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REVIEW PAPER

Odontogenic Maxillofacial Space Infections: A 5-Year Retrospective Review in Navi Mumbai

Ekta S. Keswani[1] · **Gokul Venkateshwar**[1]

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Abstract
Purpose The aim of this study is to comprehensively review and analyse pure odontogenic maxillofacial space infections in a tertiary care hospital in Navi Mumbai over a period of 5 years.
Methods A retrospective analysis of 315 patients treated at Dr. D. Y. Patil Dental College and Hospital at Nerul, Navi Mumbai, from January 2007 to December 2011 was done. Multiple variables were analysed. Localised infections like dentoalveolar infections without space involvement and infection of non-odontogenic cause were excluded from the study.
Results Analysis of the records was done. Majority of patients were from lower socioeconomic background and were daily wage workers who had either consulted a general physician or a general dental practitioner or had self-medicated themselves before presenting to us with acute symptoms. Early recognition and prompt treatment involving intravenous antibiotics with extraction of involved tooth/teeth and incision and drainage helped in resolution of infections in a span of 72 h. Medically compromised patients had longer duration of hospital stay as compared to the patients who had no underlying medical condition. Majority of space infections involved multiple spaces and local anaesthesia with sedation was found to be the satisfactory mode of anaesthesia. Complications were very few.
Conclusion We concurred that any form of odontogenic maxillofacial space infection should be rendered prompt and aggressive treatment and hospitalisation should be recommended wherever required.

Keywords Infection · Odontogenic · Maxillofacial space · Incision and drainage

Introduction

The term odontogenic maxillofacial space infection refers to infections involving potential spaces and facial planes of the maxillofacial region originating from a purely odontogenic cause [1–12]. Though the incidence of odontogenic infections has significantly decreased due to improved dental care and efficacy of antibiotics, they can be potentially life threatening because of ignorance by the patient, by the general practitioner, antibiotic therapeutic failure, depressed immune system, concomitant medical condition or unavailability of proper healthcare facilities in a developing country [10, 12–14]. These infections can disseminate rapidly in a matter of few hours or few days leading to life-threatening complications like respiratory obstruction, sepsis, necrotising fasciitis, descending mediastinitis, cavernous sinus thrombosis and pericarditis all of which could prove fatal [2, 4–9, 11–13]. It becomes important to adopt a comprehensive therapeutic protocol for such kind of infections, and therefore, early diagnosis and prompt treatment should be instituted immediately to avoid these life-threatening complications [2–4, 7]. In all our cases, the dental focus has been the solitary cause of maxillofacial infections. However, life-threatening infections of maxillofacial region can also be related to non-odontogenic causes, e.g. submandibular gland sialadenitis, compound mandibular fractures, oral soft tissue

✉ Ekta S. Keswani
drekta.k@gmail.com

[1] Department of Oral and Maxillofacial Surgery, D Y Patil School of Dentistry, Nerul, Navi Mumbai 400706, India

lacerations and/or secondary infections due to pathologies in the oral cavity [2, 3, 7, 11–13].

Materials and Methods

Study Design and Sample Size

The epidemiologic survey was carried out by collecting data from patient records at the Department of Oral and Maxillofacial Surgery of the Dr. D. Y. Patil Dental College and Hospital, Nerul, Navi Mumbai. Case records of patients treated between January 2007 and December 2011 were analysed. Three hundred and fifteen patients were enrolled in the study. All the patients were treated at the Dr. D. Y. Patil Dental College and Hospital. Variables reviewed included age, gender, seasonal variations, socioeconomic background, signs and symptoms, time of onset till presentation, medically compromised patients, tooth involved, fascial spaces involved, imaging modalities, mode of anaesthesia, treatment instituted, type of infection, length of hospital stay, complications. The ethical clearance was given by the ethical committee of the institution.

Data Collection, Management and Analysis

The data were collected from 315 patient records who came to Dr. D. Y. Patil Dental College and Hospital. The data are analysed using Statistical Package for Social Science (SPSS) and Excel. Descriptive statistics method is used for analysing the data. The graphical procedures are used for the presentation of data.

