Journal of Dental Sciences (2013) 8, 129–132

Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.e-jds.com

ELSEVIER

Journal of Dental Sciences

ORIGINAL ARTICLE

Odontogenic cellulitis in children requiring hospitalization

Jun Kuo [a], **Yai-Tin Lin** [b], **Yng-Tzer Joseph Lin** [b]*

[a] *Department of Dentistry, Kaohsiung Chang Gung Memorial Hospital and Chang Gung University College of Medicine, Kaohsiung, Taiwan*
[b] *Pediatric Dentistry, Kaohsiung Chang Gung Memorial Hospital and Chang Gung University College of Medicine, Kaohsiung, Taiwan*

Received 22 February 2012; Final revision received 26 April 2012
Available online 20 June 2012

KEYWORDS
facial cellulitis;
infection;
odontogenic

Abstract *Background/purpose:* Facial cellulites are frequently seen in children's hospitals, and it can lead to complicated systemic illnesses. The purpose of this retrospective study was to investigate clinical characteristics of odontogenic facial cellulitis in children requiring hospitalization.
Materials and methods: One hundred and fifty hospitalized children (75 boys and 75 girls), with an average age of 5.17 ± 2.09 years, who were treated for odontogenic facial cellulitis at Kaohsiung Chang Gung Children Hospital, Taiwan, were selected for this study. An infectious primary lesion was identified when the infection originated from a fresh lesion of an infected tooth, compared to a secondary lesion. Study variables included age, gender, location of the cellulitis, source of the infection, length of hospitalization, and symptoms and signs of infection during the hospitalization.
Results: The mean hospitalization length was 5.15 ± 1.52 days. A greater association of upper-face infections with upper anterior teeth was found than lower anterior teeth with lower-face infections. Fever during hospitalization and the source of the infection in the anterior teeth were found to have occurred significantly more frequently with a primary than with secondary infectious lesion ($P < 0.05$).
Conclusion: Differences in upper- and lower-face infections were not clinically significant except for the source of the infection. In terms of the effects of the infectious lesion,

* Corresponding author. Pediatric Dentistry, Kaohsiung Chang Gung Memorial Hospital, 123 Ta Pei Road, Niao-Sung, Kaohsiung 833, Taiwan.
E-mail address: Joe0430@ms13.hinet.net (Y.-T.J. Lin).

doi:10.1016/j.jds.2012.05.011

significant differences were found between primary and secondary lesions in terms of having a fever during hospitalization and an anterior source for the infection.

Introduction

Early diagnosis and treatment of pediatric facial cellulitis are challenging because of its variable clinical presentations, including multiple potential sources of infection and multiple organisms within the head and neck area.[1,2] Facial cellulitis is classified as nonodontogenic and odontogenic, depending on the source of the infection, and as upper or lower face, depending on the anatomical location.[3] Odontogenic facial cellulitis refers to infections arising from the dentition and its adjacent supporting periodontal structure. Biederman and Donson[1] found that odontogenic cellulitis accounted for approximately 50% of total facial infections in a hospitalized population over a 10-year period. Our previous retrospective study investigated all pediatric patients with odontogenic facial cellulitis in 2003, and found that hospitalization was needed for 53.6% of patients and, in 57.1% of cases, the upper face was affected.[4] Approximately half of patients requiring hospitalization prompted us to conduct this survey in order to discern any significant clinical characteristics that might help establish criteria for hospitalization.

Children with odontogenic facial cellulitis are commonly seen by many medical specialists in hospitals prior to being referred to a dental specialist. This may be partly due to difficulty in ascertaining the source of the infection, as mentioned above, and partly due to a lack of access to dental services. Thikkurissy et al[5] investigated the management of odontogenic facial cellulitis in hospitalized pediatric patients compared to nationally reflective data, and concluded that rapid treatment had a significant impact on the length of stay and the total cost of treatment. An early, accurate diagnosis of the source of infection is important in preventing the development of complications and reducing the length of hospitalization. To better understand and manage odontogenic facial cellulitis, especially in hospitalized pediatric patients, we conducted a retrospective study to investigate its clinical characteristics and to determine clinical differences between upper- and lower-face infections and between those resulting from primary and secondary infectious lesions.

