Clinical Features and Presentation of Cervicofacial Infection: A Maxillofacial Trainee Research Collaborative (MTReC) Study

Abstract

Introduction: Cervicofacial infection (CFI) is a common presentation to the Oral and Maxillofacial (OMFS) department and accounts for significant emergency activity. The current study aims to understand the aetiology, management and clinical features of patients hospitalised with CFI.

Methods: Our study included all patients admitted for management of CFI from May to October 2017 at 25 OMFS units across 17 UK regions. Data were collected prospectively and included age, comorbidities, prior treatment received, markers of sepsis and presenting clinical features.

Results: One thousand and two (1002) admissions were recorded; 546 (54.5%) were male. Median age was 34 years (1-94 years). The most common presenting complaints were trismus (46%) and dysphagia (27%). Airway compromise was present in 1.7% of cases. Odontogenic infection accounted for 822/1002 (82%) admissions. Of those with an infection of odontogenic origin, 453/822 (55.1%) had received previous treatment. Two-thirds of those who had received treatment were managed by antibiotics alone (300/453, 66.2%) Patients met criteria for sepsis in 437/1002 (43.6%) of CFI, and in 374/822 (45.5%) of odontogenic infections.

Conclusion: This is the largest study worldwide of patients requiring inpatient management for CFI. Infection due to odontogenic origin is the most frequent reason for admission and

nearly half do not seek treatment before presentation. Patients with CFI often present late in their disease and frequently meet criteria for sepsis, requiring timely and aggressive treatment

to ensure optimum outcomes. Trismus is an emerging dominant feature with all the implications related to the anaesthetic management of these patients. Knowledge of these factors has implications for the referrer, triage, the emergency department, the anaesthetic team and members of the OMFS team.

Keywords: cervicofacial, infection, odontogenic, sepsis, airway, trismus

Introduction

Cervicofacial infection (CFI) patients are a common presentation to the oral and maxillofacial surgery department (OMFS). CFI can be caused by numerous aetiologies and present with variable clinical features. Initial management often relies on relatively junior staff, and there is much variation in treatment protocols between OMFS UK.[1] In depth knowledge of the presenting features and the aetiology of infection, and clinical characteristics of this patient group are crucial to further define and understand this population and to improve their management.

CFI describes infection within the anatomical boundaries of the neck and face. The source of CFI is commonly odontogenic but can also originate from the salivary glands, the tonsils and skin.[2] Extensive dental disease is prevalent within the general UK population; the UK Adult Dental Health Survey found that 7% of adults had features suggestive of extensive dental caries causing significant problems in need of early attention.[3] Patients who don't receive this early attention may progress to require admission and hospital treatment for CFI.

The primary treatment aim of CFI is the removal of the underlying cause and drainage of purulent collections. This is aided with antibiotic therapy if the patient is systemically unwell.

Surgical treatment of odontogenic infections commonly involves extraction of teeth, together with surgical drainage of pus via incision, exploration and drainage procedures. Determining the likely source can be challenging and requires extensive clinical examination and radiography.

Many patients receive antibiotic therapy from dentists, general medical practitioners or the emergency department. The proportion of patients that visit healthcare providers prior to admission, and details of the provided treatment have not been previously examined. A previous study[2] has defined the proportion of patients who presented to a general dentist prior to admission, but that alone may not be representative.

Sepsis is a recognised complication of odontogenic infection with a wide range of reported prevalence from 16% to 61.2% in retrospective analyses.[4,5] Appropriate triage and timely management require an understanding of the underlying aetiology with identification of key presenting features and markers for sepsis. The literature lacks prospectively collected data around this crucial parameter.

In this prospective, multicentre study we aimed to investigate the aetiology, type of treatment prior to presentation to OMFS and presenting clinical features of CFI including the prevalence of sepsis. We hope that detailed description of the patient population and their presentation will improve understanding of CFI and encourage appropriate allocation of resources and optimise outcomes. The study was conducted using the trainee collaborative model.

Methods

This snapshot audit was devised and delivered by the Maxillofacial Trainee Research Collaborative (MTReC) CFI project group. MTReC regional leads together with a team of trainee collaborators in regional OMFS units were responsible for gaining local audit approval.

Data were captured prospectively with the use of standardised collection forms for all patients admitted under OMFS for management of a CFI of any aetiology. The study ran from May to September 2017.

Data Collected

Data collected included patient age, sex, smoking status, comorbidities, details regarding any treatment prior to admission, source of infection, presenting symptoms and biological markers of infection (heart rate, blood pressure, c-reactive protein level, white cell count, blood glucose level).

