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Original Article

Maxillofacial infections of dental origin: risk factors for hospital admission

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Aim: to evaluate the occurrence of maxillofacial infection cases, which were treated at local hospital, identifying the main risk factors that determine the need for hospitalization of patients and the factors associated with staying length. **Methods:** A retrospective review of 191 records of patients with maxillofacial infection of odontogenic origin was performed, statistically evaluated by frequency and percentage of involvement, p values (based on the chi-square test) and odds ratio with a 95% confidence interval. A p-value <0.05 was considered statistically significant. **Results:** Among all the 191 patients, 31 had some harmful habits, such as smokers (13%) and alcoholics (1%). In addition, 39 patients reported some general health problem, such as systemic arterial hypertension (8.3%), depression (6.8%), diabetes (3.6%) and some immunosuppression (1.57%). Involvement of infection in deep facial spaces was present, with 119 patients presenting a deeper infection (62.3%) and 72 patients a superficial infection (37.7%). The most prevalent clinical signs and symptoms in the initial evaluation were pain (91.1%) and edema (90.1%), followed by erythema/hyperemia (44.5%), trismus (37.7%), abscess (30.9%), cellulitis (27.7%), fistula (16.8%), fever (16.8%), dysphagia (11%), dehydration (9.9%), odynophagia (7.9%) and dyspnea (3.7%). Pulp necrosis was considered a risk factor for treatment in a hospital environment (0.032) and root canal treatment decreases the risk of hospitalization (p=0.002). Considering the evaluated patients, 146 (76.4%) were admitted and 45 (37.7%) were not admitted for hospitalization after initial clinical evaluation. **Conclusion:** there is a high occurrence of maxillofacial infection cases of dental origin, considering that involvement of infection in deeper facial spaces, as well as presence of pain, edema, erythema/hyperemia, trismus, abscess, cellulitis and pulp necrosis, represent the main risk factors for hospitalization and staying length.

Keywords: Focal infection, dental. Hospitals. Risk factors. Time-to-treatment.

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Introduction

Maxillofacial infections usually have odontogenic origin and they can reach deep tissues of the head and neck, compromising vital structures[1,2]. Although the incidence of these infections has decreased considerably due to the use of antibiotics and better oral hygiene conditions[3], these infections continue to be a source of severe morbidity with associated mortality rates[4,5]. In general, decisions must be made in a short period of time by the oral and maxillofacial surgeon[1].

The most of infections is originated from the teeth, dental sockets and their supporting structures, affecting the jaws, face and deep tissues of the head and neck[1,2]. The involvement of the infectious process can vary from a well-localized form, which requires a simple approach, to a highly complex infection, requiring a multidisciplinary intervention in a hospital environment. The definition of objective criteria for the admission of odontogenic infection cases is important to improve patient management and limit the risk of deep infections[6].

Therefore, professionals who receive patients in the emergency unit of a hospital must be aware of the clinical characteristics of maxillofacial infections, distinguishing their etiologies and carefully evaluating their clinical signs and symptoms. In addition, the qualified understanding of the general medical history of and the course of the infection, so that the best conduct and treatment regimen are carried out, in order to decrease the rates of associated complications. The literature presents some studies that identify the risk factors associated with sign and symptoms of maxillofacial infections. However, there is no relation with the possible reasons for hospital admission and staying length in their findings, with few information regarding this topic.

This study aimed to describe the occurrence of cases of maxillofacial infection attended by the Residency Service of Oral and Maxillofacial Surgery and Traumatology of the Clinic Hospital in the city of Passo Fundo (Passo Fundo, RS, Brazil), identifying the main risk factors that determine the need for hospitalization of patients, as well as factors associated with staying length. The hypotheses were that (i) systemic conditions, (ii) location of infectious process, (iii) depth of infectious process, (iv) presence of clinical signs and symptons, (v) pulp vitality and (vi) use of medication represent risk factors for hospital admission of patients with maxillofacial infection of dental origin.