Materials and methods

One hundred and fifty hospitalized children (75 boys and 75 girls) being treated for facial cellulitis at Kaohsiung Chang Gung Children Hospital, Taiwan, were selected for this study. All participants complied with the following inclusion criteria: all were aged $<$17 years, the period of hospitalization determined from a computerized data was between January 1, 2006 and December 31, 2009, and all cases were diagnosed with a facial infection of odontogenic origin.

The ages of the selected 150 cases ranged from 1 year 10 months to 12 years 4 months, with a mean age $\pm$ standard deviation (SD) of 5.17 ± 2.09 years. Study variables included age, gender, location of the cellulitis, source of the infection, and length of hospitalization. Symptoms and signs of infection during hospitalization included subjective toothache and fever ($\geq$37.5°C) on the first day of hospitalization, and white blood cell (WBC) count and C-reactive protein (CRP) values prior to the initiation of treatment.

Infections were classified as upper or lower face according to their anatomical location, as modified from Dodson's definition.[3] Upper-face infections involved swelling located above the lip line, including the maxillary dentition and periorbital, maxillary, frontal, nasal, and upper-buccal regions. Lower-face infections were defined as those below the lip line, and included the mandibular dentition and the mandible, floor of the mouth, and cervical regions.

The source of infection was classified as a deciduous second molar (E), deciduous first molar (D), or deciduous canine and incisor (ABC). An infectious primary lesion was identified when the infection originated from a fresh lesion of an infected tooth, due to either dental decay or trauma. In contrast, a secondary infectious lesion was attributed to treatments such as restorations or pulp therapies on the infected tooth prior to the occurrence of swelling. Data on the location of cellulitis and the source of infection by gender were also collected and compared.

A chi-square test was used to assess differences between upper- and lower-face infections and between infectious primary and secondary lesions for the various study variables. A *t* test was used to compare continuous data such as age and length of hospitalization. A P value of $<$0.05 was considered statistically significant.

Results

Upper- and lower-face infections were, respectively, reported in 56% and 44% of study participants. Infections originating from the deciduous posterior teeth (D and E) (81.3%) were more common than those originating from deciduous anterior teeth (ABC) (18.7%). No origin of infection from a permanent tooth was found. Sources of upper-face infections were more in the deciduous posterior teeth (67.9%) than in the deciduous anterior teeth (32.1%). Moreover, the source of lower-face infections was almost all in deciduous posterior teeth (98.5%) compared to deciduous anterior teeth (1.5%). Regarding the source of infection from primary or secondary lesions, the ratio of primary to secondary lesions in the deciduous posterior

Table 1 Comparisons of upper- and lower-face infections for each study variable.

Study variables	Upper face ($n = 84$)	Lower face ($n = 66$)	P
Age	4.89 ± 1.84[a]	5.53 ± 2.32	0.070
Gender			0.622
Male	44	31	
Female	40	35	
Toothache during hospitalization			0.082
Yes	15	19	
No	69	47	
Fever ($\geq$37.5°C)			0.384
Yes	30	26	
No	54	40	
Length of hospitalization	5.10 ± 1.12	5.21 ± 1.93	0.662
Source of infection			0.000*
E	22	35	
D	35	30	
ABC	27	1	
WBC (10^3/mm^3)	12.53 ± 3.74	12.21 ± 3.79	0.607
CRP (mg/L)	26.13 ± 30.18	29.22 ± 32.82	0.549

*Significant difference ($P < 0.05$).
ABC = deciduous canine and incisor; CRP = C-creative protein; D = deciduous first molar; E = deciduous second molar; WBC = white blood cell.
[a] Mean ± SD.

teeth was approximately 1.5:1, compared to that in the deciduous anterior teeth of 6:1.

The mean ± SD length of hospitalization was 5.15 ± 1.52 days. A subjective toothache and fever on the first day of hospitalization were, respectively, found in 22.7% and 37.3% of cases. The mean ± SD WBC count and CRP value prior to the initiation of treatment were $12.39 \pm 3.75 \times 10^3/\text{mm}^3$ and 27.49 ± 31.3 mg/L, respectively.

Comparisons between upper- and lower-face infections for each study variable are presented in Table 1. No statistically significant differences were found for age; gender; symptoms and signs of infection such as a toothache, fever, WBC count, and CRP value; or length of hospitalization. A statistically significant difference was found in the source of infection between upper- and lower-face infections ($P < 0.01$). A greater association was found between upper-face infections and upper anterior teeth than between lower-face infections and lower anterior teeth.

