Deep Neck Infection Causing Abscess Formation due to Oral Infectious Disease

Shigeo Tanaka, Maya Oshima, Chikashi Ishizawa, and Masamichi Komiya

Department of Oral Surgery, Nihon University School of Dentistry at Matsudo, Matsudo, Chiba 271–8587, Japan

Introduction

A large number of muscle groups are located in the head and neck region. The fascia of these muscle groups forms many fascial spaces (referred to as “spaces” hereafter) that contain large amounts of adipose tissue and loose connective tissue. Once an infection extends into such a space, the lesion often spreads rapidly and widely (1–4). These lesions are referred to as deep neck infections and may contain abscesses and cellulitis (5). Although deep neck infections have become somewhat rare disease because of advances in medications, such as antibiotics, caution is still required because serious cases may exhibit potentially fatal complications including mediastinitis, cervical necrotizing fasciitis, sepsis, or disseminated intravascular coagulation (6, 7). Major causative diseases are odontogenic infection and tonsillar and peritonsillar infection. In recent years, odontogenic infection has been reported to be the most common cause of this condition (1, 2, 6, 8–17).

Many reports have been published on deep neck infections because they are one of the deadliest diseases (1, 2, 4–17). Important items to be considered in these study results are severity-related indices. However, results of these studies differ depending on the study center facili-

Original Article

Deep Neck Infections Cause Cellulitis or Abscesses to Form in the Deep Neck Space. Despite advances in antibiotics, some advanced cases develop mediastinal abscess, sepsis, or disseminated intravascular coagulation, which can be fatal.

In this retrospective cohort study, we included 34 patients to examine the factors involved in deep neck abscess severity. We evaluated and compared parameters like sex, age, causative disease, causative site, etc. Patient age was 8–78 years, with a higher proportion of males (24 cases; 70.6%) than females (10 cases; 29.4%). The causative tooth of the 31 cases of odontogenic infection (excluding three cases of osteomyelitis of jaw and peri-implantitis) was a mandibular molar in 30 cases (96.8%) and maxillary molar in one case (3.2%).

Overall, the mean (± standard deviation) hospital stay was 22.7±20.3 days and was longer for females (31.0±20.3 days) than for males (19.2±19.6 days). C-reactive protein (CRP) levels were significantly correlated with hospital stay duration. Multivariate analysis revealed that patients with an abscess in the masticator, parapharyngeal, or anterior visceral space had significantly longer hospital stays. Patients with actinomycetes had significantly longer hospital stays. No significant differences in hospital stay were noted based on whether the patient was a compromised host.

This study suggests that CRP levels, abscess location, and existence of actinomycete infection contribute to the severity of deep neck abscess.

Keywords:
oral infectious disease, odontogenic infection, deep neck abscess, deep neck infection
ties. In addition, deep neck infections have not been studied at Nihon University Hospital at Matsudo despite their life-threatening nature. Therefore, presently, we conducted this study to search for predispositions in the form of severity indices of abscess formation in cases of deep neck infection in Nihon University Hospital at Matsudo.

Materials and Methods

Subjects included 34 patients with deep neck infection caused by oral infectious disease who required inpatient treatment and underwent incisional drainage between November 2006 and April 2020 at Nihon University Hospital at Matsudo. Moreover, all 34 patients were treated by the author (Tanaka S) as the attending physician. This study was approved by the Institutional Review Board of Nihon University School of Dentistry at Matsudo (approval no. EC 17–037).

We extracted information from patient records and comparatively investigated patient sex, age, causative disease, causative site, white blood cell (WBC) count, C-reactive protein (CRP) level, abscess site, detected bacteria, whether the patient was a compromised host, and the length of hospital stay.

In addition, we determined the causative disease and causative site of odontogenic infection using panoramic X-ray and computed tomography images. Moreover, we sampled the detected bacteria using fine-needle aspiration from the closed cavity or by collecting the pus discharged during incision drainage using a sterile swab. The maximal preoperative (open drainage) values of WBC and CRP are shown in Table 1 and Figures 2 and 3.

Analysis

Microsoft Excel 2010 was used for database management. SPSS 23.0 for Windows (IBM Japan, Ltd., Tokyo, Japan) was used to calculate statistical values.

Statistical methods

Spearman’s rank correlation coefficients were calculated to analyze the correlation between the following: length of hospital stay and age, length of hospital stay and WBC count, and length of hospital stay and CRP levels.

Generalized linear regression analysis was used to examine the impact of abscess site and detected bacteria on the length of hospital stay considering length of stay as the dependent variable and the link function as the logarithm.

