Journal of Visualized Experiments

Oral Health Assessment by Lay Personnel for Older Adults

--Manuscript Draft--

Article Type:	Invited Methods Collection - JoVE Produced Video
Manuscript Number:	JoVE60553R1
Full Title:	Oral Health Assessment by Lay Personnel for Older Adults
Keywords:	oral health; dental care for the aged; oral medicine; pneumonia, bacterial; diabetes mellitus, type 2; dementia; dental plaque index; quality of life
Corresponding Author:	Cameron B Jeter The University of Texas Health Science Center at Houston Houston, Texas UNITED STATES
Corresponding Author's Institution:	The University of Texas Health Science Center at Houston
Corresponding Author E-Mail:	Cameron.B.Jeter@uth.tmc.edu
Order of Authors:	Natalia S. Rozas
	June M Sadowsky
	Jordyn Stanek
	Cameron B Jeter
Additional Information:	
Question	**Response**
Please indicate whether this article will be Standard Access or Open Access.	Standard Access (US$2,400)
Please indicate the **city, state/province, and country** where this article will be **filmed**. Please do not use abbreviations.	Houston, Texas United States of America

UTHealth
The University of Texas
Health Science Center at Houston

School of Dentistry
Department of Diagnostic & Biomedical Sciences

July 9, 2019

Dear Editor,

We are submitting a protocol module entitled “Oral health assessment by lay personnel for older adults” for consideration for publication in JoVE.

As the world’s population of older adults continues to increase over the next couple of decades, caregivers need a broader set of tools to meet their diversity of health needs. Oral health is an oft-overlooked component of health. Indeed, oral health is key to overall health, with individuals diagnosed with Type II diabetes more likely to develop periodontitis, an inflammatory gum disease. So, too, persons with periodontitis are more likely to develop Type II diabetes. Thus, health care providers and family members alike should be equipped to evaluate oral health regularly, quickly, and comprehensively. Though our protocol is suitable for adults of all ages, it is intended for elders who are more prone to inflammation and chronic diseases that are interlinked with oral health.

In sum, the goal of our protocol is to enable all caregivers – health care providers and lay caregivers – to assess oral health status of older adults across time. We desire this to spark proactive discussions and collaborations among dental health professionals, geriatricians, nursing staff and family for the health benefit of their patients and loved ones.

Your favorable consideration is greatly appreciated.

Sincerely,

Cameron B. Jeter, Ph.D.
Associate Professor
Diagnostic and Biomedical Sciences
The University of Texas School of Dentistry at Houston
7500 Cambridge Street, Suite 5371
Tel: 713-486-4427
Houston, TX 77054
Email: Cameron.B.Jeter@uth.tmc.edu

TITLE:

Oral Health Assessment by Lay Personnel for Older Adults

AUTHORS AND AFFILIATIONS:

Natalia S. Rozas[1], June M. Sadowsky[2], Jordyn Stanek[1], Cameron B. Jeter[1]

[1]Department of Diagnostic and Biomedical Sciences, The University of Texas Health Science Center at Houston School of Dentistry, Houston, TX, USA

[2]Department of General Practice and Dental Public Health, The University of Texas Health Science Center at Houston School of Dentistry, Houston, TX, USA

Corresponding Author:

Cameron B. Jeter (Cameron.b.jeter@uth.tmc.edu)

Email Addresses of Co-Authors:

Natalia S. Rozas (Natalia.S.Rozas@uth.tmc.edu)

June M. Sadowsky (June.M.Sadowsky@uth.tmc.edu)

Jordyn Stanek (Jordyn.A.Stanek@uth.tmc.edu)

KEYWORDS:

oral health, dental care for the aged, elderly, caregiver, oral medicine, pneumonia, type II diabetes mellitus, dementia, dental plaque index, quality of life, dysphagia

SUMMARY:

The goal of this protocol is to enable non-dental professionals to assess oral health status for research or health-screening purposes. Aspects assessed include lips, tongue, soft and hard tissues, natural and artificial teeth, oral cleanliness, plaque, swallowing, and impact of oral health on quality of life.

ABSTRACT:

Oral health is an often-undervalued contributor to overall health. The literature, however, underscores the myriad of systemic diseases influenced by oral health, including type II diabetes, heart disease, and atherosclerosis. Thus, assessments of oral health, called oral screenings, have a significant role in assessing risk of disease, managing disease, and even improving disease by oral care. Here we present a method to assess oral health quickly and consistently across time. The protocol is simple enough for non-oral health professionals such as students, family, and caregivers. Useful for any age of patient, the method is particularly key for older individuals who are often at risk of inflammation and chronic disease. Components of the method include existing oral health assessment scales and inventories, which are combined to produce a comprehensive assessment of oral health. Thus, oral characteristics assessed include intraoral and extraoral structures, soft and hard tissues, natural and artificial teeth, plaque, oral functions such as swallowing, and the impact this oral health status has on the patient's quality of life. Advantages of this method include its inclusion of measures and perceptions of both the observer and patient, and its ability to track changes in oral health over time. Results acquired are quantitative

totals of questionnaire and oral screening items, which can be summed for an oral health status score. The scores of successive oral screenings can be used to track the progression of oral health across time and guide recommendations for both oral and overall health care.

INTRODUCTION:

Oral health affects overall health. Oral movement serves to move food and debris immediately from the mouth, and together with the protective functions of saliva, they are the body's natural defense mechanism against oral infections and tooth decay[1]. Lack of oral health leaves individuals highly prone to accumulation of oral pathogens, inflammation, and infection that can spread to the body. For example, patients with type II diabetes are at higher risk of developing periodontitis, an inflammatory gum disease. So too, patients with periodontitis are more likely to develop type II diabetes, as periodontal disease can affect glycemic control[2,3]. Poor oral health is linked with many additional systemic, or body-wide diseases, including heart disease, stroke, and osteoporosis[4–6].

The need to screen patients for oral health status, then, is not only important for diagnosing oral disease, but also assessing systemic disease risk. This is particularly important in older individuals, who more often develop inflammatory chronic conditions[6]. Further, poor oral health begets social isolation, dehydration, and malnutrition. Patients with infirmities such as dementia, stroke, and Parkinson's disease (PD) often develop dysphagia, or have trouble swallowing[7]. In addition to causing unsightly drooling, this life-threatening condition can cause oral bacteria to be swallowed inadvertently into the lungs. Aspiration pneumonia is a common outcome and major cause of death in the elderly[8].

Our objective is to provide an oral screening protocol that non-dental professionals can use for research or health purposes. We describe a compilation of existing oral screening tools that together are a comprehensive and expedient assessment of oral health. We chose these tools primarily to allow dental students to collect data in research studies and gain patient experience. Legal restrictions limit the techniques students (i.e., non-degreed, non-licensed trainees) can perform; this compilation is designed to be conducted by any pretrained or calibrated student. In addition, nurses, caregivers, and family members may also use these protocols in the oral health monitoring of senior adults. These tools include the General Oral Health Assessment Index (GOHAI)[9], the swallowing subscale of the Radboud Oral Motor Inventory (ROMP)[10], the Brief Oral Health Status Examination (BOHSE)[11], and the Simplified Oral Hygiene Index (OHI-S)[12]. Oral characteristics assessed include intraoral and extraoral structures, soft and hard tissues, natural and artificial teeth, plaque, oral functions such as swallowing, and the impact this oral health status has on the patient's quality of life. Anyone can complete this oral screening legally and safely, even those without dental training or dental instruments. The brief nature of the oral screening allows caregivers and researchers to track changes in oral health easily across time.

In addition to the fact that almost anyone can learn to administer this oral screening, an advantage of this method is that it includes both screener and self-report components. Thus, concrete measures of oral health can be partnered with the functional and emotional perceptions of the patient.

