Journal of Craniomaxillofacial Research

Vol. 6, No. 1 Winter 2019

Epidemiologic evaluation of maxillofacial infections and their risk factors and associated complications in a one year period in Shariati hospital in 2013-2014

Hamid Mahmood Hashemi, Reza Sharifi, Mahboube Hasheminasab, Mostafa Mortazavi*

Craniomaxillofacial Research Center, Tehran University of Medical Sciences, Tehran, Iran; Department of Oral and Maxillofacial Surgery, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran.

ARTICLE INFO

Article Type:
Original Article

Received: 23 Oct. 2018
Revised: 28 Nov. 2018
Accepted: 15 Dec. 2018

**Corresponding author:*
Mostafa Mortazavi

Craniomaxillofacial Research Center, Tehran University of Medical Sciences, Tehran, Iran; Department of Oral and Maxillofacial Surgery, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran.

Tel: +98-21-84902473
Fax: +98-21-84902473
Email: Drmo_mortazavi@Yahoo.com

ABSTRACT

Purpose: Maxillofacial infections (MIs) commonly occur in patients of all ages, representing a life-threatening challenge when reaching deep facial spaces. The epidemiologic studies of MIs and their characteristics are very important and beneficial for both patients and clinicians. Therefore, the aim of this prospective study was to determine the annual incidence, etiology, risk factors and complications of MIs in all patients who were admitted to the department of oral and maxillofacial surgery of the Shariati hospital during a 1-year period.

Material and Methods: The demographic data, levels of some serum markers on day of admission, such as erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), bandemia, serum albumin, predisposing factors for each patient referred for treatment of MI were recorded by one researcher in November 2013 to November 2014. The linear regression test was used to evaluate whether there was a relationship between the amount of changes in ESR, CRP and albumin levels and age of the patients, pregnancy, gender and severity of infection. Panoramic radiography as well as axial and coronal CT scans with soft tissue window were performed for all cases, except pregnant participants. The origin of MIs, including odontogenic, pathologic and foreign body, was identified for each patient.

Results: During the study period, a total of 157 patients (87 female, 70 male), with an age range of 3 to 74 years (mean, 23.5±13.2 years), were admitted to the department of maxillofacial surgery. Regardless of the gender, the most frequent cause of MIs was odontogenic sources (128 cases, 81.5%). The most common affected area was the buccal space with 106 positive cases (67.5%). The most common teeth responsible for maxillofacial fascial space infection were mandibular third molars. A positive association was found between CRP and ESR levels and the severity of infections. Serum albumin and ESR levels were significantly reduced and increased in the patients with severe infection and pregnant patients, respectively.

Conclusion: The results of this study indicated that odontogenic origins were the main cause of MIs and the most common involved space was the buccal space. Diabetes mellitus was the most commonly found systemic disease among the participants of this study. The findings of this study suggest that dentists should consider that the most appropriate treatment of odontogenic infections involves surgical intervention and selection of a suitable antibiotic as an adjunct.

Keywords: Maxillofacial infection; Risk factors; Complications.

Introduction

MIs commonly occur in patients of all ages, representing a life-threatening challenge when reaching deep facial spaces. MIs are infections that affect the potential spaces and fascial planes of maxillofacial region which has a complex anatomy [1]. These infections are mostly developed secondary to necrotic pulpal tissue following a deep dental carious lesion [2]. However, MI can also have infective, inflammatory, and traumatic origins, of which, odontogenic infections are the most common causes [3-4].

Management of MIs, especially those originated from odontogenic sources, is a challenging task for surgeons [5]. Symptomsof MIs are evident due to the proximity between muscles, ligaments, and nerves, which quickly impairs the function of affected region, resulting in pain and trismus [6]. Untreated patients with odontogenic MI often present involvement of multiple secondary spaces that can be life-threatening due to airway obstruction [6]. Odontogenic infections originate from pulpal orperiodontal tissuesas well as infected tooth sockets afterextractions [7]. Various risk factors and complications have been reported to be associated with infection in maxillofacial area. Even though the epidemiology of MIs are more or lesssimilar in different societies, it is necessary for each country to have its ownepidemiologic data to be able to have a more precise planning to preventand treat such infections. In addition, epidemiologic studies of MIs and their characteristics arevery important and beneficial for both patients and clinicians [8]. Therefore, the aim of this study was to determine the annual incidence, etiology, risk factors and complications of MIs in all patients who wereadmitted to the department of oral and maxillofacial surgery of the Shariati hospital from November 2013 to November 2014.