Material and Methods

Study design

The present study was submitted and approved by the Research Ethics Committee of the University of Passo Fundo (Passo Fundo, RS, Brazil), under protocol number 4.023.577. The documentary, retrospective and descriptive study was carried out through the electronic medical records contained in the PEP SOUL MV System of Clinic Hospital, reviewing the attendances.

In the data collection, 191 records of patients with maxillofacial infection associated to odontogenic origin were included in the present study. The evaluation and data collection were performed by the Oral and Maxillofacial Surgery and Traumatology team at the emergency unit of the Clinical Hospital of Passo Fundo (Passo Fundo, RS, Brazil) through clinical examination, in the period of time between December 2014 and September 2020.

Data on the patient's initial condition were collected at the hospital's emergency unit and the evolution was daily evaluated in the hospitalized patients. In those who were not hospitalized, returns for reassessment took place at an outpatient clinic, every 48 hours.

Inclusion and exclusion criteria

For the inclusion criteria of patients, all data in the medical records should be duly completed. For the exclusion criteria of patients, forms with incomplete records and cases of maxillofacial infection with no odontogenic origin were excluded, totaling 22 cases that were not included in the present study, due to one of these reasons. The collected data were arranged in a custom spreadsheet created in the Microsoft Excel program (Seattle, WA, United States).

Study variables

After the data recording, information about sex, age, past medical history, presence or absence of harmful habits, infection location, etiology, clinical signs and symptoms, and use of medication prior to the initial assessment were considered. The variables were correlated with the outcome of hospitalization and time of hospitalization.

Statistical analysis

The results were statistically evaluated by frequency and percentage of involvement, p values provided by the chi-square test, and *odds ratio* (O.R.) with a 95% confidence interval. In addition, the T-Student test was used to assess whether the location of the infection, medical comorbidities, etiologies or conducts interfered with the patients' length of stay. A p-value <0.05 was considered statistically significant. Data were analyzed by using the SPSS sofwtare (Chicago, IL, United States).

Results

After data collection, the results of present study revealed a male:female ratio of 92:99 from a total of 191 patients, being 48% men and 52% women. The average age of all patients treated was 29.8 years, ranging from 11 and 48 years. Considering the evaluated patients, 146 (76.4%) were admitted and 45 (37.7%) were not admitted after initial clinical evaluation. It was observed that hospitalized patients had a mean age of 28.5 years and non-hospitalized patients had a mean age of 30.9 years.

Among all the evaluated patients, 31 had some harmful habit, being 28 (13%) smokers and 3 (1%) alcoholics. In addition, 39 patients reported general health problem, in which 16 (8.3%) had a diagnosis of systemic arterial hypertension (SAH), 13 (6.8%) depression, 7 (3.6%) diabetes and 3 (1.57%) presented some form of immu-

nosuppression (HIV positive, cancer patient and/or chronic imusuppressant user). The total of 75 patients reported use of previous medication, self-medication or professional prescription, with 52 (27.2%) using antibiotics and 23 (12%) non-steroidal anti-inflammatory drugs (NSAIDs) (Table 1).

Table 1. Analysis of variables: location of infection, harmful habits, medical comorbidities, etiology and use of previous medication for risk factors for hospital admission through chi-square test and *odds ratio* (N=191).

Category	Variable	Admission			P value	*Odds ratio*	CI 95%
		Yes	No	Total			
Location	Maxilar	41	16	54	0.338	0.708	0.348 – 1.438
	Mandible	105	24	134			
Smoking	Yes	23	5	28	0.441	1.496	0.534 – 4.194
	No	123	40	163			
Alcoholism	Yes	1	2	3	0.076	0.478	0.163 – 1.397
	No	145	43	188			
Hipertension	Yes	10	6	16	0.170	0.478	0.163 – 1.397
	No	136	39	175			
Depression	Yes	13	0	13	0.038	1.338	1.229 – 1.458
	No	133	45	178			
Diabetes	Yes	6	1	7	0.556	1.886	0.221 – 16.091
	No	140	44	184			
Imunossupression	Yes	2	1	3	0.688	0.611	0.054 – 6.901
	No	144	44	188			
Pulp necrosis	Yes	111	24	135	0.032	2.096	1.056 – 4.159
	No	43	21	64			
Tooth extraction	Yes	19	5	24	0.736	1.197	0.420 – 3.411
	No	127	40	167			
Endodontics	Yes	15	13	28	*0.002	2.365	1.428 – 3.918
	No	131	32	163			
Pericoronitis	Yes	3	2	5	0.380	0.451	0.073 – 2.788
	No	143	43	186			
Antibiotics	Yes	43	9	52	0.213	1.670	0.741 – 3.763
	No	103	36	139			
NSAIDs	Yes	16	7	23	0.407	0.668	0.256 – 1.743
	No	130	38	168			