Self-report components (patients' opinions of their oral health)

General Oral Health Assessment Index

The GOHAI is a self-reported measure of oral health quality of life status in older adults[9]. The survey has 12 questions that rate oral function, oral pain and discomfort, and psychosocial impacts (**Table 1**). Used to assess oral health in over 200 scientific publications, the GOHAI questionnaire has been shown to be sensitive to the provisions of dental care[13] and to predict subjective well-being after 10 years[14]. Furthermore, a caregiver can complete the GOHAI if the patient is unable to communicate effectively[15].

Several questionnaires exist to measure oral health-related quality of life; the most popular include the Oral Impacts on Daily Performances (OIDP)[16], the Oral Health Impact Profile (OHIP)[17,18], and GOHAI. The OIDP measures eight daily performances in frequency and severity but is not specifically designed for elderly patients. The OHIP was originally designed as a 49-statement survey but was later shortened to 14 statements (OHIP-14)[19]. Several studies have compared the effectiveness of OHIP-14 and GOHAI. All conclude that both assessments are comparable, although a few studies show that elderly people with high oral health needs may identify better with GOHAI, and that GOHAI may be more sensitive to objective values of oral functioning[20–26]. Therefore, we chose to use the GOHAI over the OHIP-14.

Swallowing subscale of the Radboud Oral Motor Inventory

Dysphagia (swallowing difficulty) commonly affects the elderly population due to muscle atrophy. It can affect up to 35% of elderly people over 75 years of age, and it greatly increases the risk for malnutrition and aspiration pneumonia[27]. The percentage of affected patients increases to more than 50% if the patient has a neurological disorder (e.g., Parkinson's disease, Alzheimer's disease, multiple sclerosis, stroke, and others)[28]. Most objective measures of dysphagia are too invasive for the elderly, or require the expertise of a professional (i.e., clinician or speech and language pathologist) as well as specialized equipment (i.e., endoscope or videofluoroscope). Therefore, using a validated self-assessment questionnaire is a good alternative when students are collecting data or caregivers must quickly assess dysphagia in a patient for referral to a specialist.

There are over two dozen self-evaluation questionnaires for dysphagia, each specific for a certain type of patient[29–32]. The most comprehensive and popular is the Swallowing Quality-of-Life (SWAL-QOL) questionnaire[33], which is designed for many different types of patients, including patients with neurodegenerative disorders. However, this questionnaire is rather long, consisting of 44 questions.

A patient may be overwhelmed answering a battery of questionnaires and sitting for long sessions while examiners collect data, especially if the patient is suffering an age-related disorder. The ROMP was originally created to measure dysphagia, sialorrhea, and speech problems in

patients with PD[10]. The swallowing portion of the ROMP consists of 7 questions with a 5-point Likert scale response option (**Table 2**). It can be administered in a short time and even in frail elderly. Therefore, this compilation includes the swallowing portion of the ROMP. For research purposes, investigators may evaluate other swallowing assessment surveys to ensure use of the best option for their research goals[32].

Screener components (screener's rating of patients' oral health)

Brief Oral Health Status Examination and Simplified Oral Hygiene Index

Oral health has improved over the years, with more elderly keeping their teeth and thus needing oral care into their last decades[34,35]. Certain sectors of this population, however, remain with poor oral health. Specifically, elderly people living in long-term care facilities and those suffering age-related diseases have prevalent oral problems including caries (i.e., cavities), gingivitis, plaque accumulation, denture problems, and mucosal lesions[36–39]. Ideally, elderly have a dental visit at least twice a year and upon admittance to a long-term care facility, but most often this is not the case. The final two components of our oral health assessment employ observation of the oral cavity but without the need of dental expertise or professional dental instruments.

Few oral health assessments are designed for a lay or inexperienced person to evaluate oral health. The index for Activities of Daily Oral Hygiene (ADOH) is an assessment of physical ability to perform oral hygiene and evaluates an elderly individual complete flossing, brushing, topical fluoride application, and oral rinses[40]. Whereas this tool is a good option to record the progressive loss of oral hygiene capacity by elderly people, it does not assess oral status and is involved and time consuming. The Oral Health Screening Tool for Nursing Personnel (OHSTNP) was recently published and validated[41]. This oral screening tool has 12 items, including many that are very similar to the BOHSE. The screening includes evaluation of basic nutrition and oral functioning during meal intake and swallowing. Yet, no other studies corroborate its validity. The Oral Health Assessment Tool (OHAT) is an 8-item tool, derived from the BOHSE, widely used to screen oral health in residents of long-term care, including those with dementia[42]. Therefore, we include the BOHSE (**Table 3**) as it is well-established, reliable, validated and can be used by lay personnel[11,42,43]. To include measurement of plaque accumulation, we added the OHI-S (**Table 4**) with a modification to help nurses, caregivers, and health students calculate debris index easily without interfering with dental license restrictions[12,44].

Together, these four oral health assessments comprise a short and easy evaluation tool that can be used by nurses and caregivers to quickly assess oral health status in elderly individuals at home, long-term care or even the hospital before referring to a dental professional. This compilation is also useful to engage health students in research and patient interaction, particularly helping future dental professionals care for the growing elderly population.

PROTOCOL:

The Institutional Review Board (IRB) of The University of Texas Health Science Center at Houston

has approved all methods described here.

1. General recommendations

1.1. If time allows, complete the questionnaires and the oral health assessment on subsequent days or with a break between them as this reduces patient fatigue and resistance.

1.2. Begin with the questionnaires to create rapport and trust between the screener and patient, which eases the transition to the oral screening, when the screener will be in close proximity to the patient's face and mouth.

1.3. Always allow the patient to rest between questions if they request. Elaboration on the questionnaire items is not necessary, so as needed, gently keep the conversation on topic.

1.4. For research purposes, randomize the order of the questionnaires and include information regarding the last time the patient had a meal or drink (other than water) and the last time the patient performed oral hygiene (i.e., brushing teeth, using oral rinse, etc.), as needed.

1.5. Use proper infection control techniques. Be mindful of the sequence of physical contact the oral screener has with the patient and surrounding objects. For example, do not use examination gloves (or bare hands) to touch the patient's mouth, pick up a pen to write the results on paper, and then return to the patient's mouth.

1.6. Recruit a second observer to serve as the scribe, writing the results of the oral screening on the paper questionnaires.

NOTE: This allows the oral screening to proceed more quickly and also serves as an infection control, limiting the oral screener's physical contact to the patient.

1.7. Include all patients over 50 years of age.

NOTE: As the assessment is intended for use to rate oral health for possible referral to a dentist, the method can be used on all patients, including those who have dentures, are edentulous, bed-ridden, mute, or cognitively impaired. In the latter cases, ask caregivers for responses to the self-report questions.

2. Training

2.1. Read the original research papers for the four oral health assessment tools included here. Pay particular attention to the Introduction and Discussion sections of the papers, as they describe why and for what populations each tool was created.

2.2. Watch the video associated with this publication to see the oral health screening in action.

2.3. Practice screening friends and family for oral health status using **Table 1**, **Table 2**, **Table 3**, **Table 4**, and the protocol described here. Repeat until an individual's oral screening can be repeated in under 30 min.

3. General Oral Health Assessment Index (GOHAI)[9]

3.1. Ask the patient to sit comfortably to answer questions. Tell the patient to consider the last 3 months when answering. If the patient is unable to answer the questions due to a disability, have a caregiver answer the questions and make a note of this.

3.2. Ask questions from **Table 1** one at a time. Mark the patient's answers on a paper or digital copy of this GOHAI questionnaire. At the conclusion of the 12 questions, thank the patient and ask if he/she has any comments to add.

3.3. Score the GOHAI in one of two ways, either the additive or simple count methods.

NOTE: Additive score: For the 3 questions worded in a positive way (question 3, 5 and 7), reverse the codes (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always to 1 = always, 2 = often, 3 = sometimes, 4 = seldom, 5 = never). Sum the response codes for the 12 answers. For this method, the GOHAI scores range from 12 to 60. The simple count GOHAI score is used to ensure that patients did not get confused using a 5-point scale. Score 0-points for "never" and "seldom" and 1-point for "sometimes" "often" and "always". Summed GOHAI scores with the simple count method range from 0 to 12. In both cases, higher scores represent poorer oral health-related quality of life.

