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ORIGINAL RESEARCH

Oral Health Status Using the Revised Oral Assessment Guide and Mortality in Older Orthopaedic Patients: A Cross-Sectional Study

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Purpose: Orthogeriatric hospitalised patients with fractures of the lower limb constitute a vulnerable population with increased risk of morbidity, polypharmacy, and mortality as well as impaired oral health. The aim of this cross-sectional study was to investigate whether any relationship existed between oral health issues in older orthopaedic patients and mortality.

Material and Methods: The study population consisted of older orthopedic patients emergently admitted to a hospital in southern Sweden due to mainly fractures of the hip. Their oral health at admission was assessed by trained nurses using the revised oral assessment guide (ROAG), as well as examined by dental hygienists. Medical and demographic data were collected from medical records and mortality from the national population registry. Comorbidity was assessed using the Charlson Comorbidity Index (CCI). Data were analysed using foremost dichotomized data derived from mean values and then processed using multiple logistic regression adjusted for identified probable confounders.

Results: Of the 187 study patients (≥65 years) with a mean age of 81 (SD 7.9) years, 71% were women, mean CCI score was 6.7 and 90-days mortality 12.3%. Oral health issues (ROAG >8, 73%) consisted mainly of problems with teeth/dentures (41%), tongue (36%), lips (35%), and saliva (28%). In patients with any oral health impairment (ROAG >8) the 90-days mortality was significantly increased (p=0.040), using logistic regression analysis adjusted for age, gender, comorbidity, and use of ≥5 drugs. In patients with a ROAG score ≥10 (≥mean) the association remained at 90-days (p=0.029) and 180-days (p=0.013). Decayed teeth were present in 24% and was significantly associated with ROAG >8 (p=0.020).

Conclusion: The main finding of this study was a possible relationship between oral health impairment at admission and early mortality in orthogeriatric hospitalised patients. The opportunity to identify their oral health problems can help improving further care planning and care.

Keywords: oral health problems, mortality, orthogeriatric patients, revised oral assessment guide

Introduction

Fall injuries are a global public health problem affecting older people and are the second most common cause of injuries leading to death in the world (WHO, Falls 2021). Conditions that increase with age, such as dementia, dizziness, impaired walking, disturbed balance, and use of fall-risk increasing drugs, have been reported to cause falls in older people.[1] Another aspect of ageing is the physiological changes and functional decline that occurs causing both oral frailty and systemic frailty as concluded by Dibello et al.[2] Common characteristics of those affected with fall injuries are old age, female gender, low socio-economic status, and poor living conditions.[3] One of the most grave consequences of falls in elderly is hip fractures and the negative impact that often follows on performing activities of daily life, chronic pain, increased comorbidity, increased use of medications, dependency on help from others, impaired quality of life, and mortality.[3–6] All-cause mortality in 2043 older hip fracture patients (>60 years) from the county of Skane, southern

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Sweden, a study by Kragh Ekstam et al, was found to be 8.5% at 30-days and 24.6% at 1-year after the fracture.[7] Several risk factors have been identified to increase mortality in hip fracture patients, including medication, chronic diseases of kidneys, heart, lung, and liver, cognitive disorders, diabetes, as well as accumulated comorbidity (Charlson Comorbidity Index (CCI) over 2), and male gender.[8]

Tooth retention is common today among older people, even well up in ages, compared to previous decades.[9] However, more natural teeth in old age can cause oral health problems when diseases, medication and functional disabilities affect older persons.[10] Additionally, disabilities and chronic diseases can make self-care of teeth and oral cavity difficult and can also impair the ability to visit dental centers.[11] In addition, intake of medications often reduce the saliva production as a side effect with a significant risk of developing dental caries.[12,13]