Regarding the location of the infectious process, two macrosites were considered: maxilla and mandible. The most common site of involvement was the mandible with 134 (70.2%) cases, followed by the maxilla in 57 (29.8%) cases. The physical examination and imaging evaluation allowed to evaluate whether the infection was superficial in the

vestibular space or in a deeper space, where 119 (62.3%) patients had a deeper infection and 72 (37.7%) had a superficial infection. Most hospitalized patients 105 (71.9%) underwent tomography, but the primary evaluation was through physical examination.

The most prevalent clinical signs and symptoms in the initial evaluation were: pain in 174 patients (91.1%) and edema in 172 patients (90.1%), followed by erythema/hyperemia in 85 patients (44.5%), trismus (after measurement, maximum opening up to 25mm) in 72 patients (37.7%), abscess in 59 patients (30.9%), cellulitis in 53 patients (27.7%), fistula (spontaneous drainage) in 32 patients (16.8%), fever (axillary temperature > 37.6°C) in 32 patients (16.8%), dysphagia in 21 patients (11%), dehydration in 19 patients (9.9%), odynophagia in 15 patients (7.9%) and dyspnea in 7 patients (3.7%) (Table 2).

Table 2. Analysis of clinical signs and symptoms and use of medication prior to the initial assessment for risk factors for hospital admission using the chi-square test and *odds ratio* (N=191).

Category	Variable	Admission			PValue	*Odds ratio*	CI 95%
		Yes	No	Total			
Pain	Yes	131	43	174	0.230	0.406	0.089 – 1.848
	No	15	2	17			
Edema	Yes	140	32	172	0.001	9.479	3.348 – 26.840
	No	6	13	19			
Deep facial Space	Yes	111	8	119	0.001	14.668	6.248 – 34.436
	No	35	37	72			
Erythema/ Hyperemia	Yes	73	12	85	0.006	2.750	1.317 – 5.741
	No	73	33	106			
Trismus	Yes	71	1	72	<0.001	41.653	5.589 – 310.407
	No	75	44	119			
Abscess	Yes	43	16	59	0.438	0.757	0.373 – 1.534
	No	103	29	132			
Celulitis	Yes	48	5	53	0.004	3.918	1.453 – 10.564
	No	98	40	138			
Fistula	Yes	22	10	32	0.261	0.621	0.269 – 1.433
	No	124	35	159			
Fever	Yes	31	1	32	0.003	11.861	1.571 – 89.537
	No	115	44	159			
Disphagia	Yes	21	0	21	0.007	1.360	1.243 – 1.488
	No	125	45	170			
Dehydration	Yes	19	0	19	0.011	1.354	1.239 – 1.480
	No	127	45	172			
Odynophagia	Yes	15	0	15	0.025	1.344	1.232 – 1.465
	No	131	45	176			
Dyspnea	Yes	7	0	7	0.135	1.324	1.219 – 1.437
	No	139	45	184			

The patients who were diagnosed with pulp necrosis as an etiology of the infectious process was shown to be associated with a higher risk for treatment in a hospital environment (0.032), confirming the fifth hypothesis of present study. Furthermore, it is noteworthy that root canal treatment reduces the risk of hospitalization, as the variable endodontics was considered a protective factor for hospitalization (p=0.002). In the analysis of the use of antibiotic and anti-inflammatory medication prior to the evaluation in the emergency unit, it was found that indiscriminate use, or even prescribed at the primary or secondary care level, was not significant as a risk or protection factor for hospitalization of patients (p=0.213, p=0.407) (Table 1), rejecting the sixth hypothesis of present study.