A multivariate model was constructed with each abscess site and each detected bacterium as an independent variable.

Mann–Whitney U test was used to correlate the association between susceptible underlying disease (presence of diabetes) and length of hospital stay.

Summary statistics

Summary statistics in this study are presented as frequency (n), percentage (%), mean, standard deviation (SD), median, range, and interquartile range.

Significance level

For all statistical tests, a two-tailed level of significance of 0.05 was used.

Results

Patient characteristics

The patients included 24 males (70.6%) and 10 females (29.4%); there were more than twice as many males as females, with a male-to-female ratio was 2.4:1 (Table 1). Patient age ranged from 8–78 years. The mean patient age was 49.6 years (median 53.5 years; Table 1).

Causative disease

The causative disease was periapical periodontitis in 24 cases (70.6%), infection after tooth extraction in four cases (11.8%), osteomyelitis of jaw in two cases (5.9%), pericoronitis of wisdom tooth in two cases (5.9%), and peri-implantitis in one case, indicating that periapical periodontitis was the most common causative disease (Table 1).

Causative site of odontogenic infection

We determined the causative site of odontogenic infection using panoramic X-ray and computed tomography images.

There were 31 cases caused by odontogenic infection (excluding two cases of jaw osteomyelitis and one case of peri-implantitis). Of the 31 cases of odontogenic infection, the causative site was a mandibular molar in 30 cases (96.8%) and a maxillary molar in one case (3.2%). Thus, the most common site of odontogenic infection was mandibular molar (Table 1).
| Characteristics                                      | Value          |
|-----------------------------------------------------|----------------|
| **Age in years (N = 34)**                           |                |
| mean (SD)                                           | 49.6 (18.6)    |
| Median (IQR)                                        | 53.5 (33.5–69) |
| Range                                               | 8 - 78         |
| **Sex (N = 34)**                                    |                |
| Male n (%)                                          | 24 (70.6)      |
| Female n (%)                                        | 10 (29.4)      |
| **Disease (N = 34)**                                |                |
| Periapical periodontitis n (%)                       | 24 (71.0)      |
| Marginal periodontitis n (%)                         | 1 (2.9)        |
| Osteomyelitis of jaw n (%)                           | 2 (5.9)        |
| Infection after tooth extraction n (%)              | 4 (11.8)       |
| Pericoronitis of wisdom tooth n (%)                 | 2 (5.9)        |
| Peri-implantitis n (%)                              | 1 (2.9)        |
| **Causative site of odontogenic infection (N = 31)** |                |
| Mandibular molar n (%)                              | 30 (96.8)      |
| Maxillary molar n (%)                               | 1 (3.2)        |
| **WBC count (×1000 cells/μL) (N = 34)**             |                |
| Mean (SD)                                           | 12.2 (4.4)     |
| Median (IQR)                                        | 10.9 (9.0–13.8)|
| Range                                               | 6.3–24.6       |
| **CRP level (mg/dL) (N = 34)**                      |                |
| Mean (SD)                                           | 12.4 (8.9)     |
| Median (IQR)                                        | 9.6 (4.0–19.7) |
| Range                                               | 1.5–31.3       |
Abscess site (N = 34)
Sublingual space n (%) 24 (70.6)
Submandibular space n (%) 34 (100)
Submental space n (%) 3 (8.8)
Masticator space n (%) 15 (44.1)
Parapharyngeal space n (%) 4 (11.8)
Anterior visceral space n (%) 4 (11.8)

Bacteria detection
No n (%) 6 (17.6)
Yes n (%) 28 (82.4)

Chronic disease (N = 34)
No n (%) 19 (55.9)
Yes n (%) 15 (44.1)

Chronic disease type
Diabetes mellitus n (%) 5 (14.7)
Hypertension n (%) 12 (35.3)
Hyperlipidemia n (%) 3 (8.8)
Angina pectoris n (%) 2 (5.9)
Cerebral infarction n (%) 1 (2.9)
Myocardial infarction n (%) 1 (2.9)
Arrhythmia n (%) 1 (2.9)
Breast cancer n (%) 1 (2.9)
Hypothyroidism n (%) 1 (2.9)
Osteoporosis n (%) 1 (2.9)
Asthma n (%) 1 (2.9)

Hospital stay (N = 34)
Mean (SD) 22.7 (20.3)
Median (IQR) 15.0 (10.8–27.3)
Range 5.0–92.0

N: Total sample size, n: applicable sample size
Laboratory values

The maximal preoperative (open drainage) values of WBC and CRP are shown in Table 1 and Figures 2 and 3. The patients' WBC counts (reference value: 3500–9000/µL) were as follows: minimum 4400/µL, maximum 24,600/µL, mean 12,200/µL, and median 10,900/µL (Table 1). CRP levels (reference value: <0.30 mg/dL) were minimum 8.9 mg/dL, maximum 31.3 mg/dL, mean: 12.4 mg/dL, and median 9.6 mg/dL (Table 1).

