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Changes in oral health status in terminal cancer patients during the last weeks of life

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Background: Many studies have shown deterioration of the oral health environment in palliative care patients; however, most of these studies are cross-sectional. In this longitudinal observational study, we aimed to determine the oral symptoms and how they change in palliative care patients.

Methods: The participants were 82 patients (37 men, 45 women) admitted to two palliative care units in Japan between January 2018 and December 2021. The oral condition was evaluated once a week from the time of admission using the Oral Health Assessment Tool (OHAT) and performance status (PS). Friedman tests were performed on the OHAT and PS scores at 1, 2, and 3 weeks before the week of death. In addition, the Bonferroni method was used to determine how many weeks before death the changes occurred.

Results: PS continuously deteriorated from three weeks before death. The total OHAT score 2 weeks before death (3.44±2.10) was significantly different compared to that in the week of death (4.37±2.45). In terms of oral conditions, the properties of the saliva changed, and dry mouth became obvious.

Conclusions: The results of this study revealed that the oral environment of palliative care patients became significantly dry 2 weeks before death, suggesting that it may be useful for predicting the stage of death.

Keywords: Oral health environment; oral dryness; palliative care; terminal cancer

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Introduction

Cancers are currently the leading cause of death in Japan (1). In our super-aging society, the number of deaths from cancer is increasing year by year. Currently, it has been estimated that one out of two Japanese persons will develop cancer during their lifetime. The main issue is improving and maintaining the quality of life (QOL) among terminally ill patients. Patients in palliative care have been shown to exhibit various physical symptoms, including frailty, anorexia, and depression (2). It has also been reported that oral discomfort symptoms such as xerostomia and oral mucositis are frequent, and that oral-related QOL is often reduced (3). Poor oral-related QOL not only reduces food intake but may also reduce overall QOL due to discomfort symptoms and speech difficulties.

In the present study, dental examinations were performed for all hospitalized patients in two different palliative care units using the Oral Health Assessment Tool (OHAT) (4) in cooperation with nurses, dentists, and dental hygienists. This tool assesses eight items (lips, tongue, gingiva/

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mucosa, saliva, oral cleaning, remaining teeth, dentures, and toothache) on a three-point scale (0= healthy, 1= slightly poor, and 2= morbid). Recently, an association between the OHAT score and general condition has been reported, and the relationship between systemic diseases such as dementia, renal disturbance, and sarcopenia, as well as the Charlson comorbidity index, has been clarified (5-7). In addition, Maeda *et al.* (8) reported that a high total OHAT score was an independent predictor of in-hospital mortality.

There are many reports showing the deterioration of the oral health environment in palliative care patients; however, most of them are cross-sectional studies, and none of them evaluated deterioration over time. We hypothesized that palliative care patients' oral environment would deteriorate as their general condition worsened. In this longitudinal study, we aimed to determine the oral symptoms in palliative care patients, and how they change over time. We present this article in accordance with the STROBE reporting checklist (available at https://apm.amegroups.com/article/view/10.21037/apm-23-456/rc).

Methods

This longitudinal observational study included 82 patients (37 men and 45 women) admitted to two different palliative care units (Fujita Medical University Hospital and Nanakuri Memorial Hospital) between January 2018 and December 2021. The inclusion criteria for subject selection included individuals who had been hospitalized for more than 3 weeks, were discharged from the hospital due to death, and provided informed consent after receiving a full explanation of their participation in the study. Exclusion criteria encompassed individuals with impaired consciousness or an inability to undergo oral examinations.

Upon admission to the ward, the initial oral condition was assessed using the OHAT, and the number of the remaining teeth was recorded by one dentist (M.O.). Thereafter, once a week from the time of admission, the oral status was assessed by 30 ward nurses using the OHAT. All nurses were briefed in advance about the OHAT, and the assessment criteria were verified with written instructions. The same subjects were then used to test the agreement of their ratings with the author's (M.O.), and the total scores were in perfect agreement for 22 of them (72.1%).

The general condition and continuation or interruption of oral intake were also evaluated using performance status (PS) (9). In addition, the following data were retrieved from the electronic medical records: age, sex, main disease during hospitalization, hospitalization period, and number of remaining teeth. This study was approved by the Fujita Health University institutional Ethics Review Committee (No. HM21-415). The research was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from all the patients or their relatives.

Highlight box

Key findings

- This study unveils significant oral health changes in palliative care patients.
- Performance status continuously worsened from three weeks pre-death.
- Two weeks before death, the Oral Health Assessment Tool score sharply declined, indicating deteriorating oral health.
- Saliva properties changed, leading to noticeable dry mouth as patients neared the end of life.

What is known and what is new?