Results

A total of 315 patients with odontogenic maxillofacial space infections were included in this study, with an age range of 6–70 years. Mean age for males is 38.12 with a standard deviation of 6.57, and for females, mean age was 37.28 with the standard deviation of 5.92 as mentioned in Table 1, including 174 males (55.23%) and 141 females (44.76%). The age and gender distribution of patients is shown in Figs. 1 and 2, respectively.

Most of our patients (208 patients) (66.03%) reported during summer season comprising of months from March to May, and in October (68 patients) (21.58%) where the temperature in Navi Mumbai is high in the range of 37–40 °C. Distribution of patient according to the seasonal variations is shown in Fig. 3.

Table 1 Standard deviation of age

	Mean	SD
Male	38.12	6.57
Female	37.28	5.92

Most of the patients (262 patients) were from the lower socioeconomic background (83.17%).

The main aetiology was pulpal (219 patients) (69.52%), pericoronitis (84 patients) (26.66%) and periodontal (12 patients) (3.8%). The graphical representation of the same is shown in Fig. 4. In majority of cases, the teeth involved were mandibular and maxillary first, second and third molars (95.9%) and also maxillary canines, maxillary premolars and mandibular central incisor (4.1%). The most commonly involved teeth were mandibular third molar (194 cases).

The most commonly affected fascial spaces were the submandibular (128 patients) (40.63%), buccal space (84 patients) (26.66%), pterygomandibular space (52 patients) (16.50%), masseteric space (14 patients) (4.44%), canine (12 patients) (3.8%), sublingual (10 patients) (3.17%), submental (10 patients) (3.17%), temporal (3 patients) (0.94%), lateral pharyngeal (2 patients) (0.63%). Distribution of patients according to fascial spaces involved is shown in Fig. 5. However, combination of various spaces has been observed, the most common being the combination of submandibular and buccal space.

Majority of our patients had abscess (284), and rest were cellulitis (31). This is shown in Fig. 6. Principal signs were pain (100%), swelling (100%), lymphadenopathy (100%), fever (62.26%), trismus (42.28%), malaise (36.14%), dysphagia (58.12%), dyspnoea (15.4%), odynophagia (25.53%).

The average duration of time of onset of symptoms till the time the patient presented to us was 7–9 days in our study. Majority of our cases (142 patients) reported to us after having undergone unsuccessful treatment by a general dentist or by a general physician (45.07%). Some patients (101 patients) resorted to self-medications (over the counter) before presenting to us (32.06%), and the remaining patients (72 patients) directly approached us for the treatment (22.85%). Among patients who were immunocompromised, 54 cases were found to be having type II diabetes mellitus, 16 cases were anaemic and 4 cases were diagnosed with tuberculosis, 2 cases were HIV positive, and 2 cases were HbsAg positive.

Conventional radiographs like OPG and IOPA were sufficient to determine the aetiology of the infection; however, in two cases, CT scans were advised in severe cases so as to assess the extent or spread of infections in the deep fascial spaces.

Majority of the cases were done under local anaesthesia with conscious sedation (306 patients) (97.14%), and (9 patients) (2.86%) cases were done under general anaesthesia. Graphical representation of the mode of the anaesthesia used is shown in Fig. 7.

In our study to cover all the microbial flora, the regimen that we followed comprised of parenteral administration of