Material and Methods

This prospective study was performed duringa 1-year period starting from November 2013 to November 2014. Participants of this study included all patients who were admitted to maxillofacial surgery ward of the Shariati hospital for treatment of MIs. The demographic data, including sex, age, cause of infection, the involved fascial space, levels of some serum markers on day of admission, such as erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), bandemia, serum albumin (to assess nutritional status), predisposing factors, including diabetes mellitus, pregnancy, hypothyroidism, anemia, immunodeficiency, and chronic steroiduse, type of treatment, post admission antibiotic therapy, previous endodontic treatment of the causative tooth, the presence of post extraction or post RCT infection and the presence of trismus for each patient were recorded by one researcher.

Culture and sensitivity tests to antibiotic therapy werenot performed prior tothe initiation of antibiotic therapy. Panoramic radiography as well asaxial and coronal CT scans with soft tissue window were performed for all cases, except pregnant participants to study the involved spaces? The origin of MIs, including odontogenic, pathologic and foreign body, was identified for each patient. The superficial and deep fascial spaces of maxillofacial region were classified as follows: vestibular, subcutaneous, buccal, sublingual, submandibular, submental, masticator, parotid, lateral pharyngeal, retropharyngeal, pretracheal, visceral, danger, carotid sheath, mediastinum, palatal, infraorbital, periorbital spaces and space of the body of mandible [9]. All the above-mentioned data were collected by one researcher. Ethical code and ethical approval ethics committee of Tehran University of Medical Sciences approved the study design and informed consent was obtained from all patients to include their data in this study.

Statistical Analysis

The obtained data were analyzed using the SPSS 20.0 software package (SPSS Inc., Chicago, IL, USA). Descriptive statistics were usedfor gender, space involvement, immune system status, causative permanent teeth, antibiotic therapy, and origin of infectious frequencies. The differences in CRP, ESR, and albumin levelsbetween male and female patients were analyzed by one way ANOVA. Pearson correlation test was used to evaluate the relationships between each of ESR, CRP and albumin together. Linear regression test was applied to evaluate whether there was an association between the amount of changes in ESR, CRP and albumin and age of the patients, pregnancy and severity of infection indicated by the number of space involvement.

Results

During the study period, a total of 157 patients, with an age range of 3 to 74 years (mean, 23.5±13.2 years), were admitted to the department of maxillofacial surgery. The patients were classified into 8 age groups that are presented in Table 1. Most of the patients (33.8%) were between 21 to 30 years old. The study group consisted of 87 females (55.4%) and 70 males (44.6%). Regardless of the gender, the most frequent cause of MIs was odontogenic sources (128 cases, 81.5%) followed by maxillofacial pathologies (7 cases, 4.5%), prosthesis (6 cases, 3.8%), plates and free bone grafts (4 cases each, 2.5% each), fillers (3 cases, 1.9%), free fat graft (2 cases, 1.3%), foreign body, fungal infection and post trauma infection (1 case each, 0.6%).In terms of the pathological properties 5 cases of bisphosphonate-related osteonecrosis of the jaw (BRONJ), one odontogenic kerato cyst (OKC) and one flourid cemento osseous dysplasia (FLCOD) were identified.

Of the 7 cases of infected prosthesis, 3 were acrylic prosthesis placed in frontal area, one was a silicone prosthesis placed in mental area, and the remaining three medpore, preiplants were placed in mental area, malar region and orbital floor. Of the infected bone grafts, 3 were placed in mandible and one was placed inmaxilla. All of the infected grafts were harvested from iliac crest. In all 3 cases of filler infection, the alloplastic filler was injected in malar and perioral areas. Of the 2 infected fat grafts, one was placed in the orbital floor in a trauma patient andthe other onewas used for malar augmentation in a case with hemifacial microsomia.