Each participating site was provided with a secure link to a server at NHS Greater Glasgow and Clyde to allow remote data entry directly onto Research Electronic Data Capture Software (REDCap).

Data Analysis

Data was collected onto a spreadsheet (Excel, Microsoft) and Statistical analysis was carried out using SPSS (SPSS version 25, IBM). Significance of non-parametric data was tested using Pearson Chi-squared Test where appropriate.

Results

Forty trainee collaborators collected data from 25 UK OMFS hub units across 17 regions from March to September 2017. The total number of patients recorded was 1002.

The median age at time of presentation was 34 years (range 1 to 94 years), 546 patients (54.5%) were male and 456 (45.5%) were female. The number of current smokers was 327/1002 patients (32.6%), while the number of smokers in those over the age of 18 years was 322/876 (37.8%). Men were significantly more likely to be current smokers (205/546 37.5%) compared to women (122/456, 26.7%) (X^2 (1, N = 1002) = 13.16, p = .000).

Most patients (92%) had an American Association of Anaesthesiologists (ASA) score of 1 or 2. Seventy-one patients (7%) had a previous diagnosis of diabetes mellitus. Of the remaining 931 patients, random blood glucose was recorded in 348. Of these 348 patients, seven (2%) had a blood glucose level ≥ 11.1mmol/l.

Trismus was the most frequently reported symptom, noted in 462/1002 patients (46.1%). Dysphagia was present in 272/1002 (27.3%%), voice changes in 43/1002 (4.3%) and stridor in 5/1002 (0.5%). Impending airway compromise at the time of presentation was noted in 17/1002 patients (1.7%).

Odontogenic infections accounted for 822 (82%) admissions. Infection associated with mandibular teeth accounted for 61.2% of the total number of admissions and 74.7% of odontogenic infections. Other sources of infection are shown in *Table 1*, with the most frequently implicated teeth illustrated in *Figure 1*. There were a small number of cases where the source was unclear and infection arising from both a mandibular and maxillary tooth was

possible, as well as dual underlying pathologies such as a soft tissue infection with potential dental infection.

Around half (453/822, 55.1%) of the patients presenting with an infection of odontogenic origin had received treatment prior to presenting to OMFS. The majority of those (300/822, 36.5%) were managed with antibiotics alone, without any form of source control. A very small minority of 87/822 (10.6%) patients had undergone a surgical removal of a tooth in an attempt to remove the source of infection prior to presentation. Even less patients had undergone other forms of treatment as shown in *Table 2*. Two or more forms of treatment had been received by 100/822 (12.2%).

odontogenic infections separately. Of those, 269/822 patients (32.7%) had received antibiotics from a dental practitioner prior to admission. Less common sources of prescription were the emergency department (91/822; 11.1%) and general medical practitioner (36/822; 4.4%). Patients had received antibiotics from more than one source in 23/822 cases (2.8%).

Overall, 437/1002 patients (43.6%) met criteria for the definition of sepsis at the time of admission. The percentage was even higher for CFIs of odontogenic origin 374/822 (45.5%) whilst only 63/180 (35%) of those with non-odontogenic infection were septic.

The most frequently involved fascial spaces in CFI were the buccal (567/1002, 56.6%) and submandibular spaces (336/1002, 33.6%). Involvement of other spaces is shown in *Table 3*. Buccal (130/195; 56%) and canine space (81/195; 35%) involvement accounted for the majority of CFI associated with maxillary teeth. Fascial space involvement subdivided by mandibular teeth is shown in *Figure 2*.

Involvement of more than one fascial space was observed in 294/822 patients (35.8%) with odontogenic infection. Those with infections arising from mandibular teeth had around twice the prevalence of multispace involvement (41.7% mandibular vs.18.5% maxillary). Bilateral fascial space involvement was seen in 29/822 patients (3.5%) with odontogenic infection.

Discussion

To our knowledge this is the largest worldwide prospective study around CFI. The captured data provide the largest patient population to date and the only prospective study in the literature. It records a high level of detail including aetiology, pre-hospital management, clinical features and management.

This study supports previous observations that CFI occur over a wide age range.[2,5] It is interesting to note that male patients accounted for a higher proportion of admissions than female patients with a ratio of 1.2:1, despite higher levels of caries in female populations.[6] This 20% sex difference requires further investigation of potential underlying factors, aiming to reduce this excess in men.