Impaired oral health can have severe consequences on the general health, which is becoming increasingly evident in frail older persons. Decreased chewing ability, dryness in the mouth, and swallowing difficulties can, for example, lead to malnutrition.[14] Recently, impaired oral health has been reported in older orthopaedic in-care patients with fall injuries.[15] Associations were found between poor oral health and comorbidity as well as treatment with certain drugs in patients with fractures of the lower extremities, including hip fractures. Thus, there are several reasons to emphasise the importance of good oral health in frail older individuals.[16] Problems in the oral cavity must be identified as early as possible, and measures be taken at different levels of care. A standardised oral assessments tool for this purpose should therefore be used.[17] The revised oral assessment guide (ROAG) is a well-established assessment tool used in different forms of care facilities in Sweden as well as in other countries, such as Denmark, Japan, and Brazil.[18–22] ROAG has been shown to be useful in terms of both reliability and validity.[17,23]

Connections between poor oral health and mortality in older people have been found in other care settings such as intermediate care, acute geriatric care and in community-dwelling older individuals.[24–26] However, knowledge about associations between oral health and mortality in older patients urgently admitted with major fractures is limited.

The objective of this cross-sectional observational study was to establish whether or not any relationship exists between oral health status in older orthopaedic in-care patients and 90-days mortality using mainly the revised oral assessment guide.

Methods

Settings and Inclusion of Patients

This cross-sectional study took place in a medium-sized hospital in southern Sweden in an orthopaedic department admitting emergency patients only. A consecutive sample of patients, 65 years and older, admitted to the department mainly due to fractures in the lower extremities and in need of emergency surgery, was included in the study during November 2016–March 2019. During this period, 504 possibly eligible patients were admitted and of them, 240 patients (48%) gave their consent to participate in the study. However, five patients later withdrew their consent, four were moved to other wards or hospitals, two died within the first day, two were just below 65 years of age and in 40 patients an oral health assessment using ROAG at admission was missing. Figure 1. In total, 187 patients were included. When performing a drop-out analysis on the non-participating patients, no differences were found concerning gender, type of fracture, or age compared to the study participants.

Study Design

The study was performed using a cross-sectional design based on data available at admission to the hospital. Data was obtained from electronic medical records, clinical dental examinations, oral health assessments (ROAG), and the Swedish population register. Written and verbal information about the study procedures were given by the care staff before the participants signed an informed consent. Patients who were unable to take part in the oral status examination and those who could not understand the study procedure information in Swedish were excluded. Dental examinations were conducted by two dental hygienists using light source and standard dental instruments according to methods applicable in general dental care (WHO, Ooral health survey). Basic methods. 2013). Calibration of the clinical procedures between the two experienced dental hygienists was performed before the study. Oral health assessments