- Past research leaned on cross-sectional data, lacking insights into the evolving oral health of palliative care patients.
- This manuscript offers essential longitudinal data, illuminating dynamic oral health changes.
- Precisely timed oral health deterioration is identified, notably significant dryness 2 weeks before death—an important predictive indicator.

What is the implication, and what should change now?

- Care providers must vigilantly monitor declining oral health in patients' final weeks.
- Early intervention and dry mouth management can enhance palliative care patients' comfort and quality of life.

Statistical analysis

For statistical analysis, Friedman tests were performed on PS, oral feeding status, and OHAT scores at 1, 2, and 3 weeks prior to the week of death. The Bonferroni method was used to determine how many weeks before death the changes occurred. The number of cases needed to find a significant difference when there is a one-point difference in OHAT total scores was 73, assuming a standard deviation of 2 (which is the maximum difference of each OHAT score), a two-sided significance level of 95%, and a power of 80%. IBM SPSS version 24.0 (IBM, Tokyo, Japan) was used for all analyses, and the significance level was set at $P<0.05$. The analysis was performed with nonparametric tests, and the results are presented as mean ± standard deviation for clarity.

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Table 1 Characteristics of patients admitted to the palliative care units

Variable	Values
Age (years)	76.2±9.6
Sex	
Male	37 (45.1)
Female	45 (54.9)
Length of hospital stay (days)	46.9±23.0
Primary cancer site	
Lung cancer	16 (19.5)
Colorectal cancer	11 (13.4)
Gastric cancer	8 (9.8)
Pancreatic cancer	8 (9.8)
Esophageal cancer	6 (7.3)
Uterine cancer	5 (6.1)
Gallbladder cancer	4 (4.9)
Breast cancer	4 (4.9)
Other	20 (24.4)
Number of remaining teeth	
Maxilla	7.4±5.5
Mandible	7.9±5.2
Number of subjects using dentures	
Using	34
Not using	30
Unknown	18

Data are presented as mean ± standard deviation, n (%) or n.

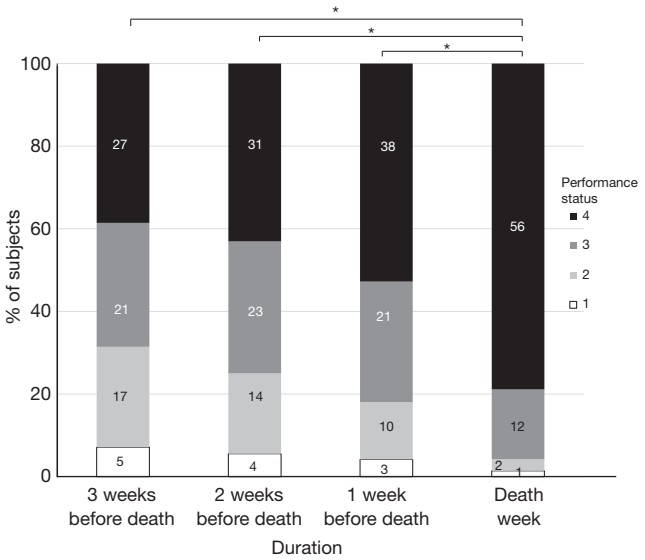

Figure 1 Changes in performance status until death. *, significant difference compared with week of death (P<0.05, Friedman tests and Bonferroni comparison).

Results

The mean age of the participants was 76.2±9.6 years, including four patients under 60 years of age, 13 patients in their 60s, 36 patients in their 70s, 27 patients in their 80s, and two patients in their 90s. The distribution of the primary cancer sites was as follows: lung, 16 patients (19.5%); colorectal, 11 patients (13.4%); gastric, 8 patients (9.8%); pancreatic, 8 patients (9.8%); esophageal, 6 patients (7.3%); and uterine, 5 patients (6.1%); gallbladder, 4 patients (4.9%); breast, 4 patients (4.9%); and others, 20 patients (24.4%). The mean length of hospital stay was 46.9±23.0 days. The mean number of remaining teeth was 7.4±5.5 in the maxilla and 7.9±5.2 in the mandible. Many patients had more than half of their teeth missing, both in the maxilla and mandible. However, less than half of the patients (34 patients) were using dentures at the time of the first assessment (*Table 1*).

The PS scores were used as an assessment of general condition (*Figure 1*). None of the patients had PS scores of 0 during the study period. Those with a PS score of 2 who could walk for short periods of time represented 26.7% of the total at 3 weeks before death. At the week of death, this figure was 3.6%, and 68% of the patients were completely bedridden (PS score: 4). Statistical analysis showed that the PS score decreased significantly in the week of death compared to the values recorded 3, 2, or 1 week before death.