Abscess site

The site of the abscess (recording of multiple sites was permitted) included the submandibular space in 34 cases (100%), sublingual space in 24 cases (70.6%), masticator space in 15 cases (44.1%), parapharyngeal space in four cases (11.8%), anterior visceral space in four cases (11.8%), and submental space in three cases (8.8%). Thus, in all cases, an abscess was confirmed in the submandibular space (Table 1).

Isolated bacteria

Bacteria identification (recording of multiple answers was allowed) was successful in 28 cases (82.4%). Facultative anaerobic bacteria were confirmed in 22 cases (64.7%), obligate anaerobic bacterium in 17 cases (50.0%), actinomycete in four cases (11.8%), and an aerobic strain of bacteria in one case (2.9%; Table 1). The isolated bacteria types were as follows: 17 strains of genus Streptococcus (50.0%), 11 strains of genus Prevotella (32.4%), and nine strains of genus Parvimonas (26.5%; Table 2).
Compromised disease

Chronic illnesses were confirmed in 29 cases. However, the only type of compromised disease was diabetes mellitus, which was present in five cases (14.7%; Table 1).

Length of hospital stay

The mean (±SD) length of hospital stay of all cases was 22.7 ± 20.3 days (Table 1). Women tended to have a longer hospital stay (31.0 ± 20.3 days) than men (19.2 ± 19.6 days; Table 3), but there was no correlation detected between age and hospital stay (ρ = 0.217, P = 0.218; Table 4; Fig. 1). No correlation was noted between hospital stay and WBC (ρ = −0.029, P = 0.604; Table 4; Fig. 2). However, hospital stays were longer in patients with higher CRP levels (ρ = 0.354, P = 0.040; Table 4; Fig. 3).

Patients with an abscess in the masticator space were found to have a 1.82-fold (e^{0.599}) longer hospital length of stay than cases without an abscess at this site (P = 0.551; Table 2). Isolated pathogens from 28 patients with deep neck abscess

| Pathogens                                | n (%) |
|------------------------------------------|-------|
| Facultative anaerobic bacteria           |       |
| Genus *Streptococcus*                    | 17 (%)|
| Genus *Staphylococcus*                   | 7 (%) |
| Genus *Enterococcus*                     | 3 (%) |
| Genus *Enterobacter*                     | 1 (%) |
| Genus *Corynebacterium*                  | 1 (%) |
| Actinomycetes                            |       |
| Genus *Actinomyces*                      | 4 (%) |
| Obligate anaerobic bacteria              |       |
| Genus *Prevotella*                       | 11 (%)|
| Genus *Parvimonas*                       | 9 (%) |
| Genus *Fusobacterium*                    | 3 (%) |
| Genus *Peptostreptococcus*               | 1 (%) |
| Genus *Clostridium*                      | 1 (%) |
| Genus *Bacteroides*                      | 1 (%) |
| Genus *Veillonella*                      | 1 (%) |
| Non–spore-forming gram-positive bacilli |       |
| Aerobic bacteria                         | n (%) |
| Genus *neisseria*                        | 1 (%) |
Table 3. Sex and hospital stay

|                  | n  | Females |        | n  | Males |        | P value |
|------------------|----|---------|--------|----|-------|--------|---------|
| Hospital stay    |    |         |        |    |       |        |         |
| Mean ± SD        | 10 | 31.0 ± 20.3 | 24 | 19.2 ± 19.6 | 0.015 |
| Median [IQR]     | 10 | 24.0 [14.8, 45.8] | 24 | 13.5 [9.0, 18.8] |        |

Data display: mean ± SD; median [IQR].

P value: Mann–Whitney U test.

Table 4. Correlation of hospital stay with age, WBC, and CRP

|                  | \( \rho \) | P value | n |
|------------------|------------|---------|---|
| Age              | 0.217      | 0.218   | 34 |
| WBC count (cells/\( \mu \)L) | -0.092     | 0.604   | 34 |
| CRP level (mg/dL) | 0.354      | 0.040   | 34 |

\( \rho \): Spearman’s rank correlation coefficient; n: sample size.