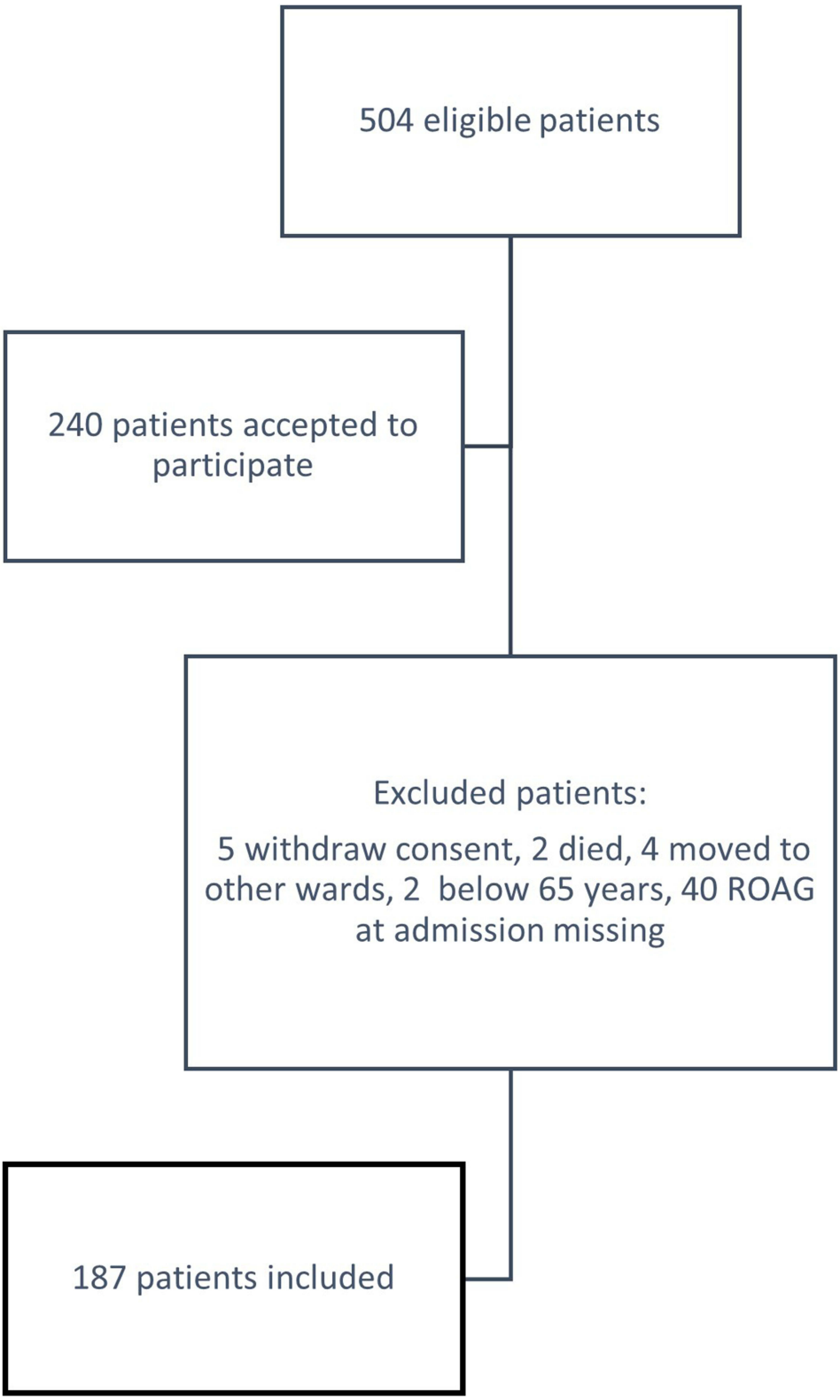

Figure 1 Flow chart of the inclusion process.

were carried out by trained nurses using ROAG, in connection with admitting the patients. The ROAG assessments were carried out using a light source and a mouth mirror.[17] Before the start of the study, the experienced dental hygienists trained the nurses (theoretical and practical education) about oral health problems and on how to perform the oral

assessments. The nurses also had the opportunity to consult one of the dental hygienists during data collection when questions arose.

Data Collection

Demographic and Medical Data

Included demographic data were age, gender, and whether the patients were community-dwellers or living in nursing homes. Medical data included type of fracture, all morbidities included in the Charlson Comorbidity Index (including among others heart disease, chronic obstructive lung disease (COPD), kidney failure, diabetes, and dementia), height, weight, and a blood test (creatinine for eGFR calculation). The patients´ regular use of medications prior to admission, divided into 5 or more drugs (polypharmacy) and 10 or more drugs (severe polypharmacy), was also compiled.

Based on earlier research, we separately analysed known oral health-related conditions such as diabetes, heart disease, dementia, and chronic obstructive pulmonary disease (COPD).[15] An evaluation of renal function was carried out by calculating the estimated glomerular filtration rate (eGFR). Reduced renal function, measured by eGFR, was defined by international standards and a value of 30 mL/min or lower was set. The Charlson Comorbidity Index (CCI), age-adjusted, was used to describe the general morbidity of the patients, and the mean value was used for comparison between groups.[27]

Oral Health Data

Relevant data for this study from the dental examination included prevalence of edentulousness, number of natural teeth, and prevalence of decayed teeth, for details see Andersson and Kragh Ekstam.[15] Number of teeth was dichotomized into <20 teeth versus ≥20 teeth.[28] Decayed teeth were registered when a carious cavity (tooth or root remnant) was apparent by visual inspection (manifest caries). In case of doubt whether the tooth was decayed or not it was registered as free of caries.

