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Elective tracheostomy scoring system for severe oral disease patients

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Abstract (J Korean Assoc Oral Maxillofac Surg 2014;40:211-219)

Objectives: The purpose of this research was to create a scoring system that provides comprehensive assessment of patients with oromaxillofacial cancer or odontogenic infection, and to statistically reevaluate the results in order to provide specific criteria for elective tracheostomy.

Materials and Methods: All patients that had oral cancer surgery (group A) or odontogenic infection surgery (group B) during a period of 10 years (2003 to 2013) were subgrouped according to whether or not the patient received a tracheostomy. After a random sampling (group A: total of 56, group B: total of 60), evaulation procedures were observed based on the group classifications. For group A, four factors were evaluated: TNM stage, reconstruction methods, presence of pathologic findings on chest posterior-anterior (PA), and the number of systemic diseases. Scores were given to each item based on the scoring system suggested in this research and the scores were added together. Similarly, the sum score of group B was counted using 5 categories, including infection site, C-reactive protein level on first visit, age, presence of pathologic findings on chest PA, and number of systemic diseases.

Results: The scoring system rendered from this research shows that there is a high correlation between the scores and TNM stage in oral cancer patients, or infection sites in odontogenic infection patients. However, no correlation between pathologic findings on chest PA could be found in either group. The results also indicated that for both groups, the hospital day increased with the tracheostomy score. The tracheostomy score cutoff value was 5 in oral cancer patients and 6 in odontogenic infection patients which was used for elective tracheostomy indication.

Conclusion: The elective tracheostomy score system suggested by this research is a method that considers both the surgical and general conditions of the patient, and can be very useful for managing patients with severe oral disease.

Key words: Tracheostomy, Scoring system, Airway management, Mouth neoplasms, Odontogenic infection

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I. Introduction

Maintaining the airways of patients with severe oral diseases such as oral cancer or oral infection, is one of the most important demands for oral maxillofacial surgery and various factors can affect postoperative airway maintenance. The factors could include cancer resection cancer, reconstruction, postoperative edema, inherent systemic diseases[1-3] in oral cancer cases, as in odontogenic infection, infection site edema, airway distortion, or systemic diseases. These factors were cited as clinically important by practicing clinicians[4-6].

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Tracheostomy is an effective technique for airway maintanence after oral maxillofacial surgery. Because the demands of long-term postoperative airway maintenance can vary depending on the patient's circumstances, elective tracheostomy is recommended for patients with a high risk of airway obstruction. However, careful patient selection is required in elective tracheostomy because complications such as bleeding, local infection, pneumonia, obstruction or airway distortion, and airway stenosis can occur after a tracheostomy is performed[7-9]. Moreover, because of the invasive nature of the tracheostomy, this procedure can cause additional risks for the patient.

For these reasons, Kruse-Lösler et al.[10] invented a scoring system based on tumor size and location, multiple complications, alcohol intake, and pathologic findings based on chest radiograph to determine whether to perform a tracheostomy.

Kruse-Lösler et al.[10] conducted a significance test on 20 factors that can influence patients that require a tracheostomy. As a result, the research determined that significant factors

included pathologic findings on chest posterior-anterior (PA) and underlying disease (systemic disease). However, Kruse-Lösler et al.'s scoring system[10] lacked consideration in regards to surgical factors.

Cameron et al.[11] introduced a standard for elective tracheostomy by scoring factors such as the tumor location, mandibulectomy, neck dissection, and reconstruction. However, insufficient consideration of the tumor size and systemic health condition was not included.

Similarly, Flynn et al.[12-15] reported a severity score for each facial space infection site in dental infection patients, but this study is limited because it developed suggestions based on anatomical considerations and lacked systemic consideration.

In spite of these studies, a sufficient comprehensive and objective evaluation index for elective tracheostomy has not been developed. Crosher et al.[16] predicted in their study on elective tracheostomy that an evaluation standard would benefit patients with the disease.

Therefore, this study was conducted to develop a comprehensive patient evaluation scoring system and to statistically revaluate the scoring system to prepare the system as an elective tracheostomy standard based on several factors. Furthermore, this study compared the average hospital day of postoperative oral cancer patients and severe infection patients in regards to tracheostomy performance.