Discussion

Oral infectious diseases are frequently encountered in routine clinical care during oral and maxillofacial treatment. Most cases are odontogenic infections and, if the inflammation is localized in the gingiva (alveolar ridge) and an appropriate surgical procedure such as incision and drainage is performed and/or antibacterial chemotherapy administered, the condition will usually improve within a few days. However, some cases become serious and develop into deep neck infection. In deep neck infection, cellulitis or abscesses form in spaces in the neck, and the condition can be fatal in advanced cases.

In this study, deep neck infection was found to be more common in men. This finding was consistent with the results of previous studies (6–14). However, it is not known why deep neck infection is more common in male patients, and no previous studies have been able to clarify this point (13–18).

Reports have indicated that the age of onset of deep neck infection varies (2, 13, 14, 16–18). However, it has...
also been reported to be common in elderly patients due to systemic diseases and decreased defense mechanisms (19). Our results indicated that the mean age of onset was 49.6 years, and the median age of onset was 53.5 years. However, no statistically significant differences in age were noted in terms of the number of cases.

The cause of deep neck infection is mainly odontogenic infection or tonsillar and peritonsillar infection. However, in recent years, many studies have reported that odontogenic infection is the most common cause (1, 2, 6, 8, 9, 15, 19, 20–25). It has also been reported that the most frequent causative site and condition for odontogenic infection is periapical infection of the mandibular molars (1, 8).

In our study, we found that 31 cases of deep neck infection were caused by odontogenic infection, and 30 of these cases (96.8%) were caused by periapical periodonti-

| Abscess site                  | n | Regression coefficient | Standard deviation | β   | t value | P value | Regression coefficient | Standard deviation | β   | t value | P value |
|-------------------------------|---|------------------------|--------------------|-----|---------|---------|------------------------|--------------------|-----|---------|---------|
| Sublingual space              | 34| 0.171                  | 0.276              | 0.109| 0.620   | 0.540   |                        |                    |     |         |         |
| Submandibular space           | 34|                        |                    |     |         |         |                        |                    |     |         |         |
| Submental space               | 34| 0.923                  | 0.416              | 0.365| 2.219   | 0.034   | 0.633                  | 0.321              | 0.250| 1.974   | 0.058   |
| Masticator space              | 34| 0.862                  | 0.205              | 0.597| 4.213   | 0.000   | 0.599                  | 0.169              | 0.415| 3.551   | 0.001   |
| Parapharyngeal space          | 34| 1.097                  | 0.342              | 0.493| 3.205   | 0.003   | 0.670                  | 0.256              | 0.301| 2.614   | 0.014   |
| Anterior visceral space       | 34| 1.349                  | 0.313              | 0.606| 4.310   | 0.000   | 0.743                  | 0.288              | 0.334| 2.577   | 0.015   |

β, standardized regression coefficient

\[ R^2 = 0.690 \]

Hospital stay underwent logarithmic conversion for use as a dependent variable.

\[ \text{Adjusted } R^2 = 0.647 \]

• Analysis method:

Linear regression analysis was performed on hospital stay using abscess site as the independent variable to investigate which abscess sites were associated with longer hospital stays.

• Analysis results:

Multivariate analysis revealed that hospital stays were significantly longer in cases with abscesses located in the masticator space, parapharyngeal space, and anterior visceral space.

We estimated that when an abscess was located in the masticator space, logarithmic converted hospital stay was lengthened by 0.599 days. When the index transformation was performed, this resulted in \[ \exp(0.599) = 1.82 \], indicating that the hospital stay was lengthened 1.82-fold. For the parapharyngeal space, logarithmic converted hospital stay was lengthened by 0.670 days, and when the index transformation was performed, this resulted in \[ \exp(0.670) = 1.95 \], indicating that the hospital stay was lengthened 1.95-fold. For the anterior visceral space, logarithmic converted hospital stay was lengthened by 0.599 days, and when the index transformation was performed, this resulted in \[ \exp(0.743) = 2.10 \], indicating that the hospital stay was lengthened 2.10-fold.
Int J Oral-Med Sci 19(3):158–170, 2020

tis of the mandibular molars.

Many cases of deep neck infection exhibit leukocytosis
upon admission (8, 26). Many of our cases also exhibited
leukocytosis, with a mean WBC count at admission of
12,200±4400/µL and median WBC count of 10,900/µL.