4. Swallowing subscale of the Radboud Oral Motor Inventory (ROMP)[10]

4.1. Tell the patient to consider the last 3 months when answering the next 7 questions. If the patient is unable to answer the questions due to a disability, have a caregiver answer the questions and make a note of this.

4.2. Ask questions from **Table 2** one at a time. Mark the patient's answers on a paper or digital copy of this swallowing subscale of the ROMP. Thank the patient and ask if he/she has any comments to add.

4.3. Sum the scores of each swallowing question for a total swallowing score.

NOTE: ROMP swallowing scores range from 7 to 35; higher scores represent worsened swallowing ability. The simple count method can also be used with this questionnaire (see step 3.3 for more information).

5. Brief Oral Health Status Examination (BOHSE)[11]

5.1. Have a paper copy of the BOHSE for the oral screening and mark scores on it during

examination of each oral and dental area (**Table 3**). Recruit a second observer to serve as a scribe to speed the examination and prevent infections.

5.2. Ask the patient to sit comfortably and to expect observation of his/her neck, mouth, and teeth. Tell the patient he/she should not feel any discomfort and if they do, to communicate this by raising his/her hand.

5.3. Stand behind the seated patient. Cup fingers and gently palpate the submandibular and submental lymph nodes just anterior to the angle of the jaw. Ask the patient if he/she is tender to the touch. Select the BOHSE score for lymph nodes (0–2) that applies.

NOTE: Lymph nodes are small (~1 cm diameter) lumps beneath the skin but are not palpable if they are healthy. Infected lymph nodes are tender, soft, painful to the touch and are movable. Cancerous lymph nodes are hard, not painful and unmovable.

5.4. Tell the patient that next is observation of his/her lips. Observe the lips and corners of the mouth for their color, dryness and any other abnormalities (such as ulcers, bleeding, crusty scars, sores with rounded edges or discoloration at the edge of the lips that meet the facial skin). Ask the patient for how long he/she has had any abnormalities observed. Select the BOHSE score for lips (0–2) that applies.

5.5. Tell the patient that next is observation inside his/her mouth. Ask the patient to open his/her mouth and stick out his/her tongue. Observe the status of the tongue for color, dryness and any other abnormalities such as ulcers and bleeding.

5.6. Touch the tongue (with examination gloves) and assess for texture. Ask the patient for how long he/she has had any abnormalities observed. Select the BOHSE score for tongue (0–2) that applies.

NOTE: If the patient cannot protrude the tongue for as long as needed, grasp the tongue with thumb and forefinger and gently hold the tongue outside the oral cavity.

5.7. Observe inside his/her mouth at the inside of the cheeks and the floor and roof of the mouth for their color, dryness and any other abnormalities such as ulcers and bleeding. Use a tongue depressor as needed to stretch open the cheeks and a penlight for better observation. Ask the patient for how long he/she has had any abnormalities observed. Select the BOHSE score for tissue inside cheek, floor and roof of mouth (0–2) that applies.

5.8. Examine the patient's gums, using a tongue depressor to gently press his/her gums and evaluate for firmness and coloration. Ask the patient if he/she has any loose teeth or soreness around his/her teeth. Select the BOHSE score for gums (0–2) that applies.

NOTE: The gums should not have redness, bleeding, food debris or plaque at the triangle between the teeth.

5.9. Tell the patient that next is looking at his/her saliva and touching his/her tongue with a tongue depressor. Observe for oral tissue dryness and salivary flow (i.e., by saliva pooling in the floor of the mouth). Ask the patient if his/her mouth feels dry when eating or if he/she has difficulty swallowing food without drinking water. Select the BOHSE score for saliva (0–2) that applies.

5.10. Tell the patient next is inspection of the teeth. Count all of the natural (original) teeth and write the number at the bottom of the BOHSE table. Look for decayed, broken or chipped teeth while looking at the natural teeth. Select the BOHSE score for natural teeth (0–2) that applies.

NOTE: Decayed teeth may have discoloration or break down of the tooth surface, widening of the fissures of the tooth, and there may be small holes in the white enamel or even brown or black visible discolored spots.

5.11. Look at the condition of any artificial teeth (i.e., dentures, implants, or crowns). Look for chips and wear. Ask the patient: if he/she has partial dentures or has had any tooth replacements or implants, if he/she has lost any artificial teeth or other oral appliances in the past, and how often and for what purposes the artificial teeth are worn. Select the BOHSE score for artificial teeth (0–2) that applies.

5.12. Count the pairs of teeth in the chewing position.

NOTE: These are maxillary (upper) and mandibular (lower) teeth that contact when the jaw is closed, enabling bite. The pairs of teeth can be natural or artificial. For example, teeth 8 and 25 (**Figure 1**) are one pair; if one of them is missing, do not count as a pair.

5.13. Score overall oral cleanliness by observing the entire oral cavity and teeth for food particles (called food debris), and tartar (called calculus). Select BOHSE score for oral cleanliness that applies (0–2). Thank the patient for his/her willingness to participate and ask if he/she has any comments to add.

NOTE: Dental calculus is a crusty deposit at the gum line of the tooth that can trap stains on the teeth and cause yellow discoloration.

5.14. Sum the scores of each BOHSE item for a total BOHSE score.

NOTE: BOHSE scores range from 0 to 20; higher numbers represent poor oral health. Refer the patient to a dentist if any score for an item is a 2.

6. Simplified Oral Hygiene Index (OHI-S)[12]

6.1. Ask the patient to sit comfortably. Tell the patient that a dye will be applied to his/her teeth to be able to see plaque accumulation. Explain that the dye may stay in the mouth for a few hours

if he/she doesn't brush his/her teeth, but it will slowly fade away.

6.2. Remove the plaque disclosing dye swab from its plaster blister pack. Locate the cotton tip with the pink line around it. With the thumb and index finger of each hand grasping either side of the pink line, break the cotton tip from the shaft by giving the pink line a sharp snap with both hands. Confirm that the pink dye, stored in the hollow shaft of the swab, drains quickly to the other cotton tip.

NOTE: The pink disclosing dye will discolor clothing, skin, and gums, so be careful to touch the swab tip only to teeth. The dye adheres to tooth plaque and may remain in the mouth for hours, unless brushed or wiped away.

6.3. Swab the six tooth surfaces depicted in red in **Figure 1** with pink disclosing dye: the buccal (cheek-side) surfaces of the selected upper molars (teeth 3 and 14), the lingual (tongue-side) surfaces of the lower molars (teeth 19 and 30), the labial surfaces (outer side) of the upper right (tooth 8) and lower left central incisor (tooth 24). Substitute the central incisor (tooth 9 or 25, respectively) on the opposite side of the midline in the absence of either of these anterior teeth. Gently rinse with water and score the debris index using the criteria in **Figure 2** under the section "Debris Index Before Tooth Brushing".

6.4. Ask the patient or the caregiver (whoever regularly performs the patient's oral hygiene) to manually brush the patient's teeth the way he/she normally does. Score the post-tooth brushing debris index using the same criteria in **Figure 2** and under the second table labeled "Debris Index After Tooth Brushing". Provide oral hygiene instructions if the debris index was high initially and remains high after tooth brushing.

6.5. Calculate debris index by adding the debris scores for buccal, lingual and labial, and then divide the total by the number of examined surfaces.

REPRESENTATIVE RESULTS:

This compilation of oral health assessment tools was evaluated in different elderly populations. One patient with dementia (D-06) was selected to demonstrate how to interpret the results of an elderly person by a caregiver. All patients signed a consent form prior to enrollment and the studies have IRB approval.