Oral health assessments were performed using ROAG, a tool designed to detect problems related to the oral cavity by nurses. The assessment includes eight categories: voice, lips, mucous membranes, tongue, gums, teeth/dentures, saliva, and swallowing. The separate categories are described and rated from score 1 (healthy) to score 3 (severe problems), total score 8–24.[17]

Ethics

The study was performed in accordance with the Declaration of Helsinki (2013) and the Ethics Committee in Lund, Sweden (2016–199) approved the study. Written informed consent was given by the participating patients or when needed, due to cognitive impairment, from next of kin representing the patient.

Statistical Analysis

Descriptive statistics for each variable were calculated using IBM SPSS Statistics version 28 (SPSS Inc., Chicago, USA). Data for continuous variables were presented as mean and standard deviation (SD), and categorical data as proportions (%). Categorical dichotomized variables were created from the continuous data based on means and they consisted of age (below mean, ≥81 years), length of hospital stay (below mean, ≥8 days), CCI (below mean, ≥7), ROAG score (8 healthy, >8), and ROAG score ≥10 (below mean, ≥10). Chi-square test or Fisher´s exact test was used when analysing categorical data and unpaired Student´s *t*-test for continuous variables. Logistic regression analysis was used for mortality data adjusting for identified probable confounders such as age, gender, comorbidity, and polypharmacy. Two-sided p-values <0.05 were regarded as statistically significant.

Results

The study population consisted of 187 patients, with a mean age 81 years (SD 7.9, range 65–100 years), who were urgently admitted to the orthopaedic ward with primarily fracture of the hip (85%), other fractures or orthopedic conditions of the lower limbs in need of emergency surgery. Most of the patients were women (71%) and before

admission 15% lived in nursing homes, whereas 85% lived in own homes. The mean length of hospital stay was 8.5 days (SD 3.4, range 2–27 days). Table 1.

Oral Health Data Including ROAG

A majority (92%) of the patients had natural teeth (mean number 19.2, SD 6.6, range 2–28), and of these 41% had 20 teeth or less, 24% were diagnosed with decayed teeth (mean 2.3, SD 3.2, range 1–17). One or more oral problems based on ROAG (score >8) were detected in 73% of the patients (mean 10.1, SD 2.1, range 8–18) and 91 patients had a ROAG score of 10 or more (over mean).Table 1.

Patients' characteristics in relation to their oral status are presented in Table 2. Cross-tabulation showed that impaired oral health, based on a ROAG score of >8, was significantly related to high comorbidity (p=0.018). ROAG score >8 was statistically significant in relation to hip fracture (p=0.001), hospital stay of 8 days or more (p=0.022), and polypharmacy (p=0.031). One or more decayed tooth was significantly related to the presence of <20 teeth (p= 0.007), ROAG score >8 and score ≥10 (p=0.006 and p=0.048, respectively). Mortality within 90 days was significantly related to oral variables such as a ROAG score of >8 or ≥10 (p=0.010 and p=0.010) and the presence of decayed teeth (p=0.018) (Table 2).

Table 1 Descriptive Characteristics of the Study Population

	Number of Patients (%)	Mean (SD) Range
Age	187 (100)	81.1 (7.9) 65–100
Age ≥81 years mean	103 (55.1)	
Female	132 (70.6)	
Male	55 (29.4)	
Hip fracture	159 (85.0)	
Care home residents	29 (15.5)	
LOS	187 (100)	8.5 (3.4) 2–27
LOS ≥8 days (mean)	76 (40.6)	
Patients' drug use	187 (100)	6.8 (4.4) 0–25
≥5 drugs	124 (66.3)	
≥10 drugs	41 (21.9)	
eGFR	187 (100)	59.3 (20.3) 10–123
eGFR <30 mL/min/1.73 m^2	16 (8.6)	
Comorbidity, CCI	187 (100)	6.7 (2.8) 1–15
CCI ≥7 (mean)	94 (50.3)	
Heart disease	78 (41.7)	
Dementia	28 (15.0)	
Diabetes	32 (17.1)	
COPD	22 (11.8)	
Edentulousness	15 (8.0)	
Dentate patients	172 (92)	
Number of teeth		19.2 (6.6) 2–28
<20 teeth	76 (40.6)	
Decayed teeth	41 (23.8)	2.3 (3.2) 1–17
ROAG score, total	187 (100)	10.1 (2.1) 8–18
>8	137 (73.3)	
≥10 (mean)	91 (48.7)	
Mortality		
30 days	12 (6.4)	
90 days	23 (12.3)	
180 days	26 (13.9)	