The CRP level at admission was high, with a mean of
12.4±8.9 mg/dL and median level of 9.6 mg/dL. These
results were comparable with the findings reported in
previous studies (13, 17).

Many reports have indicated that deep neck abscesses

---

**Table 6. Linear regression analysis with hospital stay as the dependent variable:**

| Detected bacteria | n | Regression coefficient | Standard deviation | β | t value | P value |
|-------------------|---|------------------------|--------------------|---|---------|---------|
| Facultative       |   |                        |                    |   |         |         |
| anaerobic         | 34| 0.278                  | 0.261              | 0.186 | 1.068 | 0.293 |
| Obligate          |   |                        |                    |   |         |         |
| anaerobic         | 34| 0.306                  | 0.248              | 0.213 | 1.236 | 0.225 |
| Aerobic bacteria  | 34| -0.133                 | 0.750              | -0.031 | -0.177 | 0.860 |
| Actinomycetes     | 34| 0.754                  | 0.370              | 0.339 | 2.036 | 0.050 |

**Multivariate model 1: Forced insertion of all variables**

| n = 34 | Regression coefficient | Standard deviation | β | t value | P value |
|--------|------------------------|--------------------|---|---------|---------|

| β, standardized regression coefficient | $R^2$ | 0.205 |

Logarithmic converted hospital stay used as dependent variable

| Adjusted $R^2$ | 0.095 |

**Analysis method:**

Linear regression analysis was performed on hospital stay using detected bacteria
as the independent variable to investigate which detected bacteria were associated
with longer hospital stays.

**Analysis results:**

Multivariate analysis revealed that cases with actinomycetes had significantly longer hospital stays.

It was estimated that:

When actinomycetes were present, the logarithmic converted hospital stay was lengthened by 0.803 days.

When the index transformation was performed, this resulted in $\exp(0.803) = 2.23$, indicating that hospital stay
was lengthened 2.23-fold.

---

**Table 7. Presence/absence of diabetes mellitus and hospital stay**

| Hospital stay | n | Diabetes mellitus absent | n | Diabetes mellitus present | $P$ value |
|---------------|---|--------------------------|---|---------------------------|-----------|
| Mean ± SD     | 28| 19.4 ± 15.4              | 5 | 37.6 ± 36.8              | 0.069     |
| Median [IQR]  | 28| 15.0 [9.3, 21.5]         | 5 | 13.0 [11.5, 76.0]        | 0.669     |

Data display: mean ± SD; median [IQR].

$P$ value: Mann–Whitney’s $U$ test.
are commonly located in the parapharyngeal or submandibular space (13, 14, 19). However, in cases caused by odontogenic infection, the jaw is adjacent to the sublingual space, submandibular space, and submandibular space, meaning that infection can spread to these areas. Therefore, cases of odontogenic infection are thought to be strongly associated with abscess formation in the sublingual and submandibular spaces (14). Many reports have also indicated that of these sites, the most common site of abscess formation is the submandibular space (2, 6, 13, 14). Our results were consistent with this, indicating that the most common site of abscess formation was the submandibular space (34 cases; 100%), followed by the sublingual space (22 cases; 64.7%).

To investigate isolated bacteria, we performed microbiological analysis including aerobic ± anaerobic cultures. Samples were collected from the infection sites using either a sterilized swab or fine-needle aspiration. Microbiological diagnosis (bacteria detection) was possible for 28 patients (82%). In cases of odontogenic infection, commonly detected obligate anaerobic bacteria are reported to be genus Peptostreptococcus and genus Prevotella, followed by genus Fusobacterium (27, 28). In particular, studies have reported that the genus Prevotella is detected in 10%–87% of cases of dental abscesses (29–31). In this study, we isolated 28 strains of obligate anaerobic bacteria. Many of these were genus Prevotella (11 strains; 32.4%), followed by genus Parvimonas (nine strains; 26.5%). It has been reported that the most commonly detected types of facultative anaerobic bacteria are viridans group Streptococci and anginosus group Streptococci (27). Our results also indicated that of the 32 strains of facultative anaerobic bacteria isolated, the most common type was genus Streptococcus (17 strains; 50.0%; Table 2).

A compromised host refers to a disease in which the biological defense mechanism has been lost. Such diseases include diabetes mellitus, kidney failure, and liver cirrhosis (32). Diabetes mellitus is a common type of compromised disease observed in cases of deep neck infection, reportedly present in 20%–40% of such patients (6, 8, 13, 14, 19, 33, 34). Our subjects included five cases (15%) with diabetes mellitus, which was a slightly lower proportion than reported in previous studies. However, all cases of compromised disease in our study involved diabetes mellitus. This suggests that diabetes mellitus is the strongest risk factor for deep neck infection.