Using the four assessment tools to evaluate a patient

Patient D-06 completed the GOHAI questionnaire and scored 20 (range is from 12 to 60, higher numbers representing poor oral health-related quality of life), suggesting the patient felt fairly comfortable (**Table 5**). Answers to questions one and two suggest the patient may have discomfort during mealtime. This discomfort may have different causes; the patient may have trouble chewing and/or swallowing food or the patient may feel pain while eating. The second questionnaire evaluates swallowing ability. Patient D-06 scored 12 (range 7 to 35, higher numbers representing swallowing problems, **Table 6**). This result suggests the patient is able to swallow correctly and is not having significant choking events. However, answers to questions

three and four once more emphasize discomfort during meals. Based on the rest of the answers, one can rule out swallowing difficulties as the discomfort. Put together, these two self-reported questionnaires identify oral discomfort and limitations during meals; the patient may have chewing problems that should be addressed to prevent deterioration.

Answers to both questionnaires may yield a low total score, representing good overall oral health and swallowing ability. However, the examiner should always detect single high score answers and encourage the patient to visit a dental or other health professional for further evaluation and treatment.

The second portion of the compilation involves a screener that looks into the mouth of the patient. The total BOHSE score for patient D-06 was 4 (range 0 to 20, higher numbers representing oral health problems) (**Table 7**). This result suggests the patient had fairly good oral health and no major issues were discovered. However, the patient had some redness around the gums, a few decayed teeth, and poor overall oral cleanliness suggesting possible dental problems that can be affecting the patient's ability to eat comfortably. Finally, total OHI-S score was 2.17 (range 0 to 3, higher numbers representing more dental debris, **Table 8**). This is a relatively high score and together with the BOHSE gums, teeth and oral cleanliness scores suggests this patient may need better oral hygiene and will benefit from a visit to the dentist.

Taken together, all four assessment tools in this compilation show patient D-06 may not have any serious oral health problems. However, a few answers to both questionnaires and scores from BOHSE and OHI-S give warning signals that should not be dismissed. There is a wide range of oral health issues and no single patient may show problems in all of them. Using all four assessment tools, a caregiver may be able to identify a hidden problem, even at mild stages of its development and recommend a course of action such as improving oral hygiene or visiting a dental professional.

Using the four assessment tools for research purposes

For research purposes, investigators can use this compilation of oral health assessment tools to compare different population groups, evaluate oral health deterioration associated with certain diseases, and evaluate the efficacy of a treatment, among other inquiries. As mentioned in the previous section, different population groups may show differences in some but not all assessment tools suggesting different populations may have unique dental needs.

We first assessed the oral health of patients with mild (Montreal Cognitive Assessment [MoCA] scores from 11−26; n = 12) and severe (MoCA scores from 0−10; n = 13) cognitive impairment (CI) living in long-term care. There were no differences in age and gender between the two groups. Our results show that patients with severe CI report a significantly worse oral health-related quality of life through their GOHAI scores (**Figure 3A**; $p = 0.015$). However, no differences between the two groups were found in ROMP swallowing (mild mean ± SE: 7.8 ± 0.4; severe mean ± SE: 8.5 ± 0.4; $p = 0.3$), BOHSE (mild mean ± SE: 3.3 ± 0.3; severe mean ± SE: 4.4 ± 0.9; $p = 0.2$) and OHI-S (mild mean ± SE: 1.8 ± 0.2; severe mean ± SE: 1.7 ± 0.2; $p = 0.6$) (data not shown). This patient population did not show high scores in ROMP swallowing, suggesting this oral problem

may not affect them. Both groups showed relatively high scores for BOHSE and OHI-S suggesting both groups may present with poor oral hygiene.

Next, we evaluated oral health in elderly individuals (age > 50 years old) with lower (n = 29) and higher education (n = 34). Participants with a high school degree or less (<HS) had worse oral health than those with a higher degree (<HS) shown by greater BOHSE and OHI-S scores (**Figure 3B** and **Figure 3C**; $p = 0.026$ and $p = 0.03$, respectively). There were no differences in ROMP swallowing scores ($p = 0.1$; data not shown). GOHAI was not evaluated in this population.

We then assessed the oral health of patients with PD and compared them to age and gender-matched controls. As expected from previous research[10], patients with PD showed significantly worse ROMP (swallowing) scores (**Figure 3D**; $p < 0.01$). Patients with PD showed worse oral health than controls as evaluated with BOHSE (**Figure 3E**; $p = 0.03$), but plaque index was not significantly different ($p = 0.6$; data not shown). These results show that patients with PD may have comparable oral hygiene to controls, but show specific problems assessed in the BOHSE. Specifically, they showed significantly worse states of the lips, tongue, gums, and saliva ($p < 0.001$, $p = 0.02$, $p = 0.03$, and $p = 0.01$, respectively; data not shown). GOHAI was not evaluated in this population.

We evaluated the proposed tools in different populations and found that some populations show significantly different scores in some but not all four assessments. Thus, using these four tools together allows for a comprehensive screening of specific oral health problems that may not show up in one oral health assessment alone.

FIGURE AND TABLE LEGENDS:

Figure 1: Simplified Oral Hygiene Index (OHI-S) staining instructions. The diagram shows a map of the teeth for reference when staining them for OHI-S scoring. The human mouth has 32 teeth, labeled in the drawing. The preferred teeth for staining are colored red and alternative teeth (if the patient is missing the preferred teeth) are colored blue. Dark black bars next to each colored tooth show the side the tooth to be stained. For example, tooth 3 should be stained on the buccal side (cheek side), tooth 19 should be stained on the lingual side (tongue side), and tooth 8 should be stained on the labial side (front side).

Figure 2: Simplified Oral Hygiene Index – Debris Index (OHI-S DI) scoring instructions. The drawing depicts possible staining areas of individual teeth. Scores are designated depending on the surface area covered by the stain as shown.

Figure 3: Compilation Oral Health Assessment in different elderly populations. Different patient populations were assessed using the 4 screening tools: General Oral Health Assessment Index (GOHAI), Radboud Oral Motor Inventory (ROMP) swallowing portion, Brief Oral Health Status Examination (BOHSE), and Simplified Oral Hygiene Index (OHI-S). (**A**) Patients with mild (MoCA score 11−26; n = 12) and severe (MoCA score 11−26; n = 13) cognitive impairment (CI) completed the GOHAI questionnaire. Patients with severe CI scored significantly higher suggesting they

experience worse oral health quality of life than patients with mild CI (p = 0.015). (**B**) The oral health of elderly participants (age > 50 years old) was assessed with the BOHSE. Participants with an education of high school or less (<HS; n = 29; average age 71.3) showed worse oral health than those with higher degrees (>HS; n = 34; average age 69.7) (p = 0.026). (**C**) Dental plaque of the same group described in panel B was assessed using the OHI-S. Participants without a high school diploma showed greater dental plaque than those with higher degrees (p = 0.033). (**D**) Patients with PD (n = 10) and age and gender-matched controls (n = 10) completed the ROMP swallowing questionnaire. Patients with PD show significantly worse scores suggesting they have swallowing problems (p = 0.002). (**E**) The same population as in panel D also showed worse oral health measured with BOHSE (p = 0.03). p value calculated by two-tailed, unpaired student t test.

Table 1: General Oral Health Assessment Index (GOHAI) questionnaire. The GOHAI measures oral health-related quality of life and is an ideal tool to screen elderly individuals. Use this table to survey patients and score answers.

Table 2: Radboud Oral Motor Inventory (ROMP) swallowing questionnaire. The ROMP was originally developed to measure swallowing ability, saliva dysfunction, and speech problems in patients with PD. For this reason, the swallowing portion is a short and suitable questionnaire for elderly people, including frail elderly living in long-term care or suffering other neurological problems. Use this table to survey patients and score answers.