The infected foreign body was a piece of wood entered in submandibular area in a trauma. The fungal infection was related to acerebero rhino orbital mucormycosis in a patient with ALLwhich was started inthe maxillary sinus and the necrotic and infected tissue was found on the ala of the nose. The most common affected area was the buccal space with 106 positive cases (67.5%). The rate of involvement of other spaces is presented in Table 2. The most common teeth responsible for maxillofacial fascial space infection is presented in Table. 3. In just one case with retropharyngeal space, carotid sheath involvement and mediastinitis, the causative tooth was mandibular second molar. The number of causative teeth determining the involvement of different facial and maxillofacial spacesis presented in Table 3. Multiple space involvement was used as an indicator of severity of the infection (Table. 4). Left mandibular second molar had the highestmean value for space involvement (mean: 5). The number of the involved spaces was between 1 to 10 spaces in the patients of this study. Although more than 73.9% of the patients had no predisposing factors, some of them suffered from various conditions,such as diabetes mellitus, anemia, chronic steroid administration, malignancy andradiation therapy (Table 5).

Maximum Interincisal Opening (MIO)

The MIO of the patients of this study ranged between 0 to 50 mm (mean: 23.5±13.24mm) on the day of admission. The patients were classified intofour MIO groups; 0 to 10mm (49 patients, 31%), 11 to 20 mm (28 patients, 18%) 21 to 30mm (30 patients, 19%), and more than 31mm (50 patients, 32%).

Initial levels of CRP, ESR and albumin and their correlations

In this study, 1 to 10 mg/L and mm/hr of CRP and ESR were respectively considered as the normal ranges of these two indices. On the day of admission, the levels of CRP and ESR werewithin the normal range in 12.7% and 16.6% of the patients, respectively (Table 6). Most of the patients had a normal albumin level. The mean levels of these three parameters are presented in Table 6. Pearson correlation test was used to evaluate the relationships between the three variables. The results indicated that therewas a significant positive relationship between ESR and CRP (correlation coefficient: 0.421, P value<0.001). (Table 6).

Age group (Years)	*No. (%)*
0-10	*9 (5.7%)*
11-21	*12 (7.6%)*
21-30	*53 (33.8%)*
31-40	*43 (27.4%)*
41-51	*17 (10.8%)*
51-60	*16 (10.2%)*
61-70	*3 (2%)*
>70	*4 (2.5%)*
Total	*157*

Table 1. Frequency of MIs in participants of different age groups.

Space	No. (%)
Buccal	106 (67.5%)
Submandibular	102 (65%)
PTM	82 (52.2%)
Vestibular	66 (42%)
Canine	21 (13.4%)
Submental	19 (12.1%)
Subcutaneous	17 (10.8%)
Submasseteric	17 (10.8%)
Lateral pharyngeal	8 (5.1%)
Frontal	3 (1.9%)
Temporal	3 (1.9%)
Sublingual and frontal	3 (1.9%)
Retropharyngeal	1 (0.66%)
Carotid sheath	1 (0.66%)
Mediastinum	1 (0.66%)

Table 2. Space involvement in MIs.

Space involvement	Teeth (number of involved cases)
Vestibular	Mandibular third molars (10 teeth)
Canine	Maxillary canines (6 teeth)
Buccal	Mandibular third molars (26 teeth)
Submental	Mandibular second molars (5 teeth)
Sublingual	Mandibular second molars (2 teeth)
Submandibular	Mandibular third molars (39 teeth)
PTM	Mandibular third molars (42 teeth)
lateral pharyngeal	Mandibular third molars (5 teeth)
Submasseteric	Mandibular third molars (8 teeth)
Temporal	Maxillary third molars (3 teeth)
Retropharyngeal	Mandibular second molar (1 tooth)
Frontal area	Non odontogenic

Table 3. Involvement of various spaces and teeth.

Multiple space involvement	Number (frequency %)
1 space	15/9.6
2 space	43/27.4
3 space	62/39.5
4 space	28/17.8
5 space	5/3.2
6 space	2/1.3
7 space	1/0.6
10 space	1/0.6

Table 4. The number and frequency of multiple space involvement in MIs.

Medical condition	Frequency	Percent
None	116	73.9
Diabetes mellitus	17	10.8
Anemia	14	8.9
Chronic steroid administration	6	3.9
Malignancy+radiation therapy	3	1.9
Chronic steroid and immunosuppressive drug therapy	1	0.6
Total	157	100

Table 5.