Some kind of oral intake was recorded in 79.2% of the patients 3 weeks before death, while 48.8% of the patients did not eat in the week of death (*Figure 2*). Although some kind of meal was offered to 51.2% of the participants, only 18.3% were able to ingest it orally. Only two patients were able to ingest a normal meal in the week of death, whereas the remaining ones required a diet modified for easy swallowing.

Changes in the OHAT score during the study period are shown in *Table 2*. There was a significant difference in the total OHAT score between 3 and 2 weeks before death, and the week of death (*Figure 3*). For each OHAT item, there was also a significant difference in the "saliva" between

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3 and 2 weeks before death. There was also a significant difference in "oral hygiene" between 3 weeks before death and the week of death.

Discussion

The results of this study showed that PS and oral intake deteriorated continuously from 3 weeks before death; however, the OHAT scores deteriorated suddenly 2 weeks before death. The results also showed that the properties of saliva changed, and dry mouth became apparent. These findings suggest that changes in the oral environment leading up to death follow a different course compared to the decline in systemic function.

Previous studies have reported that the general condition does not deteriorate rapidly before death but worsens from 3 weeks to 1 week before death (10). PS was effective in the estimation of survival in outpatients with advanced cancer (11). In this study, the PS continuously decreased from 3 weeks before death to the week of death, and approximately 20% of the patients maintained a PS score of 3 or more even in the week of death, in agreement with previous research (12). In addition, Ohno *et al.* (13) reported

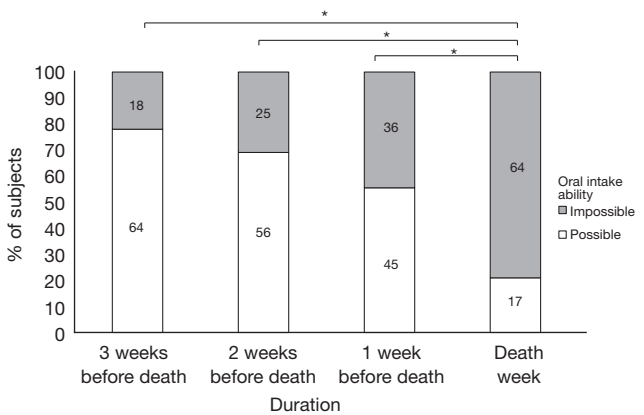

Figure 2 Changes in oral intake ability until death. *, significant difference compared with week of death (P<0.05, Friedman tests and Bonferroni comparison).

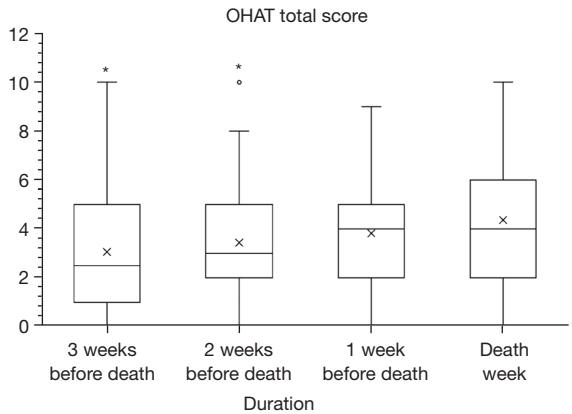

Figure 3 Changes in the total OHAT score until death. *, significant difference compared with week of death (P<0.05, Friedman tests and Bonferroni comparison). OHAT, Oral Health Assessment Tool.

Table 2 Changes in OHAT scores until death

OHAT score	3 weeks before death	2 weeks before death	1 week before death	Death week
Total score	3.06±2.23*	3.44±2.10#	3.83±2.23	4.37±2.45*#
Lips	0.44±0.50	0.42±0.50	0.59±0.54	0.65±0.53
Tongue	0.39±0.50	0.63±0.51	0.75±0.26	0.75±0.46
Gum and tissues	0.37±0.58	0.46±0.61	0.45±0.61	0.54±0.61
Saliva	0.55±0.59*	0.58±0.59#	0.75±0.61	0.91±0.62*#
Natural teeth	0.33±0.57	0.35±0.57	0.31±0.56	0.32±0.57
Dentures	0.23±0.48	0.23±0.53	0.21±0.50	0.23±0.53
Oral cleanliness	0.62±0.60*	0.79±0.59	0.75±0.63	1.00±0.67*
Dental pain	0.04±0.19	0.02±0.16	0.01±0.11	0.00

Data are presented as mean ± standard deviation. *, P<0.05 for comparison between 3 weeks before death and week of death; #, P<0.05 for comparison between 2 weeks before death and week of death; Friedman tests and the Bonferroni method comparison. OHAT, Oral Health Assessment Tool.