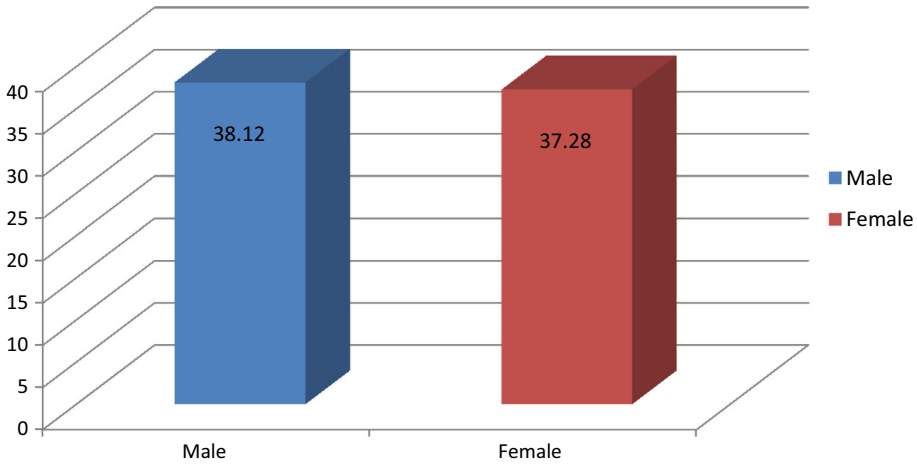

Fig. 1 Distribution of patients according to the age

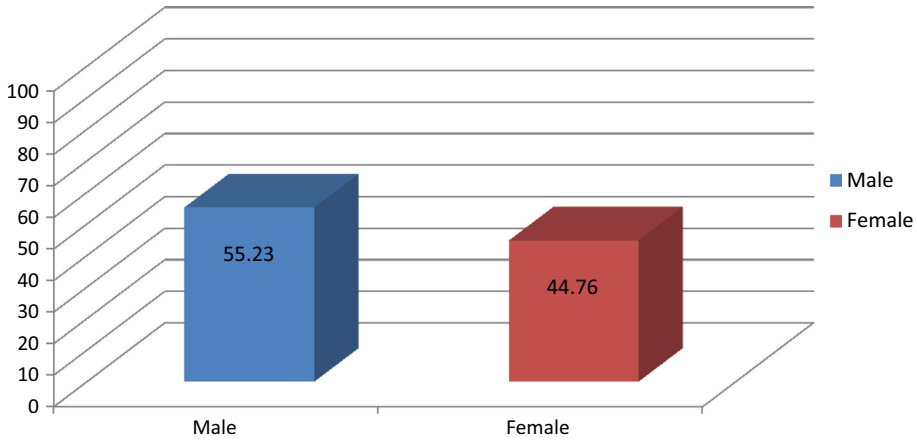

Fig. 2 Distribution of patients according to gender

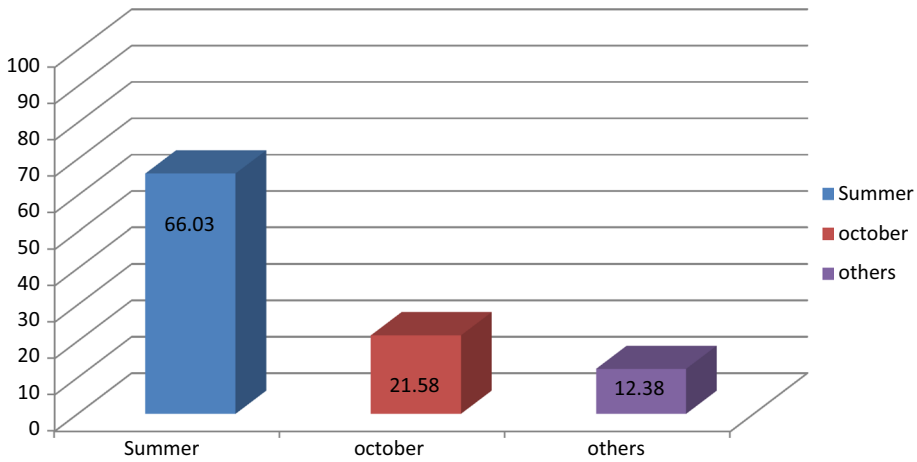

Fig. 3 Distribution of patient according to season

amoxicillin and clavulanic acid (augmentin 1.2 g BD) and metronidazole (metrogyl 100 ml TDS) and aminoglycosides (amikacin 500 mg BD). Amikacin was added in multiple space infections which yielded excellent results. Diclofenac sodium (Dynapar TDS) was administered.

Culture and sensitivity tests of 81 patients (25.71%) showed mixed flora which were sensitive to the antibiotics prescribed.