II. Materials and Methods

1. Study subjects

Oral cancer and odontogenic infection surgery patients at Department of Oral and Maxillofacial Surgery in the Dankook University Dental Hospital from 2003 to 2013 were included in this study; patients that did not have all necessary data were excluded. Patients who transferred to another hospital and patients who passed out were also exempted. Furthermore, lip cancer, malignant lymphoma, and patients with salivary gland tumors in the oral cancer patient group and mid-facial region such as canine space odontogenic infection patients were also excluded.

Oral cancer surgery patients were classified into group A and odontogenic infection patients into group B. Group A was subdivided in 2 subunits and 28 patients were selected randomly from the two subunits. Patients who had undergone

Table 1. Suggested scoring system for elective tracheostomy in oral cancer and infection patients

Groups	Scoring factor	Subsection	Score
Group A	TNM stage	I	0
		II	1
		III	2
		IV	3
	Reconstruction	No reconstruction	0
		Soft tissue free flap	1
		Soft+hard tissue free flap	2
	Chest PA	No pathologic finding	0
		Pathologic finding	1
	Number of systemic diseases	None	0
		1-2	1
		≥3	2
Group B	Site	Dentoalveolar space abscess	0
		Primary facial space abscess	1
		Secondary space abscess	2
		Tertiary facial space abscess, Ludwig's angina	3
	Age (yr)	<55	0
		≥55, <75	1
		≥75	2
	C-reactive protein (mg/dL)	<15	0
		≥15, <25	1
		≥25	2
	Chest PA	No pathologic finding	0
		Pathologic finding	1
	Number of systemic diseases	None	0
		1-2	1
		≥3	2

(PA: posterior-anterior)
Group A: oral cancer surgery group, Group B: odontogenic infection surgery group.
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Table 2. Tracheostomy scoresin oral cancer patients

Groups	Patient No.	Sex	Age (yr)	Hospital day (day)	TNM stage (score)	Reconstruction (score)	Chest PA (score)	Systemic disease (score)	Sum (score)
A1	1	F	65	18	4	0	1	1	6
	2	F	68	69	4	1	1	0	6
	3	F	57	78	4	1	0	1	6
	4	M	73	51	4	1	1	1	7
	5	M	51	23	3	0	0	0	3
	6	M	78	30	3	1	1	2	7
	7	M	66	21	3	1	0	1	5
	8	F	60	19	4	1	0	1	6
	9	F	69	46	2	1	0	2	5
	10	M	42	111	4	2	0	0	6
	11	F	81	55	4	1	0	2	7
	12	F	67	62	3	1	0	1	5
	13	F	53	45	3	2	0	0	5
	14	F	70	30	3	0	0	0	3
	15	F	50	51	3	2	1	1	7
	16	M	31	90	4	1	0	0	5
	17	M	63	43	2	1	1	1	5
	18	M	67	26	3	1	1	1	6
	19	F	81	29	3	0	1	2	6
	20	M	31	32	4	1	1	2	8
	21	M	54	41	4	0	0	1	5
	22	M	57	51	4	2	0	2	8
	23	M	52	18	3	2	0	0	5
	24	F	56	64	4	1	1	1	7
	25	M	48	33	2	1	1	1	5
	26	M	74	26	2	2	0	0	4
	27	F	69	47	3	2	0	1	6
	28	M	60	29	4	2	0	0	6
Mean			60.46	44.21	3.32	1.11	0.39	0.89	5.71
A2	1	F	55	15	1	0	0	0	1
	2	M	44	71	3	1	0	0	4
	3	F	61	18	1	1	0	1	3
	4	F	55	15	1	0	0	1	2
	5	M	68	32	3	0	1	1	5
	6	M	67	13	2	0	0	1	3
	7	F	74	10	3	0	1	1	5
	8	F	73	72	4	1	0	1	6
	9	F	45	24	4	0	0	0	4
	10	M	53	30	2	1	0	1	4
	11	F	67	28	2	1	0	1	4
	12	M	57	22	1	1	0	0	2
	13	M	65	34	2	0	0	1	3
	14	F	73	13	2	0	0	2	4
	15	F	66	22	4	1	0	0	5
	16	M	46	17	1	0	1	1	3
	17	F	68	4	1	1	0	2	4
	18	M	70	33	2	0	1	1	4
	19	M	52	23	3	1	0	0	4
	20	F	69	28	2	1	1	1	5
	21	M	78	32	1	1	1	1	4
	22	M	66	22	2	1	1	1	5
	23	M	61	34	2	1	1	2	6
	24	F	73	28	2	1	0	2	5
	25	F	34	8	4	0	0	0	4
	26	F	76	38	1	1	0	1	3
	27	M	67	17	2	1	1	0	4
	28	F	54	66	1	0	0	0	1
Mean			62.03	27.46	2.11	0.57	0.32	0.82	3.82

(PA: posterior-anterior, F: female, M: male)

A1: oral cancer group with tracheostomy, A2: oral cancer group without tracheostomy.