Regarding the subjective and objective clinical analysis, it was found that the involvement of infection in deeper spaces (O.R. 14.668), and the signs and symptoms of edema (O.R. 9.479), cellulitis (stiffened consistency of edema), trismus (O.R. 41.653), dysphagia (difficulty swallowing), fever (O.R. 11.861), odynophagia (painful swallowing), erythema/hyperemia (redness and local heat) and dehydration (prostration, toxic appearance and/or dry mouth) were statistically significant as risk factors for the hospital admission of the studied patients (Table 2), confirming the third and fourth hypothesis of present study.

Finally, no significant difference was observed in the association between hospital admission and age, harmful habits and location of the infectious process, rejecting the first and second hypothesis of present study. For the 146 patients who were hospitalized, the characteristics and the average length of staying were analyzed according to age, location of infection, presence of medical comorbidities, etiology, infection in deeper spaces and practices. It was observed that age is not correlated with a prolonged hospital staying of the analyzed patients (p = 0.937).

The T-Student statistical analysis confirmed that the highest average length of staying occurred in diabetic patients (6.67 days) (Table 3). In addition, among the conducts during hospitalization, 105 (71.9%) patients underwent computed tomography, 144 (98.6%) patients received empirical intravenous antibiotic therapy, 111 (76.0%) patients underwent drainage surgery and 76 (52.0%) patients focused on the infectious process during hospitalization. Only patients who underwent tomography were associated with a longer hospital staying (p= 0.010), and this finding may be associated with more severe infections. The other conducts were not significant for the length of hospital staying of the patients (Table 4). The mean length of staying for all patients was 5.01 days.

Table 3. Analysis of the mean length of staying according to the location of the infection, medical comorbidities, etiology and infection in deep facial spaces (N=146).

Category	Variable	Staying days			P Value
		N	Mean	SD	
Location	Maxilar	41	5.1	3.321	0.751
	Mandible	105	4.96	3.082	

Continue

Continuation					
Diabetes	Sim	6	6.67	3.724	0.189
	Não	140	4.94	3.109	
Hipertension	Sim	10	5.40	2.836	0.688
	Não	136	4.99	3.169	
Depression	Sim	13	5.38	3.280	0.657
	Não	133	4.98	3.137	
Imunossupression	Sim	2	5.00	1.414	0.995
	Não	144	5.01	3.160	
Pulp necrosis	Sim	111	5.08	2.986	0.705
	Não	43	4.86	3.516	
Tooth extraction	Sim	19	5.53	4.659	0.447
	Não	127	4.94	2.864	
Endodontics	Sim	15	3.87	1.885	0.136
	Não	131	5.15	3.232	
Pericoronoritis	Sim	3	3.67	2.082	0.455
	Não	143	5.04	3.158	
Deep facial space	Sim	111	5.21	3.390	0.186
	Não	35	4.40	2.089	

Table 4. Analysis of the average length of staying according to the practiced conduct (N=146).

Conduct	Variable	Staying days			P Value
		N	Mean	SD	
Tomography	Yes	105	5.43	3.334	0.010
	No	41	3.45	2.291	
Antibiotic	Yes	144	5.06	3.134	0.111
	No	2	1.50	0.707	
Drainage	Yes	111	5.26	3.351	0.090
	No	35	4.23	2.211	
Infection focus removal	Yes	76	5.14	3.365	0.601
	No	70	4.87	2.894	

Discussion

The vast majority of studies showed a male prevalence in maxillofacial infections of odontogenic origin[7-9]. However, in the present study, a slight prevalence of females was observed in 52% of the sample. The average age of patients in these studies was 29.8 years, which is considered a low average age when compared to other studies in the literature[6,9]. However, these findings are similiar to those data already reported in another study[10]. Regarding the hospitalization outcome, the average age of admitted

patients was 28.5 years (SD 16.9) and 30.9 years (SD 18.0) for those not hospitalized. Therefore, the mean age was not statistically significant for hospital admission, as well as the gender of the patients.