Reports have indicated that the length of hospital stay can vary (13, 14, 19). In our study, the mean overall hospital stay was 22.7±20.3 days. Differences in hospital stays might have arisen as a result of disease severity or differences among medical facilities in standards for allowing hospital discharge.

Women tended to have a longer hospital stay (31.0±20.3 days) than men (19.2±19.6 days). However, the reason for this difference is unclear.

Many reports have indicated that hospital stays are significantly longer for elderly patients (2, 8, 23). However, we did not identify any age-related differences in length of hospital stays in this study. This might have been due to the small number of elderly patients included among our subjects (mean age: 49.6 years, median age: 53.5 years).

We did not observe any differences in hospital stays associated with WBC counts. This may be because patients were administered antibiotics at another medical facility prior to being examined at our department. Alternatively, it could be related to the fact that the large number of mobilized neutrophils at the infection site indicates that, in some cases, the levels did not accurately reflect the level of severity.

We also found that CRP levels affected hospital stay, with higher CRP levels associated with a longer hospital stay.

In addition, we found that hospital stays were significantly longer for patients with abscesses located in the masticator space, parapharyngeal space, or anterior visceral space. Of these, we found that the hospital stay was 2.10-fold longer for cases with abscesses in the anterior visceral space than in cases without an abscess at this site. The anterior visceral space is the transmission pathway for infection of the mediastinum (33, 35). These facts suggest that the presence of an abscess in the anterior visceral space could be a marker of severity. Therefore, it appears that patients with an abscess in the anterior visceral space may have longer hospital stays.

Studies have also reported that because cases of infection with gas-producing bacteria are prone to developing necrotizing fasciitis as well as various complications, length of hospital stay are longer in such patients (32). Because gas-producing bacteria are generally obligate anaerobic bacteria, it is logical that cases involving infection by these bacteria will easily tend to become more se-
vere, requiring long-term hospital stay. However, the results of the present study did not demonstrate that cases in which obligate anaerobic bacteria were detected had significantly longer hospital stays. This may be related to problems with the bacteria-sampling methods and cultures, indicating that obligate anaerobic bacteria were actually present in some cases in which these bacteria were not detected.

Our results indicated that hospital stays were significantly longer in cases in which actinomycetes were detected. The basic method of treatment for actinomycosis is long-term administration of penicillin (36, 37). Hospital stays might have been longer for cases in which actinomycetes were identified than in other cases because penicillin needs to be administered intravenously until the acute symptoms have improved in such cases.

Diabetes mellitus is the most common type of disease associated with deep neck infection. Because cases with diabetes mellitus are also more prone to complications and severe pathology, researchers have reported that the duration of hospital stay is longer for patients with diabetes mellitus than for other patients (6, 34). The results of our study did not indicate that cases with diabetes mellitus had significantly longer hospital stays. However, because the hospital stay of patients with diabetes mellitus (37.6 ± 36.8 days) was longer than that of those without diabetes mellitus (19.4 ± 15.4 days), it appears that the presence of diabetes mellitus might be a factor affecting length of hospital stay.

Conclusion
Previous reports hypothesized that infection due to obligate anaerobic bacteria would become more severe and result in long-term hospital stay (32). However, cases in which obligate anaerobes were detected did not result in a statistically significant prolongation of hospital stay, although it was significantly prolonged for patients in whom actinomycetes were detected. Based on these findings, regarding the degree of severity caused by the detected bacteria, it appears that along with gas-acidic obligate anaerobes, the presence or absence of actinomycetes is an important factor for estimating the severity of infectious diseases.

The investigation of factors influencing the severity on the basis of hematologic examination data in this study revealed that WBC counts were similar to those observed in previous studies (8, 26), with leukocytosis observed in many cases in the present study. However, there was no difference in the correlation between WBC counts and length of hospital stay. As previously mentioned, it was suspected that antibacterial agents had been administered before the patients visited our hospital or that a large number of neutrophils were mobilized at the site of infection. In contrast, regarding the correlation between CRP levels and length of hospital stay, it was observed that the higher the CRP value, significantly longer was the length of hospital stay. As a result, hematologic examination data revealed that CRP levels were a highly important predisposing severity factor compared with WBC counts.

In this study, patients with abscess in the masticator space, parapharyngeal space, or anterior visceral space had significantly longer hospital stay durations. In particular, the results suggest that the presence of an abscess in the anterior visceral space leads to the highest degree of severity.

