

Severity Score as a Prognostic Factor for Management of Infections of Odontogenic Origin, a Study of 100 Cases

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Abstract

Purpose: The main objective of the current study is to determine whether it is possible to correlate the longevity of the hospitalization period (LOS) to efficacy of surgical treatment regime and severity scoring. **Materials and Methods:** A total of 100 patients met our inclusion criteria. All patient records, including results of hematologic and biochemical parameters, were recorded. The patients were later subcategorized further according to a severity score ("Low, Moderate, Severe") of their main facial space involvement. The main analysis of the study is a regression analysis model; all the variables (sex, age, CRP, white blood cell count, fever, space, and etiology) were stratified according to the overall hospital stay. A crosstab comparison was performed next; the variables were categorized and combined with hospital stay, and then entered in Spearman's rank correlation coefficient or Spearman's rho (ρ), 2-tailed (t) Test, and regression equation. The significance level was set at $p < 0.05$. Statistical analyses were conducted using SPSS version 23. **Results:** The most prevalent anatomical space infection was vestibular space abscess or cellulitis 33%, followed by an infraorbital space abscess or cellulitis 17%. Most commonly involved teeth are lower molars with 43% of the total, upper central sixth with 20% and upper molars with 10%; mandibular origin was found to be the cause in 54%. The regression equation showed no linear relation between CRP with the overall hospital stay ($p > 0.05$). No systemic temperature values were found to be correlated to any space involved or LOS. Log-rank chi-square effect tests indicated only a significant effect of severity, $p = 0.00016$. The "Moderate & Severe" group compared to the "Low" group had a longer median LOS, 4.5 (2 to 8) vs 3 (1 to 8) respectively. **Conclusion:** The findings of this study have shown severity scoring to be statistically significant parameter in LOS prediction.

*The first and second authors have contributed equally to this manuscript.

Keywords

CRP, Odontogenic Infection, Dental Abscess, C-Reactive Protein

1. Overview and Introduction

Acute dental infections are a common cause of outpatient emergency visits to the maxillofacial department; classic signs of infection such as “*Rubor*”, “*Tumor*”, “*Calor*”, “*Dolor*” and “*Functio Laesa*” are present to some degree in nearly all patients [1] [2]. Unknowingly, they are at a potentially life threatening situation due to the anatomical connectivity of one anatomic space to the other [1].

In the preantibiotic era, severe odontogenic infections were associated with high mortality rates, ranging from 10% to 40%; yet, in nowadays surgical practice implementing modern antibiotics mortality rates have been significantly reduced [3] [4].

Some attempts have been made to utilize CRP levels as an inflammatory prognostic factor in management of infections of odontogenic origin, its rapid rise and falls makes it a much more sensitive predictor than ESR and WBC count [5] [6] [7] [8] [9]. CRP has shown to be able to discriminate bacterial and viral infections and gauge of inflammatory response [10] [11].

A large scale prospective study has shown that in the U.S. alone, over a period of 24 months 13% of adult patients have sought for emergency treatment of acute dental pain and/or infections of odontogenic origin. Dental abscesses account for 47% of all dental-related attendances at pediatric emergency rooms [2].

1.1. Etiology of Acute Odontogenic Infections

Most common etiological factors of odontogenic infections are periapical lesions 66% - 70% and dental caries 33% - 80%, other local infection causative factors are pericoronitis, alveolar osteitis, periodontitis and odontogenic and non-odontogenic cystic lesions.

Post operative local infections are a common site especially after mandibular molars extractions, it constitutes for more than 50% of all post operative complications [12].

1.2. Signs and Symptoms

Severe odontogenic infections of maxillofacial origin present common signs and symptoms, other than the usual signs of infection, one may present with trismus, dysphagia, fever, pain, swelling and respiratory distress, orbital cellulitis and other [12].

1.3. Local Pattern of Infection Spread

General spread of odontogenic infections is towards the lowest point of resis-

tance, its course is usually determined by two main factors: 1) Surrounding bone thickness 2) Muscle attachments.