Parameter	Min	Max	Mean±SD (mg/L)	Percent of patients in normal range
ESR	1	97	38.8±23.6	16.6
CRP	1	135	51.7±32.8	12.7
Albumin	2.9	5.1	4.1±0.4	91.1

	CC (ESR admission)	CC (CRP admission)	CC (Albumin)
ESR admission	1	0.421**	-0.233**
P value		0.000	0.003
CRP admission	0.421	1	-0.174*
	0.000		0.029
Albumin	-0.233**	-0.174*	1
	0.003	0.029	

**: Correlation is significant at the 0.01 level (2-tailed).

*: Correlation is significant at the 0.05 level (2-tailed).

CC. Correlation coefficient.

Table 6.

Associations between ESR, CRP and albumin levels and gender, age, pregnancy and severity of infection

The linear regression test was used to evaluate whether there was an association between the amount of changes in ESR, CRP and albumin levels andage of the patients, pregnancy, gender and severity of infection. The results showed that ESR level was significantly higher in pregnant patients (p: 0.006). Moreover, CRP level was significantly higher in male patients (p: 0.04), those with more severe infections (p< 0.001) and the patients with advanced age (p: 0.092). The serum albumin level was significantly higher in men (p: 0.029), whereas it was considerably lower in pregnant patients (p: 0.003) and those with more severe infection (p< 0.001).

Treatment

In this study, the most common treatment was antibiotic therapy combined with incision, drainage and tooth extractionwhich was performed in 67 cases (42.7%) followed by combination of antibiotic therapy and incision & drainage (I&D) in 54 cases (34.4%), combination of antibiotic therapy and extraction in 11 cases (7.0%), and each of antibiotic therapy alone, antibiotic therapy and debridement, and deviceremoval was performedin 7 patients (4.5%), antibiotic therapy and I&D followed by debridement in 3 cases (1.9%) and graft removal in 1 case (0.6%). Among the 128 teeth implicated in odontogenic infections, only 8 teeth hadundergone root canal therapy (RTC) previously. No significant relationship was found between the severity of infection andprevious endodontic therapy (p: 0.481).

Overall, 9 participants (5.7%) required hospital admission due to disseminated infection following endodontic treatment. In this study, molars and premolars were the only causative teeth. Mandibular molars were the most common causativetooth for post-RCT with

5 teeth. Post-extraction infection occurred in 14 cases (8.9%), among them, mandibular third molars and maxillary third molars were respectively the causative teeth in 8 (57%) and 4 cases (28.5%). In this study, only 5.4% of odontogenic infections and 4.4% of MIs were caused by primary teeth. The average age of these pediatricpatients was 7.4 years old, witharange of 3 to 9 years. In the deciduousdentition the causative teeth were only the posterior teeth.

Discussion

MIs are significantly increasing worldwide, however, their incidence, etiology, and patternvary from onecountry to another, probably due to socioeconomic, cultural and environmental differences [10]. This study aimed to determine the annual incidence, etiology, risk factors and complications of MIs in all the patients who were admitted to the maxillofacial surgery of Shariati hospital over a one-year period. A total of 157 MI patients were included in this study during the one year of study period. During the same period of time, the number of admitted patients to the Shariati hospital, where this study was conducted, washigher than those reported by other studies from different countries [11-12].

The patients, with the mean age of 23.5±13.2 years, were classified into 8 age groups. The results indicated that the patients at their second and third decadesof life were athigher risk of MIs. In consistent with the findings of this study, Nading and Taylor (2018) have reported that the highest odontogenic infection-relatedadmission ratebelonged to the patients who were at their second and third decades of life [13]. This finding may be attributed to greater rates of untreated caries in this age group. However, their studies have demonstrated that patients with odontogenic infections were within an age range of 31 to 47 years [14-16].