Current smokers accounted for 37.8% of admissions (age > 18 years), which is more than double the rate of cigarette smokers (17.2%) reported in the 2015 UK Annual Population Survey.[7] Smoking is known to have deleterious effects on the oral environment and on immune function, and a recent systematic review and meta-analysis concluded that there is a correlation between tobacco smoking and an increased risk of dental caries.[8] The high rate of smoking observed in male patients in this cohort may provide part of the explanation for the higher rate of admission for CFI in men.

CFI of odontogenic origin constituted the largest group, accounting for over four times the number of admissions than all other aetiologies combined. Dental caries is a preventable disease and much of this disease could be effectively managed at an early stage by a general dental practitioner. It is therefore of some concern to note that nearly half (44.9%) of patients admitted with CFI of odontogenic origin had received no previous treatment prior to presenting to OMFS, whist over a third (36.5%) had been managed with antibiotics alone. When looking at those patients with infection of odontogenic origin, only 13.1% (108/822) had previously received any attempt at source control (dental extraction or dental treatment). Limited availability is often cited by the media as a barrier to dental care, which contradicts the finding of The UK Adult Dental Health Survey that 92% of adults who attempted to make a dental appointment were successful in doing so.[3] Factors other than access must therefore account for the high proportion who failed who access appropriate care. The survey also found that only 58% of adults had attempted to make a dental appointment in the previous three years. Approximately one in six patients (15.5%) with infection of odontogenic origin sought care from services other than primary dental care. It has been proposed that personal barriers to accessing dental care have their origins within the patient's previous life experiences and their psycho-social background.[9]

The vast majority of patients admitted with CFI are otherwise medically fit and well, or with underlying disease which is well controlled (ASA 1 and 2). Patients with diabetes mellitus are known to have a higher susceptibility to acquire infections.[10] The prevalence of diabetes mellitus reported in this study (7%) is similar to the national English prevalence of 6.7%.[11] However, diabetes mellitus prevalence increases with age, from 9% aged 45 to 54 to 24% aged 75 years and over. It is estimated that approximately 2% of adults aged 16 to 44 have

diabetes, and given the relatively young median age of this cohort, known diabetics are overrepresented in patients admitted with CFI.[12] This finding is in agreement with Zheng et al, who identified 77 patients with diabetes mellitus in a retrospective cohort of 192 patients with CFI, though the number of diabetic patients in our cohort was considerably lower.[13] Public health England estimates that approximately 2% of adults aged 16 to 44 have undiagnosed diabetes mellitus.[12] In our cohort 2% (7/348) of patients who had a random blood glucose recorded had a blood glucose level ≥ 11.1mmol/l, which could signify an underlying diagnosis of diabetes mellitus. However, many patients presenting with CFI (especially odontogenic infection) report extended periods without significant calorie intake. Therefore, a blood glucose 'cut-off' > 11.1 mmol/l may significantly underestimate the number of undiagnosed diabetics in this group. As time from last oral intake was not recorded in our audit, further investigation regarding impaired glucose tolerance and undiagnosed diabetes mellitus in this patient group will clarify whether presentation with CFI can be highlighted as a risk presentation for undiagnosed diabetes.

Trismus was present in almost half of those patients admitted to hospital, while dysphagia was noted in nearly a third. There was a high risk (1 in 50) that patients with CFI may present with features of advanced airway compromise. Both trismus and dysphagia are features which signify the risk of a compromised and difficult to manage airway. It is clear that CFI patients with these features require early assessment by both OMFS and an experienced difficult airway anaesthetist in order to determine the need for advanced airway management.

Sepsis is a significant threat to life and a significant burden on healthcare systems. Sepsis was prevalent in all patients at presentation; being seen in 45.5% of those with odontogenic infection and 35.0% of those with non-odontogenic infection. This finding lies between the

previously quoted range of 16% to 61.2% in retrospective studies and the large sample size and prospective nature of this study further corroborate that a large proportion of patients with cervicofacial (and specifically odontogenic) infection are at risk of developing sepsis.[4,5] Patients with sepsis have added morbidity and typically have longer hospital admissions requiring more critical care[14]. Mortality as a result of cervicofacial sepsis is rare but preventing this clearly has resource and cost implications.[15,16] The National Institute for Health and Care Excellence states that 'to reduce avoidable deaths, people with sepsis need to be recognised early and treatment initiated. This guidance states that "healthcare staff … involved in assessing people's clinical condition are given regular, appropriate training in identifying people who might have sepsis."[17] Our findings suggest that patients with CFI fall into a high-risk category and should be managed with a high index of suspicion. It is clear that recognition of sepsis parameters in primary care can be a means by which patients are efficiently fast-tracked to the hospital OMFS team as highlighted some years ago.[5]