Table 3: Brief Oral Health Status Examination (BOHSE). The BOHSE is an assessment tool to measure oral health by examining the mouth of the patient. This oral health screening can be performed by any layperson with a little training. Use this table to examine patients and score the different oral health parameters.

Table 4: Simplified Oral Hygiene Index (OHI-S) Debris Index (DI) only. The OHI-S is a simple assessment tool to measure debris and calculus. This protocol includes only the debris index. This modification allows health students to collect data without the use of dental tools or breaking legal rules regarding their interaction with patients. To calculate the score of a patient, at least two of the six possible surfaces must be dyed and examined. The debris index values may range from 0 to 3, higher number represent higher amounts of dental debris. Use this table to examine patients and score each tooth surface.

Table 5: General Oral Health Assessment Index (GOHAI) scores for a patient with dementia. Example results from a patient with dementia. Total GOHAI score was 20 (range is from 12 to 60, higher numbers representing poor oral health-related quality of life), suggesting the patient felt fairly comfortable. Answers to questions one and two suggest the patient may have discomfort during meals.

Table 6: Radboud Oral Motor Inventory (ROMP) swallowing questionnaire for a patient with dementia. Example results from a patient with dementia. Total ROMP score was 12 (range 7 to 35, higher numbers representing swallowing problems), suggesting the patient felt fairly comfortable swallowing. Answers to questions three and four suggest the patient may have

discomfort during meals but these may be unrelated with swallowing difficulties.

Table 7: Brief Oral Health Status Examination (BOHSE) for a patient with dementia. Example results from a patient with dementia. Total BOHSE score was 4 (range 0 to 20, higher numbers representing oral health problems) suggesting the patient had a fairly good oral health, although redness around the gums, a few decayed teeth, and poor oral cleanliness suggest this patient may need to improve oral hygiene and visit a dentist.

Table 8: Simplified Oral Hygiene Index (OHI-S) for a patient with dementia. Example results from a patient with dementia. Total OHI-S score was 2.17 (range 0 to 3, higher numbers representing more dental debris) suggesting the patient a higher amount of dental debris.

DISCUSSION:

Here we demonstrate a widely accessible and comprehensive methodology to assess oral health. These tools include the GOHAI[9], the swallowing subscale of the ROMP[10], the BOHSE[11], and the OHI-S[12]. Currently, oral health professionals such as dentists, dental therapists, dental hygienists, and dental assistants nearly exclusively evaluate oral health. They have the advantage of training, dental chairs, and instruments for advanced screening and care, yet many potential elderly patients do not or cannot go to the dentist due to financial or physical limitations. On the occasion oral screenings are performed outside the dental office, assessments are made informally or with an established oral screening tool. These appraisals of oral health often are repeated neither at regular intervals nor encompass enough aspects of oral health to relate the results to overall health or detect developing problems.

The goal of this protocol is to assess and, if desired, track the progression of oral health across time and guide recommendations for both oral and overall health care. We chose four oral health assessment tools specifically to screen elderly patients. Most often, elderly patients may have other disabilities and get tired more quickly. Therefore, short questionnaires were preferred to long ones. Two of the chosen assessment tools involve a caregiver to objectively score oral health. The protocols describe easy steps that any non-dental professional can learn to perform. Therefore, this protocol may be used to evaluate oral health in community-dwelling elderly people as well as long-term care-dwelling ones.

Health students are often restricted when interacting with patients. This protocol is ideal to encourage early career students to participate in research, collect data, and gain experience working with the elderly population. This valuable experience educates students on the importance of careful data collection and patient management. In addition, it prepares them to practice evidence-based dentistry in the future. Finally, this experience may encourage future generations of students to work towards improving the oral health of the growing elderly population.

The limitations of this protocol are paired with its advantages. As a research tool, this protocol, lacks the ability to evaluate and quantify more specific indicators of oral health deterioration such as periodontitis and cavities. This compilation of oral health assessment tools may serve to

prompt patients to express their discomforts, but a professional is needed to make a final diagnosis and recommend a course of treatment. However, we believe it can be a useful instrument for non-dental professionals to screen patients for research or health purposes.

ACKNOWLEDGMENTS:

The American Parkinson's Disease Association funded this work.

DISCLOSURES:

The authors have nothing to disclose.

REFERENCES:

1. Dawes, C. et al. The functions of human saliva: A review sponsored by the World Workshop on Oral Medicine VI. *Archives of Oral Biology*. **60** (6), 863–874 (2015).

2. Lakschevitz, F., Aboodi, G., Tenenbaum, H., Glogauer, M. Diabetes and Periodontal Diseases: Interplay and Links. *Current Diabetes Reviews*. **7** (6), 433–439 (2011).

3. Borgnakke, W.S., Ylöstalo, P. V., Taylor, G.W., Genco, R.J. Effect of periodontal disease on diabetes: systematic review of epidemiologic observational evidence. *Journal of Clinical Periodontology*. **40**, S135–S152 (2013).

4. Bahekar, A.A., Singh, S., Saha, S., Molnar, J., Arora, R. The prevalence and incidence of coronary heart disease is significantly increased in periodontitis: a meta-analysis. *American Heart Journal*. **154** (5), 830–7 (2007).

5. Sfyroeras, G.S., Roussas, N., Saleptsis, V.G., Argyriou, C., Giannoukas, A.D. Association between periodontal disease and stroke. *Journal of Vascular Surgery*. **55** (4), 1178–84 (2012).

6. Tavares, M., Lindefjeld Calabi, K.A., San Martin, L. Systemic diseases and oral health. *Dental clinics of North America*. **58** (4), 797–814 (2014).

7. Takizawa, C., Gemmell, E., Kenworthy, J., Speyer, R. A Systematic Review of the Prevalence of Oropharyngeal Dysphagia in Stroke, Parkinson's Disease, Alzheimer's Disease, Head Injury, and Pneumonia. *Dysphagia*. **31** (3), 434–41 (2016).

8. Scannapieco, F.A., Shay, K. Oral Health Disparities in Older Adults. *Dental Clinics of North America*. **58** (4), 771–782 (2014).

9. Atchison, K.A., Dolan, T.A. Development of the Geriatric Oral Health Assessment Index. *Journal of Dental Education*. **54** (11), 680–687 (1990).

10. Kalf, J.G. et al. Reproducibility and validity of patient-rated assessment of speech, swallowing, and saliva control in Parkinson's disease. *Archives of Physical Medicine and Rehabilitation*. **92** (7), 1152–1158 (2011).

11. Kayser-Jones, J., Bird, W.F., Paul, S.M., Long, L., Schell, E.S. An instrument to assess the oral health status of nursing home residents. *Gerontologist*. **35** (6), 814–824 (1995).

12. Greene, J.G., Vermillion, J.R. The Simplified Oral Hygiene Index. *The Journal of the American Dental Association*. **68** (1), 7–13 (1964).

13. Dolan, T.A. The sensitivity of the Geriatric Oral Health Assessment Index to dental care. *Journal of Dental Education*. **61** (1), 37–46 (1997).