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tracheostomy were grouped into A1 and patients who had not undergone tracheostomy were grouped into A2. In the same manner, the B group was divided into two subunits and 30 patients were selected randomly from the two subunits. Patients that had undergone tracheostomy were grouped into B1, and patients who had not undergone tracheostomy were grouped into B2.

2. Methods

1) Group A scoring system

The following factors were investigated in patients in the two group A subunits, and a total score was calculated after each factor was scored, based on the scoring system suggested in this study (minimum 0 to maximum 8).(Table 1)

(1) TNM stage
(2) Reconstruction necessity and reconstruction method
(3) Presence of pathologic findings on chest PA
(4) Number of systemic diseases

2) Group B scoring system

The following factors were investigated in patients in the two subunit groups of patients in group B. A total score was calculated after each factor was scored, based on the scoring system suggested in this study (minimum 0 to maximum 10). (Table 1)

(1) Infection site
(2) Age
(3) C-reactive protein (CRP) level at first visit
(4) Presence of pathologic findings on chest PA
(5) Number of systemic diseases

Table 3. Tracheostomy score and correlated factors in oral cancer and odontogenic infection patients

	Spearman correlation coefficient	*P*-value
Oral cancer patients (n=56)		
TNM stage	0.763**	<0.001
Reconstruction	0.478**	0.016
Chest PA	0.213	0.147
Systemic disease	−0.11	0.845
Odontogenic infection patients (n=60)		
Site	0.748**	<0.001
Age	0.695**	<0.001
CRP	0.642**	<0.001
Chest PA	0.230	0.076
Systemic disease	−0.437	0.031

(PA: posterior-anterior, CRP: C-reactive protein)
**Statistically positive correlation associated with tracheostomy score.
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3. Statistical analysis

To evaluate statistical significance, SPSS version 18.0 (IBM Co., Armonk, NY, USA) was used for statistical analysis at a 95% reliability level. The Mann-Whitney test and Spearman correlation coefficient test were used to compare two groups, the score system among groups, and the hospital stay period. A receiver operating characteristic (ROC) curve was used to set a cutoff for tracheostomy based on score, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV).

III. Results

1. Score systems comparison

1) Group A

The tracheostomy score for each patient is shown in Table 2. The results indicated that an average value of 5.71 was found in A1 and an average value of 3.82 was found in A2. The Mann-Whitney test showed that there was a significant difference between the two groups (A1, A2) and the value was higher in the tracheostomy group (A1) (P<0.001).

Analysis of the tracheostomy score totals and the relationship between each factor score using the Spearman correlation coefficient test showed that the Spearman correlation coefficient for the 4 index were as follows: TNM stage (0.763), reconstruction (0.478), chest PA (0.213), and systemic disease (−0.11). Only TNM stage (P<0.001) and need for reconstruction (P=0.016) were significantly associated with the tracheostomy score; the chest PA result (P=0.147) and systemic disease (P=0.845) were not significantly associated with the scores. Specifically, the TNM stage showed a correlation coefficient of 0.763 which was highly significant. (Table 3)

2) Group B

The tracheostomy score for each patient is shown in Table 4, as an average value of 6.37 in B1 and an average value of 3.27 in B2. The Mann-Whitney test showed significant differences in the two groups (B1, B2) and the value was higher in tracheostomy group (B1) (P<0.001).