Involvement of more than one neck fascial space was common in this cohort. Multispace involvement was most common (41.7%) when the infection was originating from a mandibular tooth. Multispace involvement may be considered a surrogate marker for advanced disease, suggesting that many of these patients present late. It is also clear that when infection arises from a mandibular tooth, the operating surgeon must have a higher index of suspicion for involvement of more fascial spaces and adopt a more aggressive approach to surgical management than when infection has arisen from other sites and sources.

Conclusion

This is the largest and only prospective epidemiological study on patients presenting with CFI. The study shows that CFI can affect all age groups, that over half of patients have

sought treatment from multiple sources yet very few received any type of source control. We have shown that patients with CFI have a high prevalence of sepsis and that multispace involvement and airway problems were common. Approximately half of patients had trismus, which has important implications for airway management. Findings from this study should inform future strategies to optimise management of patients presenting with CFI.

Conflict of Interest

We have no conflicts of interest.

Ethics statement/confirmation of patient permission

No ethics approval necessary. Local audit approval sough via Caldicott Guardian where appropriate.

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315 **Table 1:** Aetiology of CFI in the cohort of hospitalised patients

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	All patients (n=1002) (n, % cervicofacial infection)
Odontogenic	822 (82.2)
Mandibular	614 (61.2)
Maxillary	195 (19.5)
Mandibular and Maxillary	13 (1.3)
Soft tissue	133 (13.4)
Salivary gland	50 (5.0)

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Table 2: Treatment prior to admission for patients presenting with CFI of odontogenic origin

	Odontogenic infections (n=822) (n, % of odontogenic infections)
Antibiotics alone	300 (36.5)
Surgical removal of tooth	87 (10.6)
Incision and drainage	30 (3.6)
Dental Treatment (endodontic treatment, restoration)	21 (2.6)
Antibiotics in combination with other treatment	94 (11.4)
Extraction AND antibiotics	54 (6.6)
Incision and drainage AND antibiotics	24 (2.9)
Dental treatment AND antibiotics	16 (1.9)
Incision and drainage AND dental treatment	7 (0.9)
Incision and drainage AND extraction	4 (0.5)

321 **Table 3:** Fascial spaces involved in CFI
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Fascial Space	Cervicofacial infection (n 1002, %)	Non-odontogenic infection (n=180, %)	Odontogenic infection (n 822, %)
Buccal	567 (56.6)	39 (26.7)	528 (64.3)
Canine	94 (9.4)	8 (4.4)	86 (10.5)
Parapharyngeal	37 (3.7)	6 (3.3)	31 (3.8)
Sublingual	72 (7.2)	6 (3.3)	66 (8.0)
Submasseteric	128 (12.8)	8 (4.4)	120 (14.6)
Submandibular	336 (33.5)	42 (23.3)	294 (35.8)
Submental	68 (6.8)	13 (7.2)	55 (6.7)
Other / undefined	128 (12.8)	89 (49.4)	29 (3.5)
> 1 Fascial space	325 (32.5)	31 (17.2)	294 (35.8)

Bilateral Involvement	39 (3.9)	10 (5.6)	29 (3.5)

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Figure Legends

Figure 1: Most common teeth involved in CFI of dental origin

Figure 2: Fascial spaces associated with infections originating from mandibular teeth