Among the 315 patients, 246 patients (78.09%) were administered amoxicillin + clavulanic acid, metronidazole, diclofenac sodium and aminoglycosides, 14 patients (4.44%) were administered cephalosporins + metronidazole, diclofenac sodium and aminoglycosides, and 55 patients (17.46%) were administered amoxicillin + clavulanic acid, metrogyl and diclofenac sodium. In cases of multiple space infections, amikacin was added

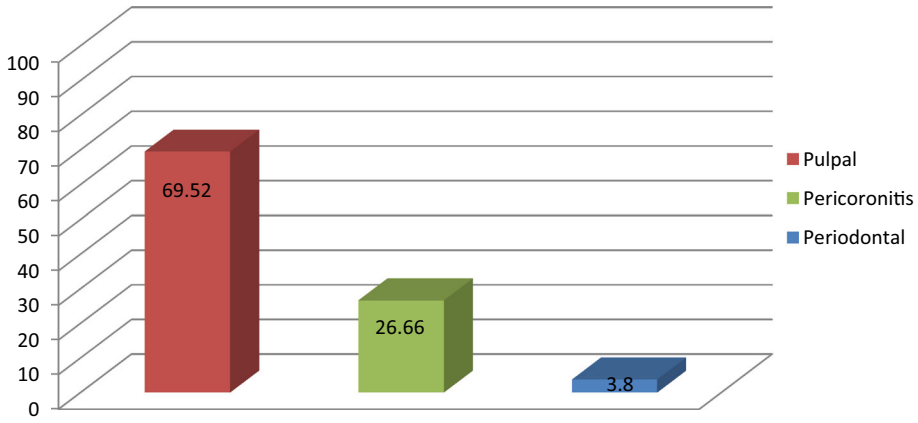

Fig. 4 Distribution of patients according to aetiology

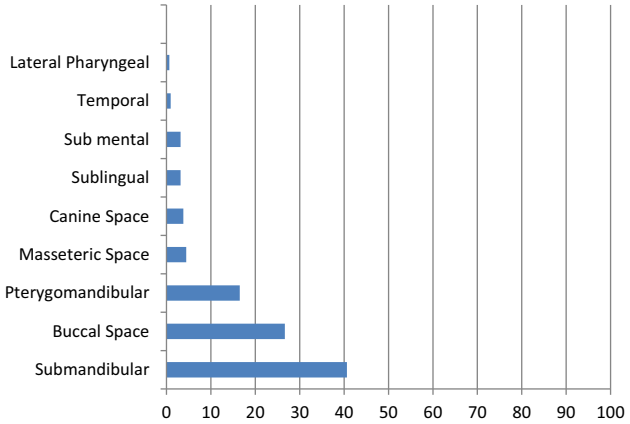

Fig. 5 Distribution of patients according to the fascial spaces

to the combination of amoxicillin and clavulanic acid–cephalosporins and metrogyl [15].

Graphical representation of the same is described in Fig. 8.

In 282 patients (89.52%), empirical antibiotics, extraction and incision and drainage followed by drain placement were done, and in 33 patients (10.47%), antibiotics were administered and extraction of causative tooth or teeth was carried out on the same day to help in early resolution of infection. Graphical representation of the same is shown in Fig. 9.

In majority of our cases (298 patients) (94.60%), we have performed extraoral incision and drainage followed by drain placement, and in few cases (17 patients) (5.39%), we have performed intraoral incision and drainage without drain placement. The graphical representation is shown in Fig. 9.

Corrugated drain was most frequently used. They were maintained on drain for a mean period of 3 days. Hospitalisation was deemed necessary in 282 patients (89.52%), because these patients showed characteristics symptoms like dysphagia, dyspnoea, constitutional signs like malaise, fever and were toxic in appearance and were not responding to oral medications. Patients who showed signs and symptoms of respiratory distress were taken up for incision and drainage within 2–3 h of presentation. Mean period of admission was 4 days, and it ranged from 3 to 10 days.

All the patients were operated within 24 h of the first presentation of the patient. The average duration of surgery was 30–45 min.