Abbreviations: LOS, length of hospital stay; eGFR, estimated glomerular filtration rate; CCI, Charlson Comorbidity Index; COPD, chronic obstructive pulmonary disease; ROAG, Revised Oral Assessment Guide; SD, standard deviation.

Table 2 Patients' Characteristics in Relation to ROAG >8, <20 Teeth, Occurrence of Decayed Teeth, and 90-Days Mortality

	ROAG >8		<20 Teeth		Decayed Teeth		Mortality 90-Day	
	N=137 (73%)	*P*	N=76 (41%)	*P*	N=41 (24%)	*P*	N=23 (12%)	*P*
Age ≥81 years	81 (59.1)	0.066	46 (60.5)	**0.046**	27 (65.9)	0.162	21 (91.3)	**0.001**
Female Male	96 (70.1) 41 (29.9)	0.798	54 (71.0) 22 (28.9)	0.868	27 (65.9) 14 (34.1)	0.470	13 (56.5) 10 (43.5)	0.108
Hip fracture	124 (90.5)	**0.001**	64 (84.2)	1.000	36 (87.8)	0.417	23 (100)	**0.035**
Care home residents	23 (16.8)	0.138	13 (17.1)	0.169	7 (17.1)	0.347	9 (39.1)	**0.000**
LOS ≥8 days	91 (66.4)	**0.022**	29 (38.2)	0.639	21 (51.2)	0.116	17 (73.9)	0.204
CCI ≥7 (mean)	76 (55.5)	**0.018**	43 (56.6)	0.091	25 (61.0)	0.075	18 (78.3)	**0.004**
Heart disease	57 (41.6)	0.961	47 (61.8)	0.641	19 (46.3)	0.351	13 (56.5)	0.080
Dementia	23 (16.8)	0.250	13 (17.1)	0.169	9 (22.0)	**0.044**	9 (39.1)	**0.000**
Diabetes	25 (18.2)	0.495	15 (19.7)	0.416	27 (65.9)	**0.001**	4 (17.4)	0.967
COPD	18 (13.1)	0.334	11 (14.5)	0.140	8 (19.5)	**0.030**	6 (26.1)	**0.037**
eGFR <30 mL/min/1.73 m^2	13 (9.5)	0.378	8 (10.5)	0.248	6 (14.6)	**0.050**	6 (26.1)	**0.001**
≥5 drugs	97 (70.8)	**0.031**	56 (73.7)	0.054	29 (70.7)	0.437	20 (87)	**0.023**
Edentulousness	15 (10.9)	0.547					3 (13.0)	0.344
<20 teeth (dentate patients)	60 (44.2)	0.175	-		26 (63.4)	**0.007**	13* (65.0)	**0.046**
Decayed teeth (dentate patients)	37 (29.1)	**0.006**	26 (34.2)	**0.007**	-		9* (45.0)	**0.018**
ROAG >8	-		60 (78.9)	0.222	37 (90.2)	**0.006**	22 (95.7)	**0.010**
ROAG ≥10 (mean and over)	-		26 (34.2)	0.357	18 (43.9)	**0.048**	17 (73.9)	**0.010**

Notes: *Mortality 90-days based on 20 dead patients; edentulous patients are excluded. Cross tabulation. Fisher´s exact test used and p-values <0.05 are presented in bold text.
Abbreviations: LOS, length of hospital stay; eGFR, estimated glomerular filtration rate; CCI, Charlson Comorbidity Index; COPD, chronic obstructive pulmonary disease; ROAG, Revised Oral Assessment Guide.