Odontogenic infections may spread to deeper spaces, potentially leading to life threatening situations due to air way compromise [12].

1.4. Surgical Procedure

Our treatment protocol includes an incision and drainage under local anesthetics by Lidocaine 2% 1:100,000 Epinephrine.

Pathogenic teeth are extracted, abscess is drained by an intra/extra oral approach according to its location and a rubber drainage is fixed for the period of two consecutive admission days, antibiotics are admitted by PO/IV route.

1.5. Antimicrobial Therapy

Penicillins are most commonly used, they are considered to be the drug of choice for treatment of acute odontogenic infections. They are cheap, well tolerated, have relative low incidence of immune responses, and they are widely available. In our practice Amoxicilin in combination with clavulanate acid is first line antibiotics, admitted by IV route (1 gr \times 3/Day) [12].

1.6. Imaging

Although different imaging techniques are available, a CT scan is considered to be gold standard (**Figure 1**, **Figure 2**). Ultrasonography has been suggested as a possible modality for imaging of infections; it is becoming increasingly available in outpatient settings, its noninvasive nature, lack of radiation and low cost, makes it an attractive option, however, so far it has not been successful in detecting deep fascial space infections.

1.7. Main Space Involvement and Severity Scoring (**Figure 3**, **Figure 4**)

Anatomic spaces of the head and neck are scored by their severity according to the potential compromise of air way and other vital structures, such as, heart, mediastinum and CNS.

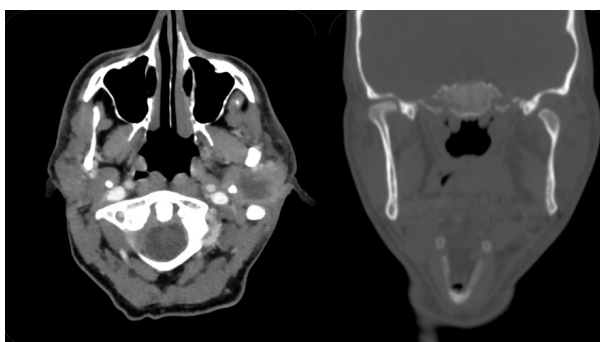


Figure 1. Axial CT scan demonstrating an acute odontogenic infection occupying the Lt. Infratemporal space region. Coronal CT scan demonstrating a pain controlled dislocation of Lt. condyle.

Low grade severity includes the Buccal, Vestibular and Subperiosteal spaces as they do not compromise vital structures or air way. Moderate grade severity includes the masticatory spaces which can be further sub classified to submasseteric, pterygomandibular and superficial and deep temporal spaces, and perimandibular spaces which can be further subclassified to submandibular, submental and sublingual spaces, those account to a moderate severity due to their access to airway and trismus potential.

High grade severity includes spaces in which swelling can directly obstruct or deviate the airway or endanger vital structures, this group includes lateral and retro pharyngeal spaces and mediastinum [10].

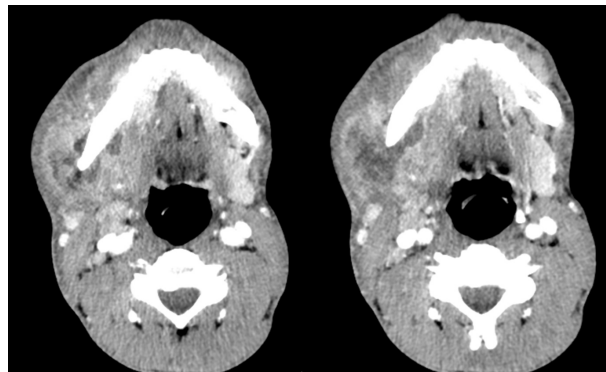


Figure 2. Axial CT scans demonstrating acute odontogenic infections occupying the Rt. Submasseteric and Pterygomandibular spaces.