In the present study, the location of the infection was divided into two macrosites: maxilla and mandible. The predominance of the mandible was higher with 134 (70.1%) cases, followed by the maxilla in 57 (29.8%) cases. This finding corroborated with previous studies[6,8]. Despite the mandible being the site with greater predominance, the location was not statistically significant for hospital admission of patients, as described by Alotaibi et al.[6], in their previous study.

The general health problems, such as diabetes, immunosuppression, alcoholism and using of chronic medication are being associated with more severe cases of odontogenic infection that requires hospital care[11]. Kamiński et al.[11], concluded that it is essential to pay attention to the high-risk group (old age, diabetes mellitus, underlying systemic disease), because they can often progress to life-threatening conditions. Furthermore, the high prevalence of diabetes mellitus (30.3%) indicates that it may be a precipitating factor in deep neck infections. In the present study, the vast majority of patients were young adults (mean age 29 years), in which only 20.4% had a systemic health problem, where 3.6% were diabetic and 1% had the harmful habit of alcoholism. Thus, diabetes, alcoholism and systemic arterial hypertension were not considered a significant risk factor for hospital admission, whereas only patients diagnosed with depression were associated with hospital admission. This data is in accordance with the results of previous studies that shows a positive association between depression and oral diseases, where all psychiatric diagnoses were associated with increased dental caries and oral pathology, being a predisposing factor for odontogenic infection, in addition to tooth loss[12,13].

The poor oral health can be observed in patients who were diagnosed with psychiatric ilness, due their lifestyle, poor oral hygiene and difficulties in access to dental care[12]. In addition, it also can be explained by the side effects of psychotropic medications like antipsychotics, antidepressants, and mood stabilizers, which are used by these patients. All of these medications induce xerostomia, reducing salivary flow[14]. Among these psychatric ilness, depression, anxiety, panic disorders, phobias, dementia and schizophrenia can be identified as potential conditions for the occurence of dental infections. As a consequence, dental erosion, dental decay and tooth loss can be developed[12]. Despite not evaluating the association of several psychiatric diseases with the development of maxillofacial infections, the present study revealed that there may be an association between depression and the onset of maxillofacial infections, which is in agreement with the previously described findings.

The etiology of odontogenic infection is predominantly related to periapical pathology associated to pulp necrosis of the dental element. In addition, there is a range of patients destinated to hospital emergency room after undergoing dental surgical procedures or due to pericoronitis[15,16]. In the present study, pulp necrosis was the most prevalent etiology, with the highest risk for hospital patients admission. According to previous studies of the literature, the systemic response to the infection is more exacerbated and the course of the infection is more severe in the absence of previous dental treatment (endodontic treatment or other dental treatment related to acute

symptoms). Further findings lead to state that incomplete debridement of the root canal during the first session increases the risk of spreading the infection with systemic symptoms. Therefore, complete debridement of the root canal during the first session is essential to minimize the risk of infection spreading, in addition to incision and surgical treatment of the abscess. If it is not possible to be performed, the tooth extraction should be considered[9,17]. The found results of the present study demonstrate that endodontic procedures represent a protective factor for hospitalization of patients with odontogenic infections.

The clinical evaluation of the signs and symptoms of a maxillofacial infection must be performed in a qualified manner, in order to determine the diagnosis and prognosis of each case, helping to define the best treatment regimen. In this sense, the patient's evaluation should involve the analysis of swelling and hardening of the face, possible blockage of the airway and the signs and symptoms reported by the patient, such as diffuse pain, facial swelling, halitosis and general malaise[18]. The present study confirmed that the presence of hardened edema and signs of dehydration (prostration and/or general malaise) represent risk factors for hospital admission in maxillofacial infections. In accordance, the requirement for hospitalization is determined by the severity, location and extention of the infectious process[8]. Gholami et al.[19], found that patients with diagnosis of dysphagia, odynophagia, trismus and fever represented clinical risk factors for hospitalization, as described in the present study, with the exception of the infection location.