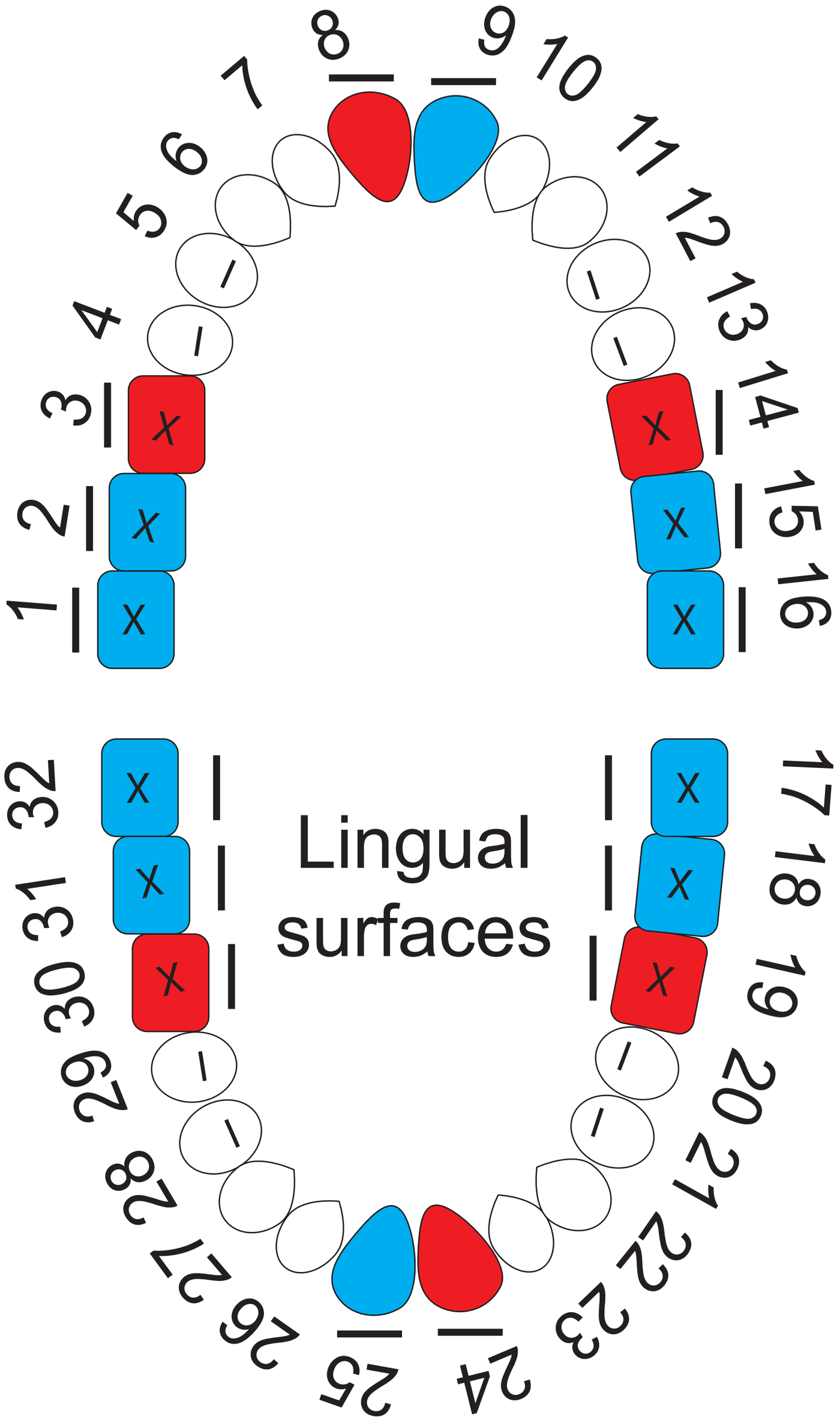
14. Klotz, A.L. et al. Oral health-related quality of life as a predictor of subjective well-being among older adults—A decade-long longitudinal cohort study. *Community Dentistry and Oral Epidemiology*. **46** (6), 631–638 (2018).

15. Zhu, H.W., McGrath, C., McMillan, A.S., Li, L.S.W. Can caregivers be used in assessing oral health-related quality of life among patients hospitalized for acute medical conditions? *Community Dentistry and Oral Epidemiology*. **36** (1), 27–33 (2008).
16. Adulyanon, S., Shieham, A. Oral Impacts on daily performances. *Measuring Oral Health and Quality of Life*. 152–160 (1997).
17. Slade G D, S.A. Development and evaluationof the Oral Health Impact Profile. *Community Dental Health*. **11** (1), 3–11 (1994).
18. Locker, D., Allen, F. What do measures of "oral health-related quality of life" measure? *Community Dentistry and Oral Epidemiology*. **35** (6), 401–411 (2007).
19. Slade G D Derivation and validation of a short-form oral health impact profile. *Community Dentistry and Oral Epidemiology*. **25** (4), 284–290 (1997).
20. Gokturk O, Y.F. Comparison of two measures to determine the oral health-related quality of life in elders with periodontal disease. *Community Dental Health*. **36** (2), 143–149 (2019).
21. Locker, D., Matear, D., Stephens, M., Lawrence, H., Payne, B. Comparison of the GOHAI and OHIP-14 as measures of the oral health-related quality of life of the elderly. *Community Dentistry and Oral Epidemiology*. **29** (5), 373–81 (2001).
22. Hassel AJ, Steuker B, Rolko C, Keller L, Rammelsberg P, N.I. Oral health-related quality of life of elderly Germans--comparison of GOHAI and OHIP-14. *Community Dental Health*. **27** (4), 242–7 (2010).
23. Osman, S.M., Khalifa, N., Alhajj, M.N. Validation and comparison of the Arabic versions of GOHAI and OHIP-14 in patients with and without denture experience. *BMC Oral Health*. **18** (1), 1–10 (2018).
24. Ikebe, K. et al. Comparison of GOHAI and OHIP-14 measures in relation to objective values of oral function in elderly Japanese. *Community Dentistry and Oral Epidemiology*. **40** (5), 406–414 (2012).
25. El Osta, N. et al. Comparison of the OHIP-14 and GOHAI as measures of oral health among elderly in Lebanon. *Health and Quality of Life Outcomes*. **10** (1), 1 (2012).
26. Rodakowska, E., Mierzyńska, K., Bagińska, J., Jamiołkowski, J. Quality of life measured by OHIP-14 and GOHAI in elderly people from Bialystok, north-east Poland. *BMC Oral Health*. **14** (1), 1–8 (2014).
27. Altman, K.W., Richards, A., Goldberg, L., Frucht, S., McCabe, D.J. Dysphagia in Stroke, Neurodegenerative Disease, and Advanced Dementia. *Otolaryngologic Clinics of North America*. **46** (6), 1137–1149 (2013).
28. Roden, D.F., Altman, K.W. Causes of dysphagia among different age groups: A systematic review of the literature. *Otolaryngologic Clinics of North America*. **46** (6), 965–987 (2013).
29. Alali, D., Ballard, K., Vucic, S., Bogaardt, H. Dysphagia in Multiple Sclerosis: Evaluation and Validation of the DYMUS Questionnaire. *Dysphagia*. **33** (3), 273–281 (2018).
30. Behera, A. et al. A Validated Swallow Screener for Dysphagia and Aspiration in Patients with Stroke. *Journal of Stroke and Cerebrovascular Diseases*. **27** (7), 1897–1904 (2018).
31. Diniz, J.G., da Silva, A.C., Nóbrega, A.C. Quality of life and swallowing questionnaire for individuals with Parkinson's disease: development and validation. *International Journal of Language & Communication Disorders*. **53** (4), 864–874 (2018).
32. Patel, D.A. et al. Patient-reported outcome measures in dysphagia: a systematic review of instrument development and validation. *Diseases of the Esophagus*. **30** (5), 1–23 (2017).