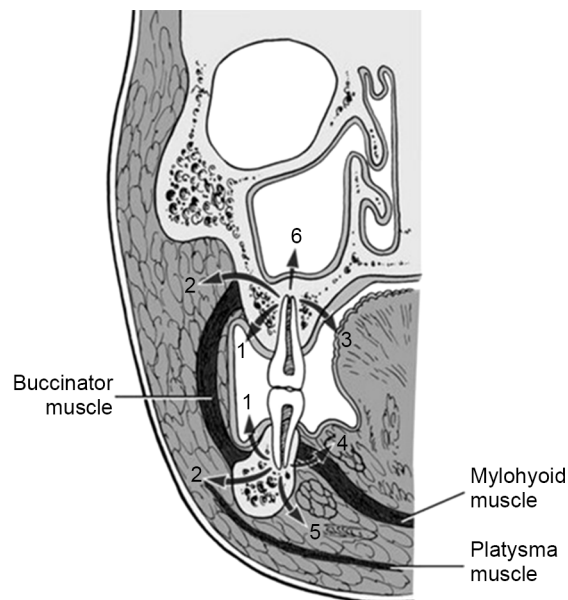


Figure 3. Odontogenic infection spread patterns. As infection erodes through bone, it can express itself in a variety of places, depending on thickness of overlying bone and relationship of muscle attachments to site of perforation. This illustration notes six possible locations: vestibular abscess (1), buccal space (2), palatal abscess (3), sublingual space (4), submandibular space (5), and maxillary sinus (6). (Adapted from Flint PW Haughey BH, Lund VJ *et al.*, editors: Cummings otolaryngology: Head and neck surgery, ed 5, Philadelphia, PA, 2010, Mosby.)

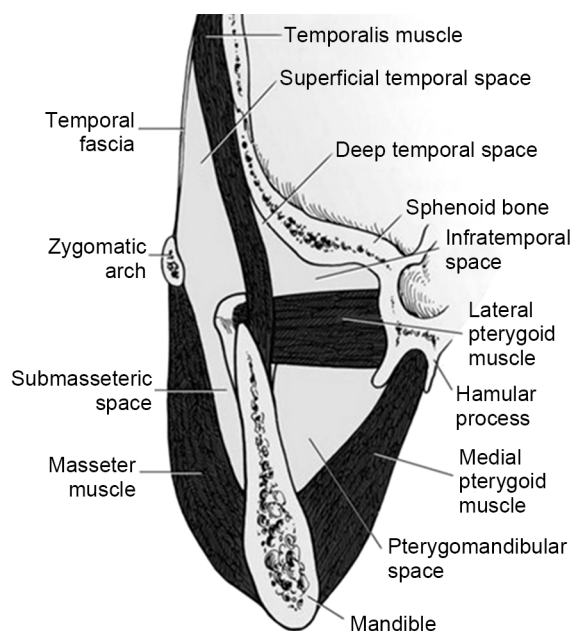


Figure 4. The superficial and deep temporal spaces are separated from each other by the temporalis muscle. The lateral pterygoid muscle divides the pterygomandibular space from the infratemporal portion of the deep temporal space, and the zygomatic arch divides the submasseteric space from the superficial temporal space. (Adapted from Flint PW, Haughey BH, Lund VJ *et al.*, editors: Cummings otolaryngology: Head and neck surgery, ed 5, Philadelphia, PA, 2010, Mosby.)

2. Materials and Methods

2.1. Purpose

The main objective of the current study is to determine whether it is possible to correlate the longevity of the hospitalization period (LOS) to efficacy of surgical treatment regime and severity scoring.

The criteria of inclusion for this study are:

- Age over 18 years.
- Complete medical records.
- Patient suffering from an infection of an odontogenic origin.

The criteria of exclusion for this study are:

- Age under 18 years.
- Patients suffering from infections of other regions other than the oral cavity were excluded from the study, as well as patients suffering from HIV/AIDS, neoplasms, hepatitis, lupus, inflammatory bowel diseases, tuberculosis, respiratory and urinary infections.