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that approximately half of the patients were incapable of oral intake from 2 weeks to 4 days before death. In this study, the percentage of patients incapable of oral intake increased from 15% to 68% from 3 weeks before death to the week of death. Many patients were not able to ingest food orally when it was provided, suggesting that the overall QOL declined during the study period.

In many of the patients, oral health deteriorated throughout the study period. Furuya *et al.* (14) reported that the tongue, gingiva, mucosa, saliva, and oral hygiene deteriorated in patients with advanced cancer. In this study, the lip, tongue, gingiva, mucosa, saliva, and oral hygiene also tended to deteriorate in the week of death. However, only saliva and oral hygiene showed significant deterioration 3 weeks before death in this study. The total score showed a tendency to deteriorate from 3 weeks before death to the week of death; in particular, a significant difference was observed when the scores from 3 weeks and from 2 weeks before death were compared. This suggests that oral health conditions do not deteriorate immediately before death, but slow deterioration begins around 3 weeks before death.

In this study, saliva decreased significantly from 3 weeks before death to the week of death. A decrease in saliva leads to a dry mouth. Dry mouth is the most frequently reported symptom in end-of-life patients; and has been identified together with dysphagia and oral candidiasis as one of the three major symptoms present in end-of-life patients by a systematic review (15,16). Reasons for dry mouth in end-of-life patients include physiological changes, dehydration, and drug side effects (17). It has a wide range of effects that include not only pain, but also speaking difficulties, progression of dental caries, and occurrence of oral candidiasis (18), all of which can reduce overall QOL (19).

Improvement of dehydration symptoms by fluid therapy, use of moisturizers, and oral care have been proposed as countermeasures for dry mouth (20). However, in end-of-life patients, the causes resulting in dry mouth become more complex with the deterioration of the general condition, and symptom improvement is harder to achieve (21). Therefore, it has been assumed that patients would show a marked tendency towards oral dryness starting at 2 weeks before death, and that the condition would remain unchanged after that.

In addition, oral hygiene showed a trend towards deterioration from 3 and 2 weeks before death to the week of death, and the absence of proper cleaning of the oral cavity seemed to make the situation worse. As with dry mouth, the deterioration did not take place suddenly before the death of the patient. Instead, remarkable deterioration was observed already 2 weeks before death, and the condition remained stable until death. This may presumably be the result of PS deterioration over time, leading to poor hygiene conditions due to difficulties in the enforcement of cleaning habits, diminished general activity, and a decrease in oral self-cleaning due to dry mouth.

Regarding the limitations of this study, the study was conducted at two different hospitals within the same university facilities, and it is not known whether the results of this study are representative of other palliative care units. However, the top four causes of death were consistent with those reported nationwide (1), and we believe that our hospital does not represent a special environment. In addition, the evaluation of the OHAT was carried out by the nursing staff, leading to some issues with its reliability. In fact, the percentage of evaluation agreement between the nursing staff and the authors was 72%. Moreover, this degree of agreement was recorded after guidance on how to evaluate the OHAT was provided to the staff, and the degree of agreement before this was even lower (52%). Therefore, in studies using the OHAT, it is necessary to further clarify the evaluation criteria. An objective index for evaluating the oral environment is also considered necessary, but sialometry is difficult to perform for our palliative patients; we plan to investigate the possibility of using an oral moisture-measuring device in the future. Despite the limitations of this method of evaluation, we were able to determine that the oral environment deteriorated from 2 weeks before death, and that saliva and oral hygiene could be used as indicators for clinical outcome prediction. Unfortunately, we did not examine the medication and infusion regimes that could potentially influence dry mouth symptoms. In this study, it is not known why changes in the oral environment occur. We would like to consider these points and determine whether oral dryness can be used as a predictor for time of death in the future.

Since end-of-life cancer patients are prone to deteriorating oral environments, healthcare teams in charge of providing palliative care need specialized training by dental professionals (22,23). It has also been reported that oral management improved dry mouth and dysgeusia symptoms in end-of-life patients (24). According to the present results, dry mouth and oral hygiene begin a noticeable deterioration 2 weeks before death and it is necessary to implement oral management from an early stage to prevent dry mouth in these patients. We believe the present study suggests that dental professionals should be involved in end-of-life care and that deterioration of

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oral health can be used to help predict the prognosis of individual patients.

Conclusions

The results of this study showed that oral health deteriorates over time as the patient's general condition declines, with saliva properties being particularly affected starting 2 weeks before death. Dry mouth is shown to be a potential predictor of fatal outcomes during end-of-life care.

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Footnote

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Data Sharing Statement: Available at https://apm.amegroups.com/article/view/10.21037/apm-23-456/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://apm.amegroups.com/article/view/10.21037/apm-23-456/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Fujita Health University institutional Ethics Review Committee (No. HM21-415). The research was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from all the patients or their relatives.

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