Many authors related the involvement of multiple facial spaces with a higher rate of severity of the infectious process[15,20-23]. In the present study, the presence or absence of infection in deeper facial spaces was correlated with the need for hospital admission. In this scenario, the presence of infection in deeper spaces represents statistically significant risk factor for admission. Previously, a clinical criteria score was developed in a research study for hospital admission due to odontogenic infections, in which trismus, dysphagia, dehydration and infection in the deeper facial spaces were considered significant risk factors for hospital admission[24]. It is also in accordance with the findings of the present study.

Regarding the previous use of antibiotics and non-steroidal anti-inflammatory drugs (NSAIDs), self-medication and inappropriate use of antibiotics, in addition to other factors, it seems to be associated with the spread of odontogenic infections[25]. Furthermore, the use of antibiotics in head and neck infections requires updated protocols, based not only on existing scientific evidence, but also on the epidemiological reality of each center[15]. According to these findings, there is an increasingly urgent need for adequate control of the indiscriminate use of these medications. Performing an univariate analysis, the use of antibiotics prior to hospital admission of patients did not statistically corroborate as a risk factor, neither as a protective factor for the hospitalization of patients with maxillofacial infection of odontogenic origin. For non-steroidal anti-inflammatory drugs, Delbet-Dupas et al.[26], analyzed whether the use of anti-inflammatory drugs would modify the prognosis of severe odontogenic infection, and concluded that dysphonia, odynophagia and fever are more frequent in this group of patients, consdering the fact that patients using anti-inflammatory drugs may present more severe dental infection upon admission. In the present study, 23 patients (12%)

arrived at the hospital using NSAIDs, and this data was not significant as a risk or protecting factor. Therefore, it is understood that the indiscriminate use of this medication should be discouraged.

Considering the staying lenght of hospitalization, the highest average number of days is found in patients with diabetes mellitus (3.6% of the 146 hospitalized patients). This result is important, as it is known that compromised immune systems can lead to the opportunistic progression of apparently minor infections, increasing the chances of superficial oral abscesses into the deep neck infections[27,28]. It is in accordance with the found data of our study. In addition, hipertension and depression are also included in the statistics of longer hospitalization, although they were not statistically significant, which may represent that patients with pre-existing comorbidities need longer hospital care, which has already been reported in specific studies[29,30].

The computed tomography has gained widespread use as the imaging modality of choice for deep infections of the neck space in the emergency setting, as it overcomes the field of view limitations of ultrasound evaluation, consuming less time and being more accessible than magnetic resonance imaging[31]. However, Christensen et al.[32], analyzed the unnecessary use of computed tomography in patients, establishing two important criteria, which must be identifiable through physical examination, when applying this imaging modality: loss of palpable limits of the mandible body and trismus. Thus, it is essential to associate these studies with the results of our research, since computed tomography performed in patients is associated with a longer hospital staying. This fact that has already been reported in the literature, especially in more severe cases[33].

The main limitation of the present study is related to its retrospective design. Due to the retrospective nature, it is necessary to have medical records to evaluate and measure the variables that were used in the present study. In addition, the group of patients and the severity of clinical signs/symptoms in the hospital emergency setting are different from those found in the outpatient setting[34]. Therefore, it is necessary to consider and evaluate the clinical differences between these situations in future studies.

Considering the limitations of present study, it is possible to conclude that there is a high occurrence of maxillofacial infection cases of dental origin, considering that involvement of infection in deeper facial spaces, as well as presence of pain, edema, erythema/hyperemia, trismus, abscess, cellulitis and pulp necrosis, represent the main risk factors for hospitalization and staying length.

Disclosure statement

The authors deny any conflicts of interest. The authors declare no financial affiliation (e.g., employment, direct payment, stock holdings, retainers, consultantships, patent licensing arrangements or honoraria), or involvement with any commercial organisation with direct financial interest in the subject or materials discussed in this manuscript, nor have any such arrangements existed in the past three years. Any other potential conflict of interest is disclosed.

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Author contribution

Vinícios Fornari – Data collection and article writing / **Matheus Albino Souza** – Data collection and article writing / **Felipe Gomes Dallepiane** – Data collection / **Adriano Pasqualotti** – statistical analysis / **Ferdinando De Conto** – Data collection.

All authors contributed significantly from manuscript findings, revision and final approval of the manuscript.

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