Study subjects were patients who visited the emergency department at the “Padeh” Poria Medical Center which is a level 2b trauma center with over 80,000 annual patients, for treatment of acute odontogenic infections of the head and neck area.

A total of 137 patients requiring hospitalization were treated between October 2014 and June of 2015 by the “Department of Oral and Maxillofacial Surgery”, 100 have met our inclusion criteria.

An examination following a standard protocol of the “Maxillofacial Department” was performed, dental radiographs were taken to assist the diagnostic procedure, a contrast enhanced computer tomography was performed upon need.

Admission criteria were swelling of the face or neck area suggesting an abscess or a cellulitis and one or more of the following: temperature above 38.3°C, white blood cell (WBC) count greater than $10.8 \times 10^3/L$, CRP levels greater than 10 mg/l, airway compromise, trismus, lower eye-lid involvement and dysphagia [10].

Antecubital venous blood was drawn on admission and on the day of release. Laboratory values analyzed included C-reactive protein (CRP) concentrations (reference range, 1 to 10 mg/L).

Body temperature was measured orally at least twice daily, mean values and standard deviations of the laboratory values were calculated.

2.2. Statistical Analysis

The clinical data recorded included medical, social, and behavioral factors such as age, gender, ethnicity, underlying systemic illnesses, smoking habits, body mass index, previous dental procedures, antibiotic therapy, symptoms on admission, delay in seeking medical therapy, and site of the infection.

All patient records, including results of hematologic and biochemical parameters, were recorded.

The patients were later subcategorized further according to a severity score (“Low, Moderate, Severe”) of their main facial space involvement.

The main analysis of the study is a regression analysis model; all the variables (sex, age, CRP, white blood cell count, fever, space, and etiology) were stratified according to the overall hospital stay. A crosstab comparison was performed next; the variables were categorized and combined with hospital stay, and then entered in Spearman’s rank correlation coefficient or Spearman’s rho (ρ), 2-tailed (t) Test, and regression equation. The significance level was set at $p < 0.05$. Statistical analyses were conducted using SPSS version 23.

3. Results

A total of 137 patients who were diagnosed clinically and radiologically with maxillofacial infections were admitted and hospitalized in the Maxillofacial Surgery Department, Baruch Padeh Medical Center, Poriya, Israel. Only patients who met the inclusion criteria were included in the study.

100 patients, 49 females mean age of 37.8 years and 51 males mean age of 36.1 years were evaluated. Most commonly involved spaces, their average longevity stay and average CRP values on admission are as presented in (Table 1).

Overall patient management was comparable among all the patients, all patients were treated by similar surgical approaches and antibiotic therapy.

The most prevalent anatomical space infection was vestibular space abscess or cellulitis 33%, followed by an infraorbital space abscess or cellulitis 17%, (Table 1).

Table 1. Data accumulation.

Space	Severity	No. Patients			CRP On Admission	CRP On Release	Admission Days	Systemic Temp	Treatment
		Total	M	F					
Vestibular Space	Low	33	17	16	55.68	40.2	2.96	37.1	Extraction, Drainage & IV. Antibiotics
Infraorbital Space	Low	17	6	11	77.3	44.6	2.88	37.2	Extraction, Drainage & IV. Antibiotics
Buccal Space	Low	1	1	-	52.5	35	3	36.6	Extraction, Drainage & IV. Antibiotics
Palatal Space	Low	1	1	-	12.4	7	4	36.7	Extraction, Drainage & IV. Antibiotics
Inflamed Cysts	Low	8	5	3	46.2	27.6	5	37.2	Extraction, Drainage & IV. Antibiotics
Sum.		60	30	30					
Average					48.82	30.88	3.57	36.96	
Lingual Space	Moderate	3	2	1	78.4	63.3	2.66	37.3	Extraction, Drainage & IV. Antibiotics
Pterygomandibular Space	Moderate	8	4	4	81.45	50.8	5.62	37.1	Extraction, Drainage & IV. Antibiotics
Submasseteric Space	Moderate	2	1	1	85.35	67.5	6.5	37.3	Extraction, Drainage & IV. Antibiotics
Infratemporal Space	Moderate	6	2	4	63.4	30.4	6.8		Extraction, Drainage & IV. Antibiotics
Submandibular Space	Moderate	1	1	-	100	50.7	7	37.2	Extraction, Drainage & IV. Antibiotics
Pericoronitis	Moderate	7	4	3	46.25	27.9	3.42	37.08	Extraction, Drainage & IV. Antibiotics
Post Operative Abscess	Moderate	8	3	5	57	48	3.6	37.2	Extraction, Drainage & IV. Antibiotics
Maxillary Sinusitis	Moderate	3	1	2	32.26	27.9	4.3	37.4	Extraction/Closure of OAF & IV. Antibiotics
Sum.		38	18	20					
Average					68.01	45.81	4.98	37.2	
Lateral Pharyngeal Space	High	2	1	1	75	11.6	5	37.05	Extraction, Drainage & IV. Antibiotics
Sum.		2	1	1					
Average					75	11.6	5	37.05	