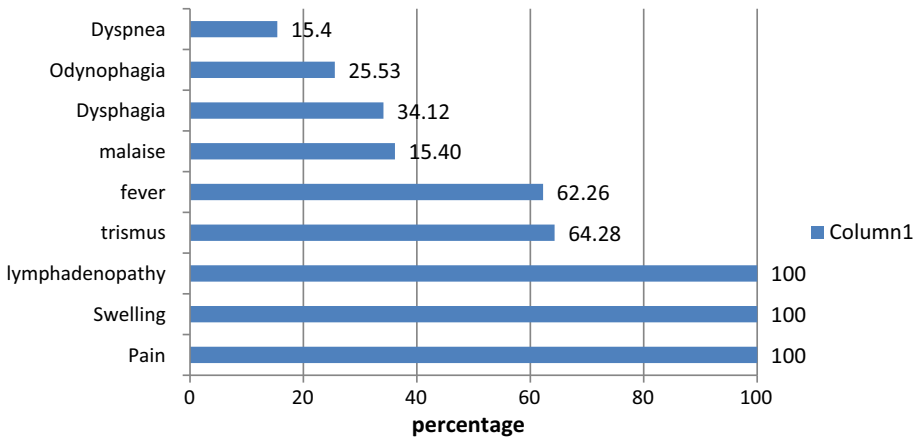

Fig. 6 Signs and symptoms

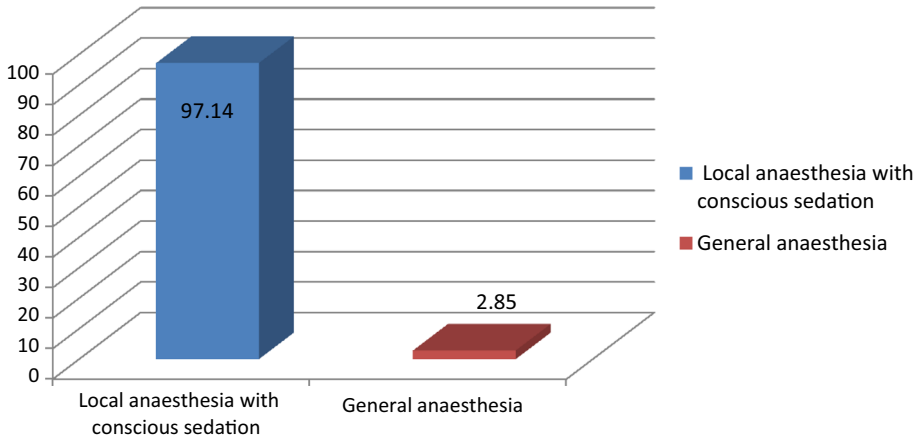

Fig. 7 Type of anaesthesia

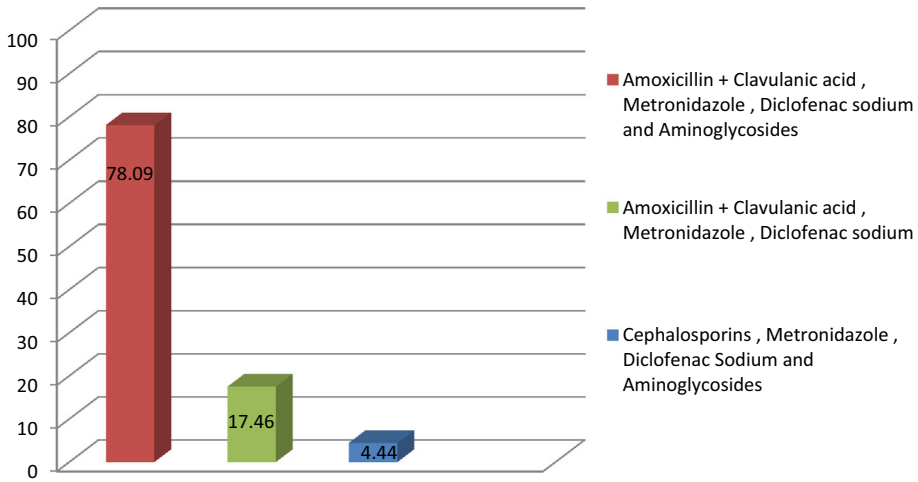

Fig. 8 Distribution of various antibiotics used

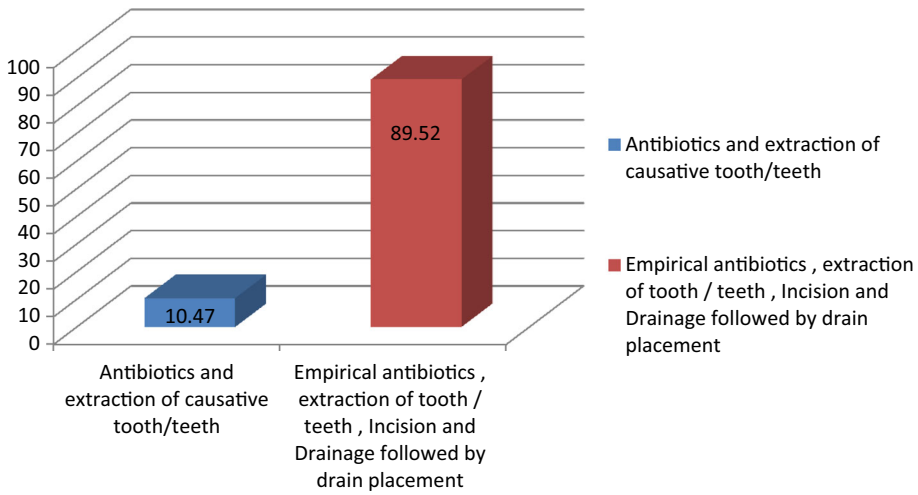

Fig. 9 Treatment modalities

Complications during treatment were minimal and only affected 2 cases. In one patient, it was progressing to necrotising fasciitis, and in other patient, the infection extended to lateral pharyngeal space.

Discussion

With the advent of antibiotics and improved socioeconomic standards, the spread of odontogenic infections is declining [2, 3, 7, 14]. However, its presence can intimidate even the most experienced clinician [2, 3, 7, 14].

Odontogenic infections are the most frequently occurring infections as compared to infections of non-odontogenic origin in our study [1, 2, 7, 9, 10, 13, 14]. Fabio Ricardo Loureiro Sato et al. reported 79.31% of odontogenic infections out of 210 cases [1]. Wang et al. reported 157 cases of odontogenic infections out of 250 cases of maxillofacial infections [13]. Zhang et al. reported 56.1% cases of odontogenic infections in 145 cases of maxillofacial space infection [10]. Odontogenic infections represented 12.2% of maxillofacial disorders seen at our hospital during the period of study.

Anamnesis was performed on every patient, and all the variables were taken into consideration. The proportion of male patients were slightly higher than female patients. Storeo et al. in their study on odontogenic infections showed no significant gender predilections [3]. All the fascial space infections originated from multiple dental foci [1, 2, 7, 9, 10, 13, 14]. A significant proportion of patients were in the age group of 20–40 years. Fabio Ricardo Loureiro Sato et al. reported a mean age of 31 years and standard deviation of 16.6 in their study on 210 patients of maxillofacial space infections. Storeo et al. in their study on odontogenic infections reported a broad age range from 3 to 56 years [3].