It has been widely reported that infectious diseases tend to become more severe in patients with diabetes (6, 34). In the present study, the length of hospital stay of patients with diabetes was not significantly longer than that in patients without diabetes. However, patients with diabetes mellitus had longer hospital stays (37.6 ± 36.8 days; mean: 13.0 days) than patients without diabetes mellitus (19.4 ± 15.4 days; mean: 15.0 days). Hence, based on the results of this study and reports published to date, it appears necessary to consider that diabetic cases are likely to become more severe.

In the present study, periapical periodontitis was the most common causative disease of deep cervical abscess due to dental infection. Hence, it is imperative for dentists to understand that deep cervical infection is a type of fatal infection and that periapical periodontitis is the most common causative disorder of deep cervical abscess due to dental infection.

In the future, we plan to increase the number of patients and perform a reexamination of the factors.

References
1. Pesis M, Bar-Droma E, Ilgiyaev A, Givol N: Deep neck infections are life threatening infections of dental origin: a presentation and management of selected cases. Isr Med Assoc J, 12: 806–811, 2019.
2. Adoviča A, Veidere L, Ronis M, Sumeraga G: Deep neck infections: review of 263 cases. Otolaryngol Pol, 30: 37–42, 2017.

3. Grodinsky M, Holyoke EA: The fascia and fascial spaces of the head and neck and adjacent regions. Am J Anat, 63: 367–408, 1938.

4. Levitt GW: Cervical fascia and deep neck infections. Laryngoscope, 80: 409–435, 1970.

5. Velhonoja J, Lääveri M, Soukka T, Irljala T, Kinnunen I: Deep neck space infections: an upward trend and changing characteristics. Eur Arch Otorhinolaryngol, 277: 863–872, 2020.

6. Das R, Nath G, Mishra A: Clinico-pathological profile of deep neck space infection: a prospective study. Indian J Otolaryngol Head Neck Surg, 69: 282–290, 2017.

7. Alegbeleye BJ: Deep neck infection and descending mediastinitis as lethal complications of dentoalveolar infection: two rare case reports. J Med Case Rep, 12: 195, 2018.

8. Almutairi DM, Alqahtani RM, Alshareaf N, Alghamdi YS, Al-Hakami HA, Algarni M: Deep neck space infections: a retrospective study of 183 cases at a tertiary hospital. Cureus, 12: e6841, 2020. doi: 10.7759/cureus.6841

9. Sharma K, Das D, Joshi M, Barman D, Sarma AJ: Deep neck space infections - a study in diabetic population in a tertiary care centre. Indian J Otolaryngol Head Neck Surg, 70: 22–27, 2018.

10. Eftekharian A, Roozbahany NA, Vaezeafshar R, Nariman N: Deep neck infections: a retrospective review of 112 cases. Eur Arch Otorhinolaryngol, 266: 273–277, 2009.

11. Marioni G, Rinaldi R, Staffieri C, Marchese-Ragona R, Saia G, Stramare R, Bertolin A, Dal Borgo R, Ragni F, Staffieri A: Deep neck infection with dental origin: analysis of 85 consecutive cases (2000–2006). Acta Otolaryngol, 128: 201–206, 2008.

12. Opite D, Camerer C, Camerer DM, Menneking H, Hoffmeister B, Adolphs N: Incidence and management of severe odontogenic infections - a retrospective analysis from 2004 to 2011. J Craniofac Surg, 43: 285–289, 2015.

13. Zheng L, Yang C, Zhang W, Cui X, Jiang B, Wang B, Pu Y, Jin J, Kim E, Wang J, Zhang Z, Zhou L, Zhou J, Guan X: Comparison of multi-space infections of the head and neck in the elderly and non-elderly: part I the descriptive data. J Craniofac Surg, 41: e208–212, 2013.

14. Seppänen L, Lauhio A, Lindqvist C, Suuronen R, Raatumann R: Analysis of systemic and local odontogenic infection complications requiring hospital care. J Infect, 57: 116–122, 2008.

15. Alotaibi N, Cloutier L, Khaldoun E, Bois E, Chirat M, Salvan D: Criteria for admission of odontogenic infections at high risk of deep neck space infection. Eur Ann Otorhinolaryngol Head Neck Dis, 132: 261–264, 2015.

16. Ridder GJ, Technau-Ihling K, Sander A, Boedeker CC: Spectrum and management of deep neck space infections: an 8-year experience of 234 cases. Otolaryngol Head Neck Surg, 133: 709–714, 2005.