Analysis of the tracheostomy score totals and the relationship between each score using the Spearman correlation coefficient showed the following correlations; site (0.748), age (0.695), CRP (0.642), chest PA (0.230), systemic disease (0.437). Only site (P<0.001), age (P<0.001), CRP (P<0.001),

Table 4. Tracheostomy scoresin odontogenic infection patients

Groups	Patient No.	Sex	Age (yr)	Hospital day (day)	Site (score)	Age (score)	CRP (score)	Chest PA (score)	Systemic disease (score)	Sum (score)
B1	1	F	67	21	2	1	2	1	1	7
	2	F	69	22	1	1	0	0	2	4
	3	M	67	16	1	1	2	1	1	6
	4	M	54	18	3	0	2	1	0	6
	5	F	62	9	3	1	1	0	0	5
	6	F	72	70	3	1	0	0	2	6
	7	M	56	11	2	1	0	0	1	4
	8	M	85	60	3	2	2	1	2	10
	9	F	76	12	2	2	2	0	1	7
	10	F	32	16	1	0	2	1	0	4
	11	M	63	39	2	1	2	1	2	8
	12	M	56	67	2	1	2	1	1	7
	13	M	60	7	2	1	2	0	1	6
	14	F	81	29	2	2	2	1	0	7
	15	F	79	57	3	2	2	0	1	8
	16	M	80	11	1	2	1	0	2	6
	17	M	49	28	0	0	2	0	1	3
	18	F	66	15	2	1	2	0	1	6
	19	M	63	13	2	1	0	1	1	5
	20	F	75	20	3	2	1	0	2	8
	21	M	57	32	2	1	0	0	0	3
	22	M	61	15	3	1	2	0	1	7
	23	M	44	30	2	0	2	0	0	4
	24	F	76	27	3	2	2	1	0	8
	25	M	75	17	2	2	2	0	1	7
	26	F	83	30	3	2	2	0	2	9
	27	F	65	22	2	1	2	0	1	6
	28	M	77	29	1	2	1	0	2	6
	29	F	80	85	3	2	2	0	2	9
	30	M	85	19	3	2	2	0	2	9
Mean			67.16	28.23	2.13	1.27	1.53	0.33	1.10	6.37
B2	1	F	67	23	1	1	2	1	1	6
	2	M	70	4	1	1	2	0	1	5
	3	M	28	10	0	0	2	0	0	2
	4	M	16	8	1	0	0	0	0	1
	5	F	78	18	1	2	1	0	0	4
	6	F	67	11	1	1	0	0	1	3
	7	F	74	10	0	1	2	1	1	5
	8	M	67	17	1	1	1	0	1	4
	9	F	64	16	1	1	0	0	1	3
	10	M	38	11	1	0	0	1	0	2
	11	M	42	8	0	0	0	0	0	0
	12	F	75	8	0	2	0	1	1	4
	13	M	69	26	0	1	0	0	1	2
	14	F	59	20	3	1	0	0	1	5
	15	M	68	40	2	2	0	1	2	7
	16	M	54	39	1	0	1	0	0	2
	17	M	23	8	0	0	1	0	1	2
	18	M	18	6	0	0	1	0	0	1
	19	M	31	9	2	0	2	0	0	4
	20	F	82	18	2	2	0	1	1	6
	21	F	68	13	0	1	0	0	0	1
	22	M	34	12	1	0	1	0	1	3
	23	M	31	7	2	1	1	0	0	4
	24	M	50	12	0	1	1	1	0	3
	25	M	35	12	1	0	1	0	0	2
	26	F	79	10	1	1	0	0	1	3
	27	F	73	24	2	1	0	0	1	4
	28	M	85	10	1	2	1	0	1	5
	29	F	55	27	1	1	0	0	1	3
	30	M	45	18	1	0	1	0	0	2
Mean			54.83	15.16	0.93	0.80	0.70	0.23	0.60	3.27

(PA: posterior-anterior, F: female, M: male)

B1: odontogenic infection group with tracheostomy, B2: odontogenic infection group without tracheostomy.

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Table 5. Hospital day, score and with/without tracheostomy in oral cancer and odontogenic infection patients

Groups			Hospital days	Score	Tracheostomy
Group A	Hospital days	Pearson correlation coefficient		0.420**	−0.434**
		P-value		0.003	0.002
		Number of patients		56	56
	Score	Pearson correlation coefficient	0.420**		−0.741**
		P-value	0.003		0.000
		Number of patients	56		56
	Tracheostomy	Pearson correlation coefficient	−0.434**	−0.741**	
		P-value	0.002	0.000	
		Number of patients	56	56	
Group B	Hospital days	Pearson correlation coefficient		0.442**	−0.438**
		P-value		0.000	0.000
		Number of patients		60	60
	Score	Pearson correlation coefficient	0.442**		−0.712**
		P-value	0.000		0.000
		Number of patients	60		60
	Tracheostomy	Pearson correlation coefficient	−0.438**	−0.712**	
		P-value	0.000	0.000	
		Number of patients	60	60	

Group A: oral cancer surgery group, Group B: odontogenic infection surgery group.
**Statistically positive correlation between hospital days, score, and tracheostomy in each groups.
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and systemic disease (P=0.031) were significantly correlated with tracheostomy score. Specifically, the infection site showed a 0.748 correlation coefficient which was highly significant.(Table 3)

2. Hospital day comparison

There was significant difference in the number of hospital days when the two groups (P<0.001) were compared and the tracheostomy group had a greater number of hospital days (A1, B1) (Mann-Whitney test).