Figure 1; Dental Origin of Infection COLOUR

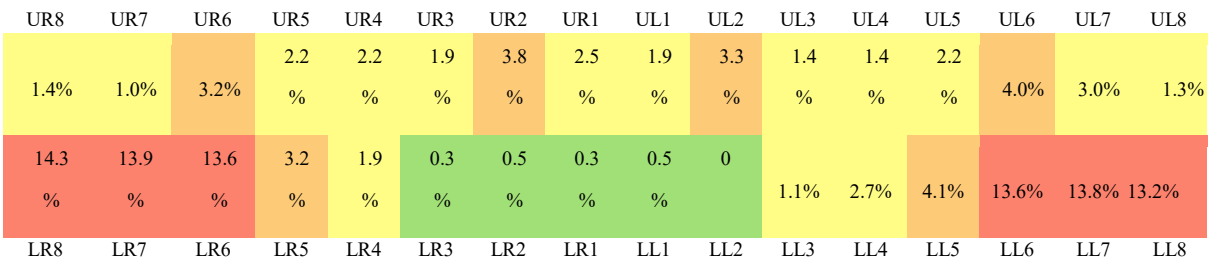
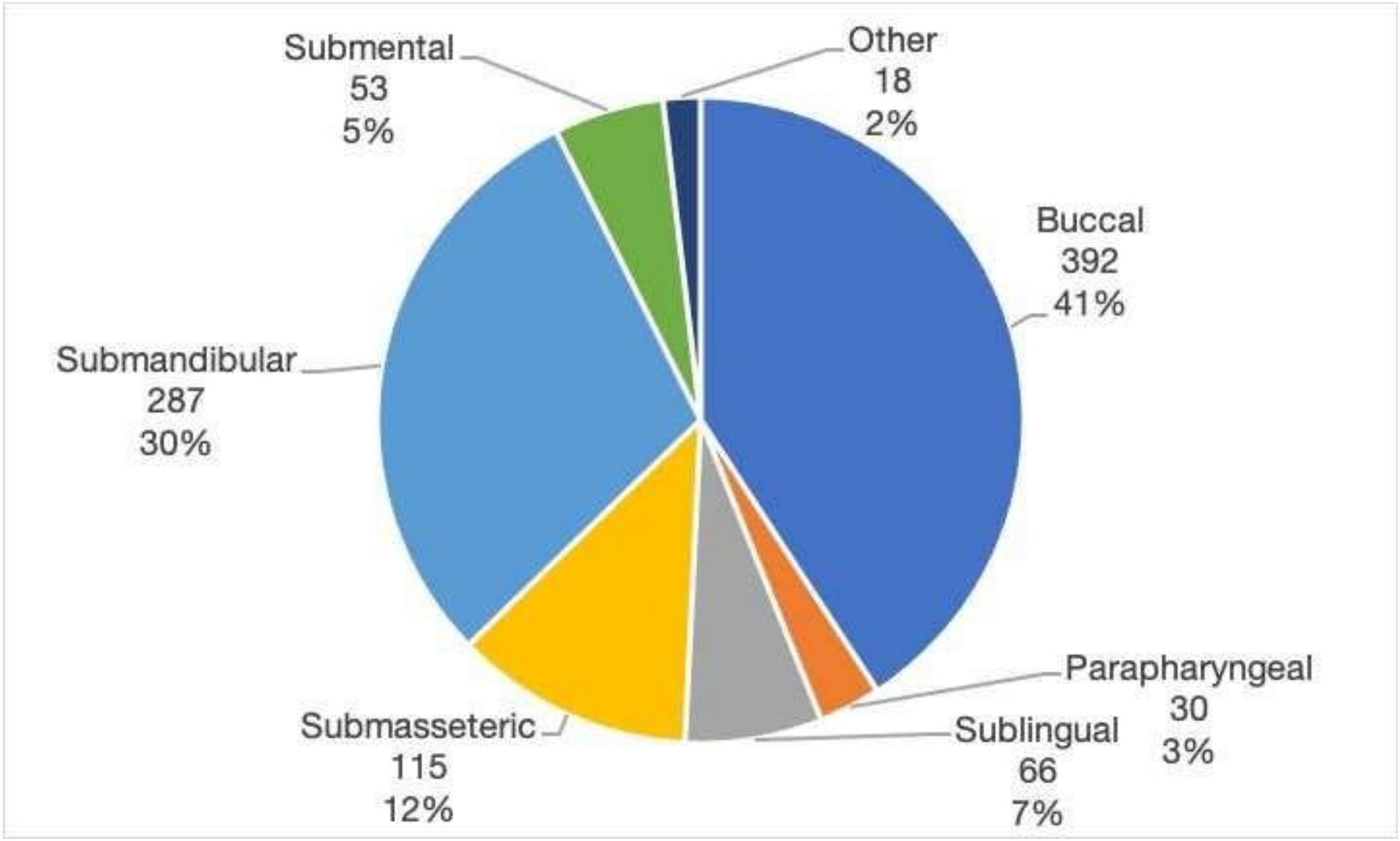


Figure 2; Fascial spaces associated with infections originating from mandibular teeth

Click here to access/download;Figure(s);Figure 2.jpg

COLOUR


Submental
53
5%
Other
18
2%
Buccal
392
41%
Submandibular
287
30%
Parapharyngeal
30
3%
Sublingual
66
7%
Submasseteric
115
12%