Socioeconomic factor was a key variable in odontogenic infections as most of our patients were daily wage workers or were dependent on a family member who was a daily wage worker [13]. Wang et al. in their study on 250 patients with maxillofacial infections stated that the maxillofacial infections are more common in underserved patients lacking access to health care through the emergency room of publicly funded hospitals [13], which concurred with our socioeconomic factor.

Majority of the patients who reported to us were during the summer season and in October where the temperatures could go up to 37 °C.

Self-medications and failure of treatment and inability to recognise the seriousness of the infection by the general practitioners were major cause of dissemination of infections [1, 10]. Fabio Ricardo Loureiro Sato in their study stated that 21.31% resorted to self-medications, 47.54% patients were prescribed medications from a general dentist and 31.15% patients were prescribed medications from physicians [1]. Zhang et al. reported 102 patients (48.1%) out of 212 patients in their study were self-medicated and they also stated that the self-medications were a relative risk factor for life-threatening complications probably as a result of a delay in the presentation [10].

The average duration of presentation from the time of onset of symptoms was approximately 4–5 days. Sanchez et al. in their study on 151 patients of severe odontogenic infections reported that most of their patients presented with a clinical course of less than 7 days (81.8%) and few patients (18.2%) presented with a clinical course of more than 7 days [9].

Recognising the state of infection (solitary or multiple space infections) when the patient presents to us is the most crucial factor in the successful management of odontogenic maxillofacial space infections because of the disseminating nature of the infections and its consequences which can be life threatening.

The common presenting signs and symptoms were pain, swelling, lymphadenopathy and trismus [2–4, 7, 10, 11, 15–17].