17. Stalfors J, Adielsson A, Ebenfelt A, Nethander G, Westin T: Deep neck space infections remain a surgical challenge. A study of 72 patients. Acta Otolaryngol, 124: 1191–1196, 2004.

18. Parhiscar A, Harel G: Deep neck abscess. a retrospective review of 210 cases. Ann Otol Rhinol Laryngol, 110: 1051–1054, 2001.

19. Sethi DS, Stanley RE: Deep neck abscesses: challenging trends. J Laryngol Otol, 108: 138–143, 1994.

20. Meher R, Jain A, Sabharwal A, Gupta B, Singh I, Agarwal AK: Deep neck abscess: a prospective study of 54 cases. J Laryngol Otol, 119: 299–302, 2005.

21. Boscolo-Rizzo P, Stellin M, Muzzi E, Mantovani M, Fuson R, Lupato V, Trabalzini F, Da Mosto MC: Deep neck infections: a study of 365 cases highlighting recommendations for management and treatment. Eur Arch Otorhinolaryngol, 269: 1241–1249, 2012.

22. Lee YQ, Kanagalingam J: Deep neck abscesses: the Singapore experience. Eur Arch Otorhinolaryngol, 268: 609–614, 2011.

23. Huang TT, Liu TC, Chen PR, Tseng FY, Yeh TH, Chen YS: Deep neck infection: analysis of 185 cases. Head Neck, 26: 854–860, 2004.

24. Wang LF, Kuo WR, Tsai SM, Huang KJ: Characterizations of life-threatening deep cervical space infections: a review of one hundred ninety-six cases. Am J Otolaryngol Head Neck Med Surg, 24: 111–117, 2003.

25. Wang LF, Tai CF, Kuo WR, Chien CY: Predisposing factors of complicated deep neck infections: 12-year
experience at a single institution. J Otolaryngol Head Neck Surg, 39: 335–341, 2010.

26. P Kauffmann, R Cordesmeyer, M Tröltzsch, C Sommer, R Laskawi: Deep neck infections: a single-center analysis of 63 cases. Med Oral Patol Oral Cir Bucal, 22: e536–e541, 2017.

27. Robertson D, Smith AJ: The microbiology of the acute dental abscess. J Med Microbiol, 58: 155–162, 2009.

28. Jacinto RC, Gomes BP, Shah HN, Ferraz CC, Zaia AA, Souza-Filho FJ: Incidence and antimicrobial susceptibility of Porphyromonas gingivalis isolated from mixed endodontic infections. Int Endod J, 39: 62–70, 2006.

29. Siqueira JF Jr, Rôças IN: Diversity of endodontic microbiota revisited. J Dent Res, 88: 969–981, 2009.

30. Fazakerley MW, McGowan P, Hardy P, Martin MV: A comparative study of cephradine, amoxycillin and phenoxymethylpenicillin in the treatment of acute dentoalveolar infection. British Dental J, 174: 359–363, 1993.

31. Külekçi G, İnanç D, Koçak H, Kasapoglu C, Gümrü OZ: Bacteriology of dentoalveolar abscesses in patients who have received empirical antibiotic therapy. Clin Infect Dis, 23: S51–S53, 1996.

32. G Engelich, D G Wright, K L Hartshorn: Acquired disorders of phagocyte function complicating medical and surgical illnesses. Clin Infect Dis, 33: 2040–2048, 2001.

33. Wei D, Bi L, Zhu H, He J, Wang H: Less invasive management of deep neck infection and descending necrotizing mediastinitis: a single-center retrospective study. Medicine (Baltimore), 96: e6590, 2017. doi: 10.1097/MD.0000000000006590

34. Huang TT, Tseng FY, Liu TC, Hsu CJ, Chen YS: Deep neck infection in diabetic patients: comparison of clinical picture and outcomes with nondiabetic patients. Otolaryngol Head Neck Surg, 132: 943–947, 2005.

35. Levine TM, Wurster CF, Krespi YP: Mediastinitis occurring as a complication of odontogenic infections. Laryngoscope, 96: 747–750, 1986.

36. Miller M, Haddad AJ: Cervicofacial actinomycosis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 85: 496–508, 1998.

37. Moghimi M, Salentijn E, Debets-Ossenkop Y, Karagözoglu KH, Forouzanfar T: Treatment of cervicofacial actinomycosis: a report of 19 cases and review of literature. Med Oral Patol Oral Cir Bucal, 18: e627–e632, 2013.