Oral health problems based on respective category of ROAG showed that problems with teeth/dentures, tongue, lips, and saliva were most frequently occurring, 41%, 36%, 35% and 28% respectively. Difficulties in swallowing were least common with 16 patients affected (9%) (Table 3).

As shown in Table 4, when patients with a ROAG score >8 were compared to those with normal ROAG score, the associations with incidence of hip fracture (p=0.007) and decayed teeth were still significantly increased (p=0.020). Data were analysed with logistic regression adjusted for possible confounders (age, gender, comorbidity with a CCI score over mean, and polypharmacy).

Mortality

When comparing patients who died within 90-days (23 patients) of admission with different demographic and clinical variables, significantly increased mortality was found in connection with some of the variables. Data were then analysed with multiple regression analysis, adjusted for identified probable confounders, such as age, gender, CCI over mean and the use of ≥5 drugs. As shown in Table 5, when data from patients with a ROAG score >8 was adjusted for these confounders, the association with 90-days mortality was still significant (p=0.040). A significantly increased mortality was also found in patients with a ROAG score of ≥10 at 90-days as well as at 180-days (p=0.029 and p=0.013 respectively).

Table 3 Patients with a ROAG Score >8, Presented as Total and Respective Category

	ROAG Score >8 N (%)
Any oral health problems ROAG score >8	137 (73.3)
Categories	
Teeth/denture	77 (41.2)
Tongue	67 (35.8)
Lips	66 (35.3)
Saliva	48 (27.7)
Mucous membranes	34 (18.2)
Voice	34 (18.2)
Gums	19 (10.2)
Swallowing	16 (8.6)

Abbreviation: ROAG, Revised Oral Assessment Guide.

Table 4 Patients' Characteristics in Relation to ROAG Score >8, and 90-Days Mortality

	ROAG >8 Score		**Mortality 90-Days**	
	N=137 (73%)	***P***	**N=23 (12%)**	***P***
Hip fracture	124 (90.5)	**0.007**	23 (100)	0.998
Care home residents	23 (16.8)	0.965	9 (39.1)	**0.036**
LOS ≥8 days	91 (66.4)	0.076	17 (73.9)	0.874
Dementia	23 (16.8)	0.644	9 (39.1)	**0.012**
COPD	18 (13.1)	0.700	6 (26.1)	0.122
eGFR <30 mL/min/1.73 m^2	13 (9.5)	0.975	6 (26.1)	0.266
<20 teeth (dentate patients)	76 (55.5)	0.175	13*(65.0)	0.228
Decayed teeth (dentate patients)	37 (29.1)	**0.020**	9*(45)	0.061

Notes: *Mortality 90-days based on 20 dead patients; edentulous patients are excluded. Logistic regression analysis with data adjusted for age, gender, comorbidity, and use of 5 or more drugs. P-values <0.05 are presented in bold text.
Abbreviations: LOS, length of hospital stay. eGFR, estimated glomerular filtration rate. COPD, chronic obstructive pulmonary disease. ROAG, Revised Oral Assessment Guide.

Table 5 Comparing Patients with ROAG Score >8, and ≥10, to Mortality at 30-, 90-, and 180-Days

	Mortality 30-Days		**Mortality 90-Days**		**Mortality 180-Days**	
	N=12 (6%)	***P***	**N= 23 (12%)**	***P***	**N=26 (14%)**	***P***
ROAG >8	12 (100)	0.997	22 (95.7)	**0.040**	24 (92.3)	0.056
ROAG ≥10 (mean and over)	8 (76.7)	0.305	17 (73.9)	**0.029**	19 (73.1)	**0.013**

Notes: Logistic regression analysis with data adjusted for age, gender, comorbidity (CCI over mean) and use of ≥5 drugs. P-values <0.05 are presented in bold text.
Abbreviations: ROAG, Revised Oral Assessment Guide; CCI, Charlson Comorbidity Index.

Dementia, chronic obstructive pulmonary disease, and renal dysfunction were also associated with increased mortality at 90-days, unadjusted data. These and other chronic diseases were all included in the calculation of CCI, and hip fractures occurred in over 90% of the patients, so these variables were not individually adjusted for.