33. McHorney, C.A. et al. The SWAL-QOL and SWAL-CARE Outcomes Tool for Oropharyngeal Dysphagia in Adults: III. Documentation of Reliability and Validity. *Dysphagia*. **17** (2), 97–114 (2002).
34. Friedman, P.K., Kaufman, L.B., Karpas, S.L. Oral Health Disparity in Older Adults. *Dental Clinics of North America*. **58** (4), 757–770 (2014).
35. Griffin, S.O. et al. Changes in Older Adults' Oral Health and Disparities: 1999 to 2004 and 2011 to 2016. *Journal of the American Geriatrics Society*. **67** (6), 1152–1157 (2019).
36. Rozas, N.S., Sadowsky, J.M., Jeter, C.B. Strategies to improve dental health in elderly patients with cognitive impairment: A systematic review. *Journal of the American Dental Association*. **148** (4), 236-245.e3 (2017).
37. Critchlow, D. Part 3: Impact of systemic conditions and medications on oral health. *British Journal of Community Nursing*. **22** (4), 181–190 (2017).
38. Weening-Verbree, L., Huisman-de Waal, G., van Dusseldorp, L., van Achterberg, T., Schoonhoven, L. Oral health care in older people in long term care facilities: A systematic review of implementation strategies. *International Journal of Nursing Studies*. **50** (4), 569–582 (2013).
39. Reed, R., Broder, H.L., Jenkins, G., Spivack, E., Janal, M.N. Oral health promotion among older persons and their care providers in a nursing home facility. *Gerodontology*. **23** (2), 73–78 (2006).
40. Bauer, J.G. The index of ADOH: concept of measuring oral self-care functioning in the elderly. *Special Care in Dentistry*. **21** (2), 63–7 (2001).
41. Tsukada, S., Ito, K., Stegaroiu, R., Shibata, S., Ohuchi, A. An oral health and function screening tool for nursing personnel of long-term care facilities to identify the need for dentist referral without preliminary training. *Gerodontology*. **34** (2), 232–239 (2017).
42. Chalmers, J.M., Pearson, A. A systematic review of oral health assessment by nurses and carers for residents with dementia in residential care facilities. *Special Care in Dentistry*. **25** (5), 227–33 (2005).
43. Chen, C.C.-H. The Kayser-Jones Brief Oral Health Status Examination (BOHSE). *ORL-head and neck nursing : official journal of the Society of Otorhinolaryngology and Head-Neck Nurses*. **27** (2), 14–15 (2009).
44. Silva, D.D. da, Gonçalo, C. da S., Sousa, M. da L.R. de, Wada, R.S. Aggregation of plaque disclosing agent in a dentifrice. *Journal of Applied Oral Science*. **12** (2), 154–158 (2004).

Right ⟵ **Upper Teeth** ⟶ Left

Labial surfaces



Labial surfaces

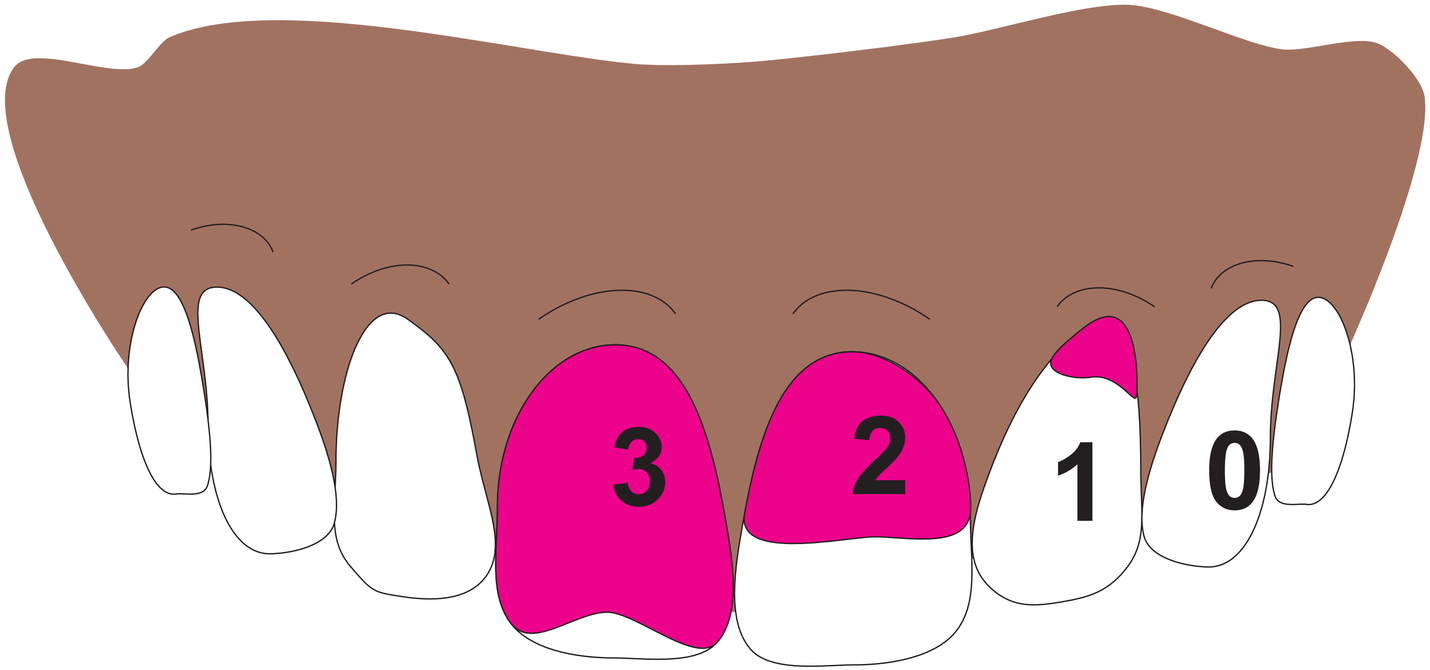
Right ⟵ **Lower Teeth** ⟶ Left

— Dye tooth and examine

— Alternative tooth to dye and examine

Figure

Click here to access/download;Figure;Figure2-OHIS-Staining.ai



0 = No stain present
1 = Stain covering not more than one-third of the tooth surface.
2 = Stain covering more than one-third but not more than two-thirds of the tooth surface.
3 = Stain covering more than two-thirds of the tooth surface

Note: Stain may be seen as irregular patches not necessarily as one stain as the drawing depicts.