As stated in the literature, fascial spaces are affected by infection in same proportion as the proximity of the roots of the teeth, as they spread along the path of least resistance [1–3, 5, 7, 12, 18]. Among the most commonly observed fascial space affected in our study was submandibular and least was temporal. Fabio Ricardo Loureiro Sato in their study on 210 patients with maxillofacial infection reported higher incidence of submandibular space infection [1]. Ylijoki et al. in their study on 100 patients with severe odontogenic infections stated that the mandibular third molars have been the most common cause of odontogenic infections and the submandibular space has been the most common location of infection [19]. Rega et al. in their study on 103 patients with head and neck space infections of odontogenic origin stated that the submandibular space was the most common location for a single space abscess (30%) [8]. Boscolo-Rizzo et al. reported that the submandibular space is the most frequently involved space in the odontogenic infections [12]. Combination of various spaces has been observed. Storeo et al. in their study on odontogenic infections stated that the submandibular space is the most frequently involved in patients with multispace infections [3]. Ariji et al. in their study on 33 patients stated that the submandibular space is one of the first to be involved by odontogenic infection [5]. Rega et al. in their study on 103 patients with head and neck space infections of odontogenic origin reported that the submandibular space was the most common location in the multiple space abscesses.

The predominant cause of odontogenic maxillofacial infections was lower third molars as infections spread to the pterygomandibular space or the submandibular space which is the gateway to the dissemination of infections to spaces beyond and also maxillary and mandibular first and second molars, maxillary canines and premolars were implicated in our study [2, 3, 7, 9, 16, 20]. Storeo et al. in their study stated that the mandibular third molar was the most frequently involved tooth [3]. Flynn et al. in their study on 37 patients stated that the most frequently involved tooth in the odontogenic infection is lower third molar [16]. Sanchez et al. in their study reported that most commonly the teeth implicated in the infection were those

located in the lower posterior segments and the second most frequent causal teeth were lower third molars [9]. Ylijoki et al. in their study on 100 patients with severe odontogenic infections stated that the mandibular third molars have been the most common cause of odontogenic infections [19].

Most of our patients were hospitalised, and treatment was instituted promptly on the same day of admission after stabilisation with intravenous fluids and antibiotics [1–4, 9–13, 15, 17, 19, 21–23]. Ylijoki et al. in their study on 100 patients admitted. All 100 patients and all of them underwent surgery and were administered intravenous antimicrobial agents [19]. All the requisite laboratory investigations and radiographs (OPG, IOPA) were performed prior to definitive treatment [1, 2, 7–9, 13, 18, 21]. Aspiration was done to differentiate between cellulitis and abscess and for culture and sensitivity. Substantial amount of cases were abscess and least were cellulitis. The aspirate that was obtained was sent for culture and sensitivity testing which did not yield any significant growth. Culture and sensitivity testing was of less significance in our study as all the patients responded well to our standard protocol of amoxicillin–clavulanic acid (Inj. augmentin 1.2 g), metronidazole (Inj. metrogyl 100 cc) parentally with diclofenac sodium (Inj. Dynapar) and aminoglycoside (Inj. amikacin 500 mg) intravenously in multiple space infections [1, 2, 4, 7–10, 13, 15, 17, 18, 21, 22, 24]. Sanchez et al. in their study on severe odontogenic infections stated that the first empirical treatment option used in their study consisted of amoxicillin–clavulanate at standard doses (1 g every 8 h via the intravenous route) [1, 2, 9, 18]. Panagiotis et al. stated that the combination of penicillin with metronidazole adequately covers the microbial flora of odontogenic abscess [18]. Boscolo-Rizzo et al. in their study used the combination of amoxicillin and clavulanate potassium/second- or third-generation cephalosporins and metronidazole to eradicate both aerobic and anaerobic organisms [12].

Airway management is a crucial factor in odontogenic space infections as an insecure airway can lead to various complications [1, 2, 7, 10–13, 15, 16, 18, 21, 25–27]. Proper preanaesthetic evaluation and airway evaluation were carried out by the anaesthesiologists prior to the procedure. Almost all the patients in our study were treated under local anaesthesia with conscious sedation. Deep sedation was avoided in view of unsecured airway; however, our anaesthetists were prepared for endotracheal intubation with tracheostomy as a standby procedure [2–4, 8, 10–13, 15, 26, 27]; however, in our study, no case required tracheostomy. Potter et al. in their study stated that tracheotomy is an effective and relatively safe technique for control of airway in patients with deep neck space infections [26]. Zhang et al. reported that close monitoring is required for the patients with respiratory obstruction so that emergency endotracheal intubation or tracheotomy can be performed if necessary [10].