1) Group A

For the factors of tracheostomy score, hospital day, and performance of tracheostomy, a significant correlation (Spearman correlation coefficient) was found and there was a positive correlation between the tracheostomy score and the hospital day.(Table 5)

2) Group B

For the three factors of tracheostomy score, hospital day, and performance of tracheostomy, a significant correlation (Spearman correlation coefficient) was identified and there was a positive correlation between the tracheostomy score and hospital day.(Table 5)

Table 6. Suggested cutoff value for elective tracheostomy in group A and group B patients

	Score	Sensitivity	Specificity	PPV	NPV
Group A	4	57	80	93	26
	5	76	90	93	74
	6	90	72	62	93
Group B	5	74	83	81	74
	6	96	80	78	96
	7	100	65	47	100

(PPV: positive predictive value, NPV: negative predictive value)
Group A: oral cancer surgery group, Group B: odontogenic infection surgery group.
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3. Tracheostomy-based score cutoff

1) Group A

We used the patient's scatter diagram as a reference to establish cutoff values at 4-6 and investigated the sensitivity, specificity, PPV and NPV. The ROC analysis indicated that the optimized results were obtained with a cutoff value of 5.(Table 6)

2) Group B

We used the patient's scatter diagram as a reference to establish cutoff values at 5-7 and investigated the sensitivity, specificity, PPV, and NPV. The ROC analysis indicated that the optimized results were obtained with a cutoff value of 6.(Table 6)

IV. Discussion

Airway management is crucial for oromaxillofacial surgery patients that undergo sugery for severe oral disease and management may be difficult for the operating surgeon[17]. Therefore, recently, overnight intubation with an endotracheal tube has been introduced for cases in which challenging airway maintenance is predicted such as in postoperative edema[18,19]. This technique can only be used for a short time period, while severe edema is present, but is advantageous because it is minimally invasive and allows for a quick recovery. In contrast, Coyle et al.[20] reported that almost every patient can be treated with overnight intubation for airway maintenance.

However, this technique is not optimal because the endotracheal tube can cause cause discomfort especially in conscious patients that are sensitive to oral intubation, hence, long-term maintenance can be very difficult. Therefore, after surgery, immediate removal is recommended after the patient recovers specific attributes. However, it can be challenging to determine the optimal time to remove the tube. Postoperative edema usually increases during the 2-3 days after surgery. Accordingly, removal one day after surgery, or 2-3 days after sugery, is considered untimely. Moreover, once the intubation tube is removed, it can complicate reintubation in emergency situations[21], for example, reintubation is required if a patient experiences obstruction after the tube is removed. However, elevating the larynx is problematic in oral cancer and odontogenic infection surgery patients due to postoperative edema and this be associated with opening limitations which increase the risk for patients. In this situation, an emergency tracheostomy can be performed, but is conducted on a concious patient with head and neck edema which can also cause complications and increase the failure rate[21].

In this aspect, elective tracheostomy is the most definite technique for maintaining the airway after surgery. Because long-term airway maintenance for up to a week may be warranted, an elective tracheostomy is recommended in high-risk patients after surgery, based on the patient's recovery status[22]. However, a tracheostomy is very invasive. Even though complications are very rare, intensive care is required in addition to a recovery period as well as cost after surgery increases[23,24]. Even though there is a possibility of postoperative airway obstruction it is important to determine the best indication to effectively treat patients.