It has been reported that smoking is directly correlated with a higher risk of MIs, moreover, the number of male smokers is considerably higher than femalesandmentend to care less about their oral health compared towomen [17]. Nevertheless, in this study, the overall femaletomale ratio (female:male) was 1.24:1. This finding is inconsistent with those reported by other studiesfrom various countries, such as India [16], United States [18], and China [19]. The most frequent number of involved spaces was 3 spaces which were detected in 62 patients (39.5%). In 99 cases (63%), more than three spaces were involved. Rastenienė et al (2015) have reported that 42.9% of cases with odontogenic MIs had two or more involvement of anatomic spaces. Inconsistent with findings of this study, they have reported that single-space infections were more common in their patients [20]. A higher risk of maxillofacial multiple space infection has been reported in China [19] and India [16]. In the present study, the most commonly involved space was the buccal space with 106 positive cases (67.5%). However, some of previous studies have reported the submandibular space as the most commonly involved space [16,21]. The predominant involvement of buccal space may be due to the fact that buccal space can be infected by numerous teeth inboth the maxilla and mandible. It has been recently reported that the submandibular and buccalspaces are the most frequently involvedfascial spaces in odontogenic MIs [12].

In the present study, the main source of MIs was odontogenic factors followed by maxillofacial pathologies. Moreover, the most frequently implicated teeth were mandibular third molars which were involved in 81.5% of cases (128/157) for odontogenic infections. It has been reported that the frequency of odontogenic MI almost remainunchanged during a 10-year period [20]. Odontogenic infections have been reported to be the most commonly encountered orofacial infections, which may spread into the adjacent anatomical spaces along the contiguous fascial planes, leading to involvement of multiple spaces which can progress to life-threatening situations [22]. Odontogenic MIs, which are the second most prevalent oral disease worldwide secondary to periodontal diseases, such as gingivitis, and periodontitis, dental caries, and endodontic infections, are associated with local (tooth loss) or systemic implications [23]. The results of this study indicated that infection following extraction of third molars occurred in some of the patients. This predominance of molars as the causal teeth in MI might be due to thedeficient oral hygiene as well asthe technical difficulty of restorative treatments in these locations [20].

Although, in this study, more than 73% of the patients did not have anysystemic disease, diabetes mellitus was the most commonly found systemic disease among the patients with MI. Alcohol consumption and intravenous drug addiction have been reported as the most common risk factors of MIs in USA. Since self-report of drug addiction and alcoholism is not reliable, we did not collect the drug and alcohol abuse-related. In this study, 10.2 % of the MIs patients were pregnant. Pregnancy is accompanied by various physiological changes which place the mother at a

higher risk of infections. Reduction of neutrophil chemotaxis, activity of natural killer cells, inflammatory macrophagesand cell-mediated immunity have been found to be presentduring pregnancy [24]. The hormonal changes in pregnancy may manifest orally by changes in periodontal tissue [25]. The obtained serological data showed that hypoalbuminemia was not a common incidenceamong patients with MIs, however, it is interesting to note that the lowest serum albumin level (2.9mg/dl) belonged to the patients with the most severe infection and involvement of 11 facial spaces, including retropharyngeal space, carotid sheath and mediastinum. Moreover, the results of this study indicated that serum albumin level was significantly lower in pregnant patients and those with severe infection. Serum albumin level decreases during inflammatory processes and infection due to depression of hepatic synthesisof negative acute phase proteins, such as albumin [26]. Decrease in the level of serum albumin also occurs during pregnancy [27].

The results of this study indicated a positive relationship between CRP levelsandgender (male), severity of infection and advanced age. CRP is a positive acute-phase protein which is present in a few healthy people. The serum level of CRP remarkably rises in response to severe infections or inflammatory processes [28]. It has been demonstrated that CRP can be an effective marker for determining the severity of an infection as well as the efficacy of a treatment in patients with fascial space infections of odontogenic origin [26]. Ren and Malmstrom (2007) have reported that the half-life of CRP in the circulation is not significantly influenced by sex or age [29]. The results of the present study showedthat CRP concentrations are significantly differentin various ages. However, it has been recently demonstrated that age does not induce any significant difference in CRP concentration [28]. The results of this study showed that ESR was significantly higher in pregnant patients. The increase inESR level during pregnancy is due to the pregnancy-relatedincrease in plasma fibrinogen level and hemodilution [30] .

In this study, the most common treatment performed for MIs patients was antibiotic therapy combined with incision, drainage and tooth extractionin 67 cases (42.7%) followed by combination of antibiotic therapy and I&D in 54 cases (34.4%). Clindamycin was administrated to the majority of the hospitalized MI patients (60.5%). Treatment of oro-facial infection is controversial. Amoxicillin and penicillin alone or in combination with other antibiotics have been the most commonly applied treatment of odontogenic space infections by other researchers [22]. However, Bhagania et al (2018) have demonstrated that clindamycin alone and thecombination of penicillin and metronidazole are both effective antibiotic regimens for treatment of infections of odontogenic origins [31].