Table 2 shows comparisons between infections originating from primary and secondary lesions for each study variable. No statistically significant differences were found for age; gender; symptoms and signs of infection including a toothache, WBC count, and CRP value during hospitalization; or length of hospitalization. However, a fever during hospitalization was found to have occurred significantly more frequently with a primary than with a secondary infectious lesion ($P < 0.05$). A significant difference was found in the source of the infection between primary and secondary lesions, especially in the anterior teeth ($P < 0.05$).

Discussion

Facial cellulitis in young children is frequently seen in hospital emergency departments. Possible complications of facial cellulitis include dehydration, central nervous system impairment, airway obstruction, and even systemic sepsis if treatment is delayed. Because the condition has varied clinical presentations and sources of infection, pediatricians prefer to consult with dentists during hospitalization to determine whether the infection is odontogenic or not, which requires dentists to be familiar with the process of facial infection, especially sources of infection. With a correct diagnosis and treatment, rapid resolution of facial cellulitis is expected, with minimization of patient's treatment costs.[5]

Clinical symptoms of odontogenic facial cellulitis in this study of hospitalized pediatric patients included toothache (22.7%) and fever (37.3%). Compared to our previous investigations with a toothache prior to swelling (76.8%) and fever (14.3%) in all pediatric patients with odontogenic infection,[4] it seemed that fever and swelling of the face were the main considerations for inpatient care in this hospital. All the participants exhibited elevated WBC counts and CRP values, indicating inflammation and infection. Fever was not common in these patients despite the

Table 2 Comparisons of infectious primary and secondary lesions for each study variable.

Study variables	Primary ($n = 97$)	Secondary ($n = 53$)	P
Age	5.10 ± 2.27[a]	5.30 ± 1.68	0.544
Gender			0.733
Male	47	28	
Female	49	25	
Toothache during hospitalization			0.541
Yes	24	10	
No	73	43	
Fever ($\geq$37.5°C)			0.017*
Yes	43	13	
No	54	40	
Length of hospitalization	5.15 ± 1.48	5.13 ± 1.62	0.933
Source of infection			0.011*
E	30	27	
D	43	22	
ABC	24	4	
WBC (10^3/mm^3)	12.44 ± 3.74	12.29 ± 3.81	0.810
CRP (mg/L)	28.16 ± 29.36	26.25 ± 34.84	0.723

*Significant difference ($P < 0.05$).
ABC = deciduous canine and incisor; CRP = C-creative protein; D = deciduous first molar; E = deciduous second molar; WBC = white blood cell.
[a] Mean ± SD.

presence of infection. Unkel et al[6] further found that compared to odontogenic cellulitis, nonodontogenic cellulitis was associated with a younger age, a higher WBC count ($>$15,000/mm^3), and temperature elevation at hospital admission.

The majority of odontogenic facial infections in this study were located in the upper face (56%), and the source of infection was more often the deciduous posterior teeth (81.3%) than the deciduous anterior teeth. This finding is consistent with previous studies, which indicated that upper-face infections outnumbered lower-face infections.[1,3–6] Compared to other study variables and clinical symptoms for upper- versus lower-face infections, we found that only the source of infection showed a significantly greater association of upper-face infections with upper anterior teeth than of lower-face infections with lower anterior teeth (Table 1). This is consistent with the finding of a higher prevalence of caries in maxillary anterior teeth and may be attributable to nursing-bottle-related tooth decay during childhood.[4,7,8] Other suspected factors contributing to this discrepancy may be differences in root lengths, surrounding bone density, and types of salivary glands in the anterior region.

