. Deep dissection with an instrument like artery forceps can endanger vital structures, while finger dissection allows controlled progress with identification of important anatomical landmarks like mandibular angle, hyoid bone, posterior edge of the mylohyoid muscle, medial pterygoid muscle and the tip of the styloid process. The adequacy of surgical access should be given precedence over cosmetic consideration. The quite acceptable cosmetic outcome can be achieved by placing incisions to pre-existing skin creases in the upper neck. Placing an incision into an area of inflamed dystrophic skin where the abscess is already approaching the surface should be avoided because it can lead to necrosis of incision's margins and development of large skin defect [28] (Fig. 4).

For drainage, wide corrugated drains that should ideally fill the whole length of the incision for maximum effect are preferred. (Fig. 5) If these are not available, we use a perforated Malecot catheter.

Like in similar studies, the most frequent culture isolates were Streptococci and Prevotella [1,3,29-33]. In 25 cases isolated microorganisms were sensitive to initial empiric treatment, and in 12 cases they were resistant. However, we did not find any statistically significant difference in treatment outcome as measured by the length of hospital stay. Moreover, the information about antibiotic sensitivity often came only after a patient was already discharged from the hospital. Microbiology cultures and antibiotic sensitivity examination does not appear to be clinically helpful [34] This attests to the primary importance of surgical treatment while antibiotics

play only a supportive role in well-localized infection in an otherwise healthy patient.

lipopolysaccharide-induced monocyte synthesis of TNF- α [38].

There are different opinions on the choice of initial empiric antibiotic medication. The choices include Penicillin [1,30], Amoxicillin/clavulanate [35,36], Amoxicillin/clavulanate and metronidazole [30], Clindamycin [1,31,35], second- or third-generation cephalosporins [36, 37] along with metronidazole or ornidazole [29], quinolone [32] or even tazobactam and piperacillin [3]. In most cases, antibiotic therapy was started with clindamycin for anaerobic coverage. Clindamycin is also a potent suppressor of bacterial toxin synthesis, facilitates phagocytosis, and causes suppression of

Diabetes mellitus with poorly controlled glycemia is known to lead to frequent infectious complications. Diabetic patients have impaired neutrophil bactericidal function, cellular immunity, and complement activation. Also, diabetic microangiopathy makes them more vulnerable to bacterial and mycotic invasion. Although 15% of our patients were suffering from diabetes, we did not find among them a significant difference in the outcome, except for the patient with necrotizing fasciitis who died. However, this patient presented late with advanced disease and he also suffered from diabetes related renal



Fig. 4. Incision of submental and submandibular abscess; diseased skin is avoided



Fig. 5. Wide incision of parapharyngeal abscess in a skin crease with corrugated drains in place

Insufficiency and hypertension. Improved management of a diabetic patient after admission under the guidance of a diabetologist will lead to better prognosis and the response to treatment after glycemia control will be similar to a non-diabetic patient [39-40].

The length of hospital stay is considered the important outcome variable characterizing the severity of disease [25, 26, 29, 30]. However, the length of hospitalization is different in different regions of the world when similar infections are compared. The factors like geography, transportation, social situation of patients, and hospitalization costs can play an important role. If the initial treatment is done properly, the length of stay may not be associated with the severity of infection [4].

5. CONCLUSIONS

We believe that the overwhelming majority of hospital admissions for odontogenic infections could be prevented by timely and competent treatment including the extractions of causative teeth in outpatient settings. The most frequent causative teeth are lower permanent molars, namely wisdom teeth. The mainstay of treatment is surgical intervention while antibiotics have a supporting role. The incision and drainage of affected anatomical spaces should be done aggressively and adequacy of surgical access should be given precedence over cosmetic consideration. Our study did not find any statistically significant relations between length of hospital stay and patient age, initial WBC value, CRP value, presence of diabetes, or adequacy of empiric antibiotic treatment. All involved patients recovered except for the case of necrotizing fasciitis.

DISCLAIMER

This study involved only patient computerized records and was conducted on already available data. No informed consent was necessary.

CONSENT

It is not applicable.

ETHICAL APPROVAL

This research complied with the Helsinki Declaration and its later amendments. As per international standard or university standard written ethical approval has been collected and preserved by the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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