The records were further subcategorized according to main anatomic space involvement and its severity score (“Low, Moderate and High”).

60 patients were classified as of low severity score (LSS), 38 of moderate severity (MSS) and only 2 as high severity (HSS).

Most commonly involved teeth are lower molars with 43% of the total, upper

central sixth with 20% and upper molars with 10%, mandibular origin was found to be the cause in 54%.

Wisdom teeth were found to be the source of infection with 29% of the cases, upper central/lateral incisors and canines were found to be the source in 20% of the cases.

The regression equation showed no linear relation between CRP with the overall hospital stay ($p > 0.05$). Regression test supported the previous results, and showed no significance in the CRP in predicting length of hospitalization stay ($p > 0.05$). No systemic temperature values were found to be correlated to any space involved nor severity scoring.

Log-rank chi-square effect tests indicated only a significant effect of severity, $p = 0.00016$, the “Moderate & Severe” group compared to the “Low” group had a longer median LOS, 4.5 (2 to 8) vs 3 (1 to 8) respectively.

4. Discussion

Attempts been made to use CRP as an inflammatory prognostic factor with odontogenic infections of the head and neck area.

Several studies have indicated CRP to be an effective predictor to hospital stay, yet, we were unable to support this premises in our study as it showed no statistical significant correlating between CRP levels on admission and longevity of stay, the rapid rise and fall of CRP with the inflammatory process makes it a highly sensitive indicator of inflammatory process but as we have witnessed surgical intervention also results with a marked elevation in CRP levels, thus resulting an overlapping high CRP level. Mean hospital longevity stay due to acute odontogenic infections of head and neck area is found to be ranging from 3.69 to 8.27 consecutive days, our study have showed a mean of 3.84 days.

Odontogenic infection of head and neck area are commonly single space infections, multiple space involvement is rare, most commonly involved spaces are vestibular space abscess corresponding to one third of the cases, second most common space is infraorbital space abscess corresponding to 17% of all cases, involvement of parapharyngeal space abscess is rare and corresponds to 2%.

Out of the 30 subjects presenting with CRP levels of 100 and higher, 26% were suffering from infraorbital space infections, this may be attributed to lower eye lid involvement and preseptal cellulitis formation.

Underlying medical conditions, highly increased inflammatory markers and complications have been shown related to prolong hospital stay. Patients suffering from odontogenic infection of mandibular teeth origin have shown relatively longer hospital stay compared with infections of maxillary teeth origin.

Our study has shown a clear correlation between clinical severity scoring and length of stay ($p = 0.00016$).

5. Conclusions

Within the limitations of this study our findings have shown that proper clinical evaluation, assessment and severity scoring are of higher prognostic value in re-

spect to LOS than other proposed indicators such as CRP which has shown to be a non-significant parameter.

A larger amount of high severity score patients is needed to withstand proper statistical analysis.

Acknowledgements

The authors declare to have no conflicts of interest.

Ethics Statement/Confirmation of Patient Permission

Ethics approval not required. Patient permission obtained.

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