Comparison of upper- and lower-face infections revealed no significant differences in age, symptoms of infection, or length of hospitalization. These results, similar to those of our 2003 investigation, present a different picture from previous reports, indicating that upper-face infections are associated with more acute symptoms, a younger age, and an unknown etiology, while lower-face infections are associated with an older age, odontogenic etiologies, and less variable organisms.[1,9,10] These differences are probably due to the inclusion of nonodontogenic samples in most previous studies.[1,3,6,11]

The mean length of hospitalization in our study was 5.15 days, which is higher than that reported in the previous studies for pediatric patients with odontogenic-based cellulitis, which ranged from 2.1 to 5 days.[5] Most of the reported data were from the USA, in which changes in healthcare policy may have shifted management to outpatient care, resulting in decreased lengths of hospital stay.[5,12] However, pediatric cellulitis is still associated with a shorter hospitalization than adult cellulitis, possibly because of children's better healing potential.[3,4,6,12] Our previous investigation showed that only 25% of cases required surgical intervention.[4] This indicates that dental and surgical interventions can be delayed through the proper use of antibiotics, because young children have a better response to antibiotics. Thikkurissy et al[5] suggested that aggressive and definitive treatment administered at the time of hospital admission had a significant impact on the length of hospitalization, especially in pediatric populations.[5]

In order to determine whether primary (fresh) or secondary lesions induce frequent, severe facial infections, we conducted this retrospective study to see which type plays a more important role. To our knowledge, no study has described the effects of the origin of facial infections from primary and secondary lesions. In this study, we found that a fever during hospitalization was significantly associated with the infection origin from a primary lesion, meaning that a patient with a fresh lesion and no treatment had a greater chance of developing a fever. It was postulated that fresh lesions without interference of bacterial progression as are secondary lesions might be a factor causing swelling and ongoing fever. As to the source of the infection, the ratio of primary to secondary lesions in deciduous posterior teeth was less than that in deciduous anterior teeth, which suggests that primary lesions are more commonly noted in the deciduous anterior teeth. A significant difference was also found in the source of infection between primary and secondary lesions, with primary lesions being more likely to result in facial cellulitis than secondary lesions, especially in the deciduous anterior teeth.

In terms of the clinical characteristics of odontogenic facial cellulitis in hospitalized pediatric patients, no statistically significant differences were found between upper- and lower-face infections except in the source of infection. In terms of the effects of the origin of tooth infection, significant differences were found between primary and secondary lesions in terms of a fever during hospitalization and the source of infection. Primary (fresh) nursing-bottle-related tooth decay affecting the upper anterior teeth may explain the higher incidence of facial cellulitis in the upper anterior region. With a correct diagnosis, dental interventions, and antibiotic treatment, rapid resolution of the infection can be expected.

References

1. Biederman GR, Dodson TB. Epidemiologic review of facial infections in hospitalized pediatric patients. *J Oral Maxillofac Surg* 1994;52:1042–5.
2. Dodson TB, Perrott DS, Kaban LB. Predictors of outcome in children hospitalized with maxillofacial infections: a linear logistic model. *J Oral Maxillofac Surg* 1991;49:838–42.
3. Dodson TB, Perrott DS, Kaban LB. Pediatric maxillofacial infections: a retrospective study of 113 patients. *J Oral Maxillofac Surg* 1989;47:327–30.
4. Lin YT, Lu PW. Retrospective study of pediatric facial cellulitis of odontogenic origin. *Pediatr Infect Dis J* 2006;25:339–42.
5. Thikkurissy S, Rawlins JT, Kumar A, Evans E, Casamassimo PS. Rapid treatment reduces hospitalization for pediatric patients with odontogenic-based cellulitis. *Am J Emerg Med* 2010;28:668–72.
6. Unkel JH, McKibben DH, Fenton SJ, Nazif MM, Moursi A, Schuit K. Comparison of odontogenic and nonodontogenic facial cellulitis in a pediatric hospital population. *Pediatr Dent* 1997;19:476–9.
7. Saravanan S, Madivanan I, Subashini B, Felix JW. Prevalence pattern of dental caries in the primary dentition among school children. *Indian J Dent Res* 2005;16:140–6.
8. Afroughi S, Faghihzadeh S, Khaledi MJ, Motlagh MG. Dental caries analysis in 3-5 years old children: a spatial modeling. *Arch Oral Biol* 2010;55:374–8.
9. Strachan DD, Williams FA, Bacon WJ. Diagnosis and treatment of pediatric maxillofacial infections. *Gen Dent* 1998;46:180–2.
10. Grossman M. Management of the febrile patient. *Pediatr Infect Dis* 1986;5:730–4.
11. Chartrand SA, Harrison CJ. Buccal cellulitis reevaluated. *Am J Dis Child* 1986;140:891–3.
12. Storoe W, Haug RH, Lillich TT. The changing face of odontogenic infections. *J Oral Maxillofac Surg* 2001;59:739–48.