Discussion

In this study, a possible relationship was found between early postoperative death and impaired oral health in orthogeriatric patients when using the ROAG assessment tool. A significant association was found between impaired

oral health (ROAG score over 8) and 90-days mortality (p=0.040). This association between early mortality and deteriorated oral health was strengthened when a mortality analysis was carried out in patients with a ROAG score of 10 or more, p=0.029 at 90-days and p=0.013 at 180-days.

The settings for the study were in-hospital care for emergently traumatised patients in need of urgent orthopaedic surgery. At admission to hospital, oral assessments were conducted with a combination of examinations of the patients´ oral cavity by dental hygienists and trained care personnel using ROAG. However, we found, that the ROAG assessment provided adequate information on the oral health status´, and the risk of early postoperative mortality, in this group of patients.

ROAG is frequently used in northern European countries, as well as in other regions, and in different health care settings for older people. However, we found that this assessment tool can also be of value as a research evaluation instrument. This warrants that the results of this study can be reproducible in further research as well as used for comparison with patients in other clinical settings, such as at primary care centers, care homes or municipal intermediate short-term accommodations. Another aspect is that the ROAG tool is easy to use and does not require any advanced equipment or premises and can easily be learned by inexperienced nursing personnel.[17]

A majority of the patients had one or more problems with their oral health and half of the patients had two or more problems. It is important to note that these problems existed already at admission to the ward and did not occur during the hospital stay. The most common findings from the ROAG assessments were problems with teeth or dentures. This result is in line with other studies in older people in different care facilities, eg, rehabilitation after stroke, short-term care and nursing homes.[17–19,29] The results when assessing the teeth and dentures showed that the presence of plaque, debris, and decayed teeth were common and thereby that the ability to carry out oral hygiene procedures was impaired among the patients. This indicates that the need of support with oral care existed already before the hospitalization.

When analysing patients with fewer than 20 teeth, we found no connection between missing teeth and mortality in our patients. It has been reported by Marin-Zuluaga that the number of teeth may be of importance for the survival rate. In their study, they found a relationship between fewer than seven teeth and mortality[30] A separate analysis of the patients with considerably less than 20 teeth could have given other results, but since we wanted to be able to compare our results with other studies, we chose the frequently used measure of less than 20 teeth.

Another important aspect is that approximately 25% of the patients had visibly decayed teeth which shows an urgent need for dental care as it takes several years for manifest caries to develop.[31] It is remarkable that these cavities had not been repaired and indicates that these older persons had not been in contact with dentistry lately. This corresponds to results from Grönbeck-Lindén et al, which showed that regular dental care often is lost among older people, both in dependent and independent persons not in need of help with daily activities.[11] Thus, it is necessary that older people are made aware of the importance of dental care throughout their lives to avoid severe damage to the mouth.

Oral dryness was another common oral health problem (28%), which can partly be explained by polypharmacy and high comorbidity, both of which were frequent among the patients. Measures to relieve and prevent oral dryness are needed to avoid consequences such as dental caries. Also, other assessment categories except saliva, foremost voice, and swallowing, can in ROAG indicate oral dryness and thereby help identify the need of appropriate measures.

In this study, we found that oral health impairment, as well as dementia and being a resident in a nursing home, was significantly linked to mortality within 90-days after admission of the patients. Even when adjusted for confounders, the connection between mortality and residing in a nursing home remained. This we consider to be linked to the high rate of the residents diagnosed with dementia, which is present in 70% of Swedish care home residents according to a study by Sm-Rahman et al.[32]

The connection between oral health and mortality found in the present study confirms those of other studies conducted in other settings and study populations, as described in a systematic review by Dibello et al.[2] It is evident that the health of the oral cavity plays an important role in developing age-related physical decline, including the nutritional aspect. Besides, the increased 90-days mortality in the group of patients with a ROAG score >8, we also found a significant association with mortality at 90- and 180-days in patients with a ROAG score of ten or more. Comparable results were reported by Maeda and Mori in 2020, that geriatric patients with multiple oral health problems, had a higher in-hospital mortality than patients with no or only minor problems.[25] In their study, the Oral Health Assessment Tool

(OHAT) was used, a tool that in most aspects can be compared with ROAG, but they had dental hygienists performing the oral assessments.