Conclusion

The results of this study indicated that odontogenicorigins were the main cause of MIs. The most frequent number of involved spaces was three spaces. Multiple space infections were more common than infections involving one space, moreover, the most common involved space was the buccal space. Diabetes mellitus was the most commonly found systemic disease among the participants of this study. The participants at their second and third decade of life were at higher risk of MIs. A positive relationship was found between CRP and ESR levels and the severity of infections. Serum albumin and ESR levels were significantly reduced and increasedin the patients with severe infection and pregnant patients, respectively. The findings of this study suggest that dentists should be consider that the most appropriate treatment of odontogenic infections involves surgical interventionand selection of a suitable antibiotic as an adjunct.

Conflict of Interest

There is no conflict of interest to declare.

References

[1] Yuvaraj V, Alexander M, Pasupathy S. Microflora in maxillofacial infections--a changing scenario? J Oral Maxillofac Surg 2012; 70(1):119-25.

[2] Yuvara V. Maxillofacial Infections of Odontogenf ic Origin: Epidemiological, Microbiological and Therapeutic Factors in an Indian Population. Indian J Otolaryngol Head Neck Surg 2016; 68(4): 396–9.

[3] Lee JK, Kim HD, Lim SC. Predisposing factors of complicated deep neck infection: an analysis of 158 cases. Yonsei Med J 2007 28; 48(1):55-62.

[4] Huang TT, Tseng FY, Yeh TH, Hsu CJ, Chen YS. Factors affecting the bacteriology of deep neck infection: a retrospective study of 128 patients. Acta Otolaryngol. 2006 Apr; 126(4):396-401.

[5] Statkievicz C, Faverani LP, Gomes-Ferreira PH, Ramalho-Ferreira G, Garcia-Junior IR. Misdiag-

nosis of Extensive Maxillofacial Infection and Its Relationship with Periodontal Problems and Hyperglycemia. Case Rep Dent 2016; 2016:5960546.

[6] Kamat RD, Dhupar V, Akkara F, Shetye O.A comh parative analysis of odontogenic maxillofacial infections in diabetic and nondiabetic patients: an institutional study. J Korean Assoc Oral Maxilloa fac Surg. 2015; 41(4):176-80.

[7] Seppänen L, Rautemaa R, Lindqvist C et al (2010) Changing clinical features of odontogenic maxillofacial infections. Clin Oral Invest 14:459–65

[8] Rajendra Santosh AB, Ogle OE, Williams D, Woodbine EF. Epidemiology of Oral and Maxillofacial Infections. Dent Clin North Am 2017; 61(2):217-33.

[9] Kitamura S. Anatomy of the fasciae and fascial spaces of the maxillofacial and the anterior neck regions. Anat Sci Int 2018; 93(1):1-13.

[10] Mabrouk A, Helal H, Mohamed AR, Mahmoud N. Incidence, etiology, and patterns of maxillofacial fractures in ain-shams university, cairo, egypt: a 4-year retrospective study. Craniomaxillofac Traus ma Reconstr. 2014; 7(3):224-32.

[11] Storoe W, Haug RH, Lillich TT. The changing face of odontogenic infections. J Oral Maxillofac Surg. 2001 Jul; 59(7):739-48

[12] Wang J, Ahani A, Pogrel MA. A five-year retroM spective study of odontogenic maxillofacial infections in a large urban public hospital. Int J Oral Maxillofac Surg. 2005; 34(6):646-9.

[13] Nadig K, Taylor NG.Management of odontogenic infection at a district general hospital. Br Dent J. 2018 22; 224(12):962-966.

[14] Bross-Soriano D, Arrieta-Gomez JR, Prado-Calleros H, et al. Management of Ludwig's angina with small neck incisions: 18 years experience. Otolaryngol Head Neck Surg 2004; 130:712–717.

[15] Sanchez R, Mirada E, Arias J, et al. Severe odontogenic infections: Epidemiological, microbiological and therapeutic factors. Med Oral Patol Oral Cir Bucal 2011; 16:e670–676.