Medically compromised patients were referred to respective specialities for concomitant management in conjunction with our treatment to help in early resolution of infections [25]. All the patients who were medically compromised had a prolonged stay in our study [9]. Sanchez et al. in their study reported that mean stay was 4.24 days, and in patients with type I and II diabetes, the mean stay was 9.2 days [9].

In majority of our cases, we administered parenteral antibiotics, extraction (removal of foci) followed by extraoral incision and drainage and exploration of all the involved fascial spaces with drain placement, and in some of our patients antibiotics, extraction and intraoral incision without drain placement were sufficient to achieve resolution of the infection [1, 2, 7, 9, 11–13, 15, 17, 18, 21–23]. Sato et al. stated that treatment for infections that affected the maxillofacial complex followed a classic protocol which comprises of removal of cause, abscess drainage and antibiotic therapy [1]. Heimdahl et al. in their study stated that in the treatment of orofacial infections, surgical drainage and proper antimicrobial therapy are mandatory for a successful outcome [21].

Penicillins continue to be the drug of choice for odontogenic infections as their use, even when empirical, is effective against microorganisms present in maxillofacial infections [1, 2, 8, 9, 11–13, 15, 17, 18, 22]. Broad antimicrobial action on the aerobic and anaerobic microorganisms is yet another positive aspect of the use of penicillins in odontogenic infections.

According to the literature, penicillins and cephalosporins do not attain satisfactory antimicrobial action against some anaerobic microorganisms [1, 2, 8, 9, 11–13, 15, 17, 18, 22]. Metronidazole is very effective, and its action is exclusive to anaerobic organisms as observed by various authors [1, 2, 9, 18]. In our experience, administration of intravenous amoxicillin and clavulanic acid combinations with intravenous metronidazole with a prompt surgical drainage of all the involved spaces and removal of the odontogenic cause improved the condition of the patient, in multiple space infections addition of intravenous amikacin (aminoglycosides) provided better coverage helping in early resolution of the infection [1, 2, 8, 9, 11–13, 15, 17, 18, 22]. We have performed extraoral incision and dependent drainage in majority of our cases in order to achieve decompression and help in early resolution of infection. Special emphasis was placed on extraoral incision and drainage over intraoral incision and drainage as we found extraoral approach had better accessibility to all the fascial spaces and the drainage was facilitated by gravity.

The length of hospital stay ranged from 3 to 10 days. Sanchez et al. in their study reported a mean stay of 4.24 days [9]. Drains were removed within 72 h, and active physiotherapy was instituted before the patient was discharged, and follow-up was done till complete resolution of the condition was achieved.

Conclusion

According to the data obtained in our study, we can conclude that almost an equal proportion of males and females were diagnosed with odontogenic infections. Dysphagia, dyspnoea, presence of constitutional signs and symptoms and involvement of one or more space were criteria for admitting the patient. Medically compromised patients should be treated in a multidimensional approach rather than infection per se. Conventional radiographs were sufficient to diagnose the condition.

We had an excellent and satisfactory result with the standard protocol of administrating amoxicillin clavulanic acid, metronidazole and aminoglycosides in severe cases. The predominant cause of infection in our study was lower third molars. Airway management was a crucial factor in severe infection. Intravenous antibiotic therapy, adequate hydration with extraction with extraoral incision, drainage wherever applicable and drain placement with concomitant management of underlying systemic diseases resulted in successful resolution of all the infections treated in our institute. Treatment was instituted on the same day following the adage "Never let the sun set on an undrained abscess".

Prompt referral by the general practitioners and increase in awareness among the patients can reduce the number of severe life-threatening infections. Biomarkers like C-reactive protein can be used as an important diagnostic tool [2, 19, 25, 27].

There was appositive correlation between the length of the hospital stay and medical status of the patient.

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Compliance with Ethical Standards

Conflict of interest Dr. Ekta Keswani and Dr. Gokul Venkateshwar declare that they have no conflict of interest.

Ethical Approval All procedures performed in the study involving human participants were as per the ethical guidelines of the institution.

Informed Consent Informed consent was obtained from all participants included in the study.

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