In consideration of these challenges, this study researched and designed a new scoring system. Both the oral cancer and odontogenic infection groups were divided largely into two factors: a surgical factor and a systemic factor. First, in the oral cancer group, surgical factors were simplified into TNM stage and reconstruction methods based on studies on other surgical factors[2,7,16,25,26], and for systemic factors, pathologic findings on chest PA and the number of systemic diseases were selected after referring to the study done by Cameron et al.[11]. Cameron et al.[11] conducted a significant number of tests on 20 factors that could influence the need for tracheostomy. The significant systemic factors were pathologic findings on chest PA and systemic disease. In the odontogenic infection group, we referenced a study by Flynn et al.[12-15] to evaluate the infection site and degree of infection. Likewise, systemic factors were set equally to the oral cancer patients based on information from the Cameron et al.'s study[11]. Moreover, age and CRP level were set as additional factors to compensate for consideration of the patient's systemic condition[27-30].

A correlation survey on the tracheostomy score total and between each of the factors showed that TNM stage for oral cancer and infection site for odontogenic infection had the highest correlation. Both groups indicated that surgical factors are more important than systemic factors. However, this correlation was only a result of a factor of the scoring system suggested in this study and cannot currently be generalized. Furthermore, additional research is necessary to identify a new systemic factor with that is highly correlated with this systemizing the theory.

Interestingly in this study, the tracheostomy score was significantly correlated with both the hospital day and whether or not the tracheostomy was performed. For patients with a high score in the preoperative score system, early tracheostomy could be perfomed by predicting the invasiveness of surgery and recovery period in advance, which could enable patient management teams to increase safety and prevent emergency situations. Crosher et al.[16] predicted that if such an evaluation index existed, patients would benefit greatly. Although a number of systemic diseases showed significant correlations, the pathologic finding on chest PA, one of the factors suggested in this study, was not significantly correlated with the total tracheostomy score in either group A or group B.

An optimal scoring system should not be complicated and should be discernable before operation or during operation[10]. However, strictly speaking, there the TNM stage factor can be limiting and accurate scoring may only be with histopathologic analysis based on radial resection. Even though such factors as the size of the tumor and overactivation of related lymph nodes can be detected in advance with positron emis-

sion tomography-computed tomography[31], the exact TNM stage is difficult to discern.

For the oral cancer patients scoring system, a history of preoperative radiation therapy and previous surgery on the same area were intended to be included as contributing factors because patients with these histories tend to have altered anatomic landmarks and airway management can be difficult[32]. However, a number of patients in our hospital who met these criteria were not included in the study for statistical analysis because other factors were too limiting.

We also tried to include arterial blood gas analysis (ABGA) results at the first medical examination in the scoring system for odontogenic infection patients. Because ABGA is the most objective index to indicate the respiratory status of a patient with an obstructed airway due to infection or edema[15]. However, we could not include this factor in the scoring system because ABGA is not manifested as respiratory acidosis, which could have been used in this study, because it is multifactorial.

The scoring system suggested in this study is based on the premise that a tracheostomy should be performed in a patient that is above a specific score level. To achieve this, we calculated the sensitivity, specificity, PPV, and NPV based on the ROC curve. A score of 5 in oral cancer patients and a score of 6 in odontogenic patients showed the highest predictive value. However, these values are not associated with an absolute scoring system. In fact, in the oral cancer patient group (group A), 2 out of 28 patients with tracheostomy score of more than 5, which was the cutoff, did not receive a tracheostomy. In the odontogenic infection patients (group B), among patients with tracheostomy score of more than 6, which was the cutoff, 3 patients did not receive a tracheostomy.

For example, an oral cancer patient that underwent a tracheostomy recovered in the general ward since the patient had shown good progress after surgery. However, the patient suddenly experienced difficulty breathing due to delayed bleeding 4 days after the surgery happened. The patient was transferred to the intensive care unit and an emergency tracheostomy was performed. Although additional research and is necessary, the scoring system suggested in this study can be used as a auxiliary index for elective tracheostomy in severe oral disease patients.

V. Conclusion

In oral cancer patients, the TNM stage, and reconstruction were significantly correlated with the tracheostomy score. However, the pathologic findings on chest PA were not significantly correlated with the score. In odontogenic infection patients, the infection site, age, CRP level at the first visit, and systemic disease were significantly correlated with the tracheostomy score, but the pathologic findings on the chest PA were not correlated in this study.

A tracheostomy score of 5 for oral cancer patient and 6 for odontogenic infection patients is considered as a relevant cutoff to determine if an elective tracheostomy is indicated.

The elective tracheostomy evaluation system suggested in this study is expected to be practical and cover both surgical and systemic factors in patients with severe oral disease.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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