Strengths and Limitations

Only a third of possibly eligible patients during the set time frame was included in the study. It can be assumed that those who did not participate differed compared to the included patients, that they were older and in poorer oral health. An analysis of the drop-out patients showed however no significant differences between non-participating and included patients, concerning age, gender, or fracture. A reluctance to participate could partly be caused by a feeling of shame about their dental condition but also by the stressful circumstances that the patients experienced when admitted to hospital. Even if we have no information about the oral health status among the non-participating patients, it can be hypothesised that a large proportion of those also had poor oral health which can cause both information and selection bias. Also, any impaired ability to gape long enough during the examination of the oral cavity can result in under-estimation of oral health problems. However, a high proportion of the examined patients was found to have impaired oral health indicating that few problems were missed.

One limitation of the study was that data on cause of death was not available. We present therefore only all-cause mortality which limits our understanding of any associations between specific oral health problems, comorbidities, and mortality. Other relevant data, for example smoking and nutritional status was not reliably available from the electronic records, which could have given a better understanding of how the patients oral status could have influenced their nutrition, and mortality.[33] When the patients' medications were assessed, we used only drugs taken on a regular basis, however many older people use for example sleeping tablets every night even though their doctors have prescribed them as per needed only.

A strength is that in this study we had access to a wide variation of data concerning clinical and medical data, including blood samples, as well as some demographic information. The collection of data from electronic medical records was carried out during the time the patients were cared for in the ward, thereby securing accurate data for the study. It was qualified dental hygienists with long experience of teaching who trained the care personnel in performing the oral assessment and assured that relevant equipment was available as well as giving support when any questions concerning oral status occurred. Also, the use of Charlson Comorbidity Index, widely used for defining comorbidity and mortality, ensures that our data can be compared with those of others.

All data were retrieved at admission, with the exception of when time of death occurred, which was obtained within 1 year after admission from the Swedish population registry, which has a high accuracy. Another strength of the study was that the statistical analyses were conducted employing generally used and appropriate methods and can, to our understanding, be easily reproduced.

Clinical Significance and Further Research

In several studies, the connection between oral frailty and systemic frailty in older people has been shown and the increased mortality in our group of patients is another sign of the physical decline that occurs in old age. Falls, hospitalization, mortality, and functional disability are factors that have been reported by several studies to be associated with oral frailty.[34]

Elderly patients who have undergone urgent orthopedic operations require at the time of discharge a structured and thorough care planning to ensure their future needs of care and support. We found that results from ROAG at admission in hospitalised patients gave important information for an efficient care planning as the transfer of care takes place from hospital to municipal and primary care. The oral status assessed using ROAG and measures related to this assessment need therefore be a part of the information included in the care planning before the patients are discharged from the hospital. Reasonable goals for future care can be set and resources be put in place from dentistry, primary care, and municipal care to the benefit of the patients. Other benefits for older patients with identifying their oral problems are the possibly negative impact on quality of life they may experience, as shown by Muirhead et al in 2014.[35] During the hospital stay, information on identified problems in the mouth and teeth should be presented to both the patients themselves and to their care supporters, helping to motivate the patients to seek help with their oral health problems.

Assessing oral health in orthogeriatric patients urgently admitted to hospital opens up an opportunity to identify individuals in need of help with oral and dental care after discharge to the community. We would like to emphasise the importance of seizing this opportunity to help improve the outcome of this group of vulnerable patients concerning their quality of life, and life expectancy.

Further research is needed on what significance this may have on establishing relevant goals in care planning and undertaking of appropriate actions.

Conclusion

The main finding of this study was a possible relationship between oral health impairment at admission to hospital and early mortality in orthogeriatric patients. The opportunity to identify oral health problems in this group of patients should be seized and can constitute an important component in further care planning and care.

Data Sharing Statement

Published data compiled for this study are available from the corresponding author at request.

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Disclosure

The authors report no conflicts of interest in this work.

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