[16] Mathew GC, Ranganathan LK, Gandhi S, Jacob ME, Singh I, Solanki M, Bither S. Odontogenic maxillofacial space infections at a tertiary care center in North India: a five-year retrospective study.Int J Infect Dis. 2012; 16(4):e296-302.

[17] Zaleckas L, Rasteniene R, Rimkuviene J, et al. Retrospective analysis of cellulitis of the floor of the mouth. Stomatologija 2010; 12:23–7

[18] Saito CT, Gulinelli JL, Marão HF, Garcia IR Jr, Filho OM, Sonoda CK, Poi WR, Panzarini SR. Occurrence of odontogenic infections in patients treated in a postgraduation program on maxillofacial surgery and traumatology. J Craniofac Surg. 2011; 22(5):1689-94.

[19] Zhang C, Tang Y, Zheng M, Yang J, Zhu G, Zhou H, Zhang Z, Liang X. Maxillofacial space infection experience in West China: a retrospective study of 212 cases. Int J Infect Dis. 2010; 14:e414-417.

[20]Rastenienė R, Pūrienė A, Aleksejūnienė J, Pečiulienė V, Zaleckas L. Odontogenic Maxillofacial Infections: A Ten-Year Retrospective Analysis. Surg Infect (Larchmt). 2015; 16(3):305-12.

[21] Ariji Y, Gotoh M, Kimura Y, Naitoh M, Kurita K, Natsume N, Ariji E. Odontogenic infection pathway to the submandibular space: imaging assessment. Int J Oral Maxillofac Surg. 2002; 31(2):165-9.

[22] Shakya N, Sharma D, Newaskar V, Agrawal D, Shrivastava S, Yadav R. Epidemiology, Microbiology and Antibiotic Sensitivity of Odontogenic Space Infections in Central India. J Maxillofac Oral Surg. 2018; 17(3):324-331.

[23] Stathopoulos P, Igoumenakis D, Shuttleworth J, Smith W, Ameerally P. Predictive factors of hospital stay in patients with odontogenic maxillofacial infections: the role of C-reactive protein. Br J Oral Maxillofac Surg. 2017; 55(4):367-370.

[24] Robinson DP, Klein SL. Pregnancy and pregnancy-associated hormones alter immune responses and disease pathogenesis. Horm Behav. 2012; 62(3):263-71.

[25] Fujiwara N, Tsuruda K, Iwamoto Y, Kato F, Odaki T, Yamane N, Hori Y, Harashima Y, Sakoda A, Tagaya A, Komatsuzawa H, Sugai M, Noguchi M. Significant increase of oral bacteria in the early pregnancy period in Japanese women. J Investig Clin Dent. 2017; 8(1).

[26] Sharma A, Gokkulakrishnan S, Shahi AK, Kumar

V. Efficacy of serum CRP levels as monitoring tools for patients with fascial space infections of odontogenic origin: A clinicobiochemical study. Natl J Maxillofac Surg. 2012; 3(2):148-51.

[27] Sufrin S, Nessa A, Islam MT, Das RK, Rahman MH. Study on Serum Albumin in Third Trimester of Pregnancy. Mymensingh Med J. 2015; 24(3):464-6.

[28] Mirochnik R, Araida S, Yaffe V, Abu El-Naaj I. C-reactive protein concentration as a prognostic factor for inflammation in the management of odontogenic infections. Br J Oral Maxillofac Surg. 2017; 55(10):1013-1017.

[29] Ren YF, Malmstrom HS. Rapid quantitative determination of C-reactive protein at chair side in dental emergency patients. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007; 104(1):49-55.

[30] Basarigidad TV, Bajentri AL, Baljoshi VS. Change in erythrocyte sedimentation rate (ESR) in pregnancy and puerperium in the same woman. NJBMS. 2013; 4: 111-113

[31] Bhagania M, Youseff W, Mehra P, Figueroa R. Treatment of odontogenic infections: An analysis of two antibiotic regimens. J Oral Biol Craniofac Res. 2018; 8(2):78-81.

Please cite this paper as:
Mahmood Hashemi H, Sharifi R, Hasheminasab M, Mortazavi M; Epidemiologic evaluation of maxillofacial infections and their risk factors and associated complications in a one year period in Shariati hospital in 2013-2014. J Craniomaxillofac Res 2019; 6(1): 11-19