Figure

Click here to access/download;Figure;Figure-3-GroupData_CJ.ai

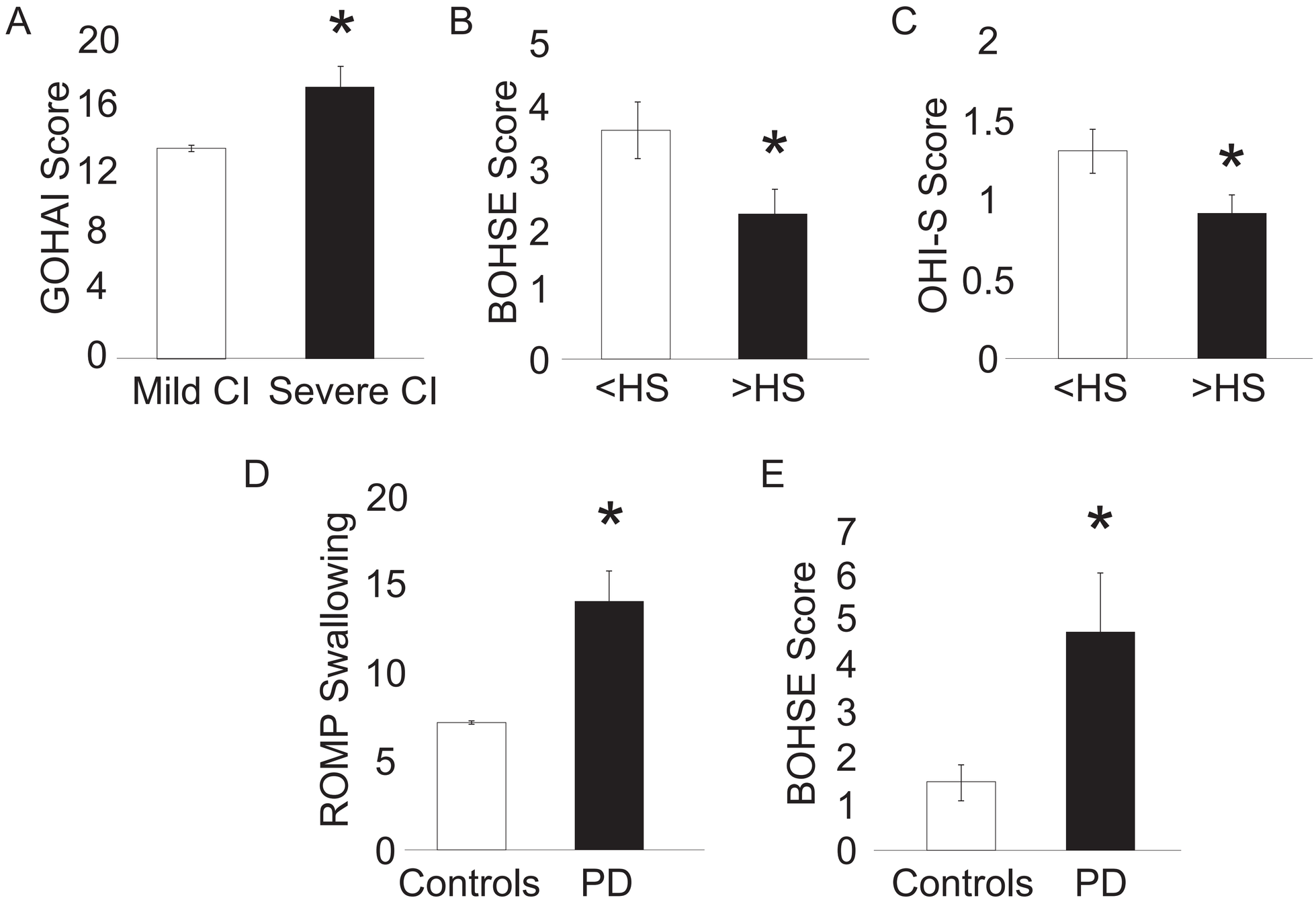


Table 1

Click here to access/download;Table;Table1-GOHAI.xlsx

General Oral Health Assessment Index (GOHAI)				
Patient ID:		Interviewer:		Date:
Answered by ☐ Patient ☐ Caregiver				Time:
"In the past 3 months…" (Say this phrase at the beginning of each question):				
Question	Never (1)	Seldom (2)	Sometimes (3)	Often (4)
1 - How often did you limit the kinds or amounts of food you ate because of problems with your teeth or denture?	☐	☐	☐	☐
2 - How often did you have trouble biting or chewing any kinds of food, such as a firm meat or apples?	☐	☐	☐	☐
3 - How often were you able to swallow comfortably?	☐	☐	☐	☐
4 - How often have your teeth or dentures prevented you from speaking the way you wanted?	☐	☐	☐	☐
5 - How often were you able to eat anything without feeling discomfort?	☐	☐	☐	☐
6 - How often did you limit contact with people because of the condition of your teeth or denture?	☐	☐	☐	☐
7 - How often were you pleased or happy with the looks of your teeth, gums or dentures?	☐	☐	☐	☐
8 - How often did you use medication to relive pain or discomfort from around your mouth?	☐	☐	☐	☐
9 – How often were you worried or concerned about the problems with your teeth, gums or dentures?	☐	☐	☐	☐
10 - How often did you feel nervous or self-conscious because of problems with your teeth, gums or dentures?	☐	☐	☐	☐
11 - How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures?	☐	☐	☐	☐
12 – How often were your teeth or gums sensitive to hot, cold or sweets?	☐	☐	☐	☐
Additional comments:				

Always (5)
☐
☐
☐
☐
☐
☐
☐
☐
☐
☐
☐
☐

Table 2 Click here to access/download;Table;Table2-ROMP.xlsx

Radboud Oral Motor Inventory - Swallowing			
Patient ID:		Interviewer:	
Answered by ☐ Patient ☐ Caregiver			
"In the past 3 months…" (Say this phrase at the beginning of each question):			
Question	Best (1)	2	3
1- How many times do you choke (cough) when eating or drinking?	☐ I do not choke at all or not more than I used to.	☐ I choke about once a week.	☐ I choke almost daily.
2- Are you limited during drinking?	☐ I can drink liquids as easily as I used to.	☐ I can easily drink liquids, but I choke a little easier than I used to.	☐ I can drink safely only when I concentrate on it.
3- Are you limited during eating?	☐ I can eat as easily as I used to.	☐ I can eat everything, but it takes me longer than before.	☐ I have to avoid tough or hard solid foods (meat, peanuts, etc).
4- Do you have difficulty swallowing pills?	☐ I take my pills just like I used to.	☐ I have a little more difficulty swallowing my pills than I used to.	☐ I can take my pills only with applesauce or using a specific technique.
5- Does your swallowing difficulty limit your dining with others?	☐ Eating with others is no problem for me at all.	☐ I dine and drink with others, but I have to take my swallowing difficulty into account.	☐ I prefer eating in the presence of familiar people in familiar places.
6- Are you concerned about your difficulty swallowing?	☐ I do not experience difficulty.	☐ I have some difficulty swallowing, but I am not concerned about it.	☐ I am a little concerned about my difficulty swallowing.
7- How bothered are you as a result of your difficulty swallowing?	☐ I have no difficulty swallowing.	☐ My difficulty swallowing bothers me a little.	☐ I am bothered by my difficulty swallowing, but it is not my top concern.
Additional Comments:			

Date:
Time:

4	Worse (5)
☐ I choke about 3 times a day or during every meal.	☐ I choke more than 3 times a day or multiple times during meals.
☐ To drink safely, I need to use a special cup or technique.	☐ I can drink safely only when I take thickened liquids.
☐ I can eat only soft or easily chewable food.	☐ I have to use supplemental or non-oral feeding.
☐ Swallowing my pills is a struggle nowadays.	☐ I cannot swallow pills anymore and need another way of taking medication.
☐ I eat only at home and in the presence of familiar people.	☐ I can eat only at home and with the assistance of a skillful caregiver.
☐ I am becoming more concerned about my difficulty swallowing.	☐ I am very much concerned about my difficulty swallowing.
☐ My difficulty swallowing bothers me a lot because it is very limiting.	☐ My difficulty swallowing is the worst aspect of my disease.

Table 3 Click here to access/download;Table;Table3-BOHSE.xlsx

Brief Oral Health Status Examination (BOHSE)			
Patient ID:	Examiner:		Date:
Answered by ☐ Patient ☐ Caregiver			Time:
Category	**Measurement**	**0**	**1**
Lymph Nodes	Observe and feel nodes	☐ No enlargement	☐ Enlarged, not tender
Lips	Observe, feel tissue and ask patient, family or staff (e.g., primary caregiver)	☐ Smooth, pink and moist	☐ Dry, chapped or red at corners
Tongue	Observe, feel tissue and ask patient, family or staff (e.g., primary caregiver)	☐ Normal roughness, pink and moist	☐ Coated, smooth, patchy, severely fissured or some redness
Tissue inside cheek, floor and roof of mouth	Observe, feel tissue and ask patient, family or staff (e.g., primary caregiver)	☐ Pink and moist	☐ Dry, shiny, rough, red, or swollen
Gums between teeth and/or under artificial teeth	Gently press gums with tip of tongue blade	☐ Pink, small indentations; firm, smooth and pink under artificial teeth	☐ Redness at border around 1-6 teeth; one red area or sore spot under artificial teeth
Saliva (effect on tissue)	Touch tongue blade to center of tongue	☐ Tissue moist, saliva free flowing and watery	☐ Tissues dry and sticky
Condition of natural teeth	Observe and count number of decayed or broken teeth	☐ No decayed or broken teeth/roots	☐ 1-3 decayed or broken teeth/roots
Condition of artificial teeth	Observe and ask patient, family or staff (e.g., primary caregiver)	☐ Unbroken teeth, worn most of the time	☐ 1 broken/missing tooth, or worn for eating or cosmetics only
Pairs of teeth in chewing position (natural or artificial)	Observe and count pairs of teeth in chewing position	☐ 12 or more pairs in chewing position	☐ 8-11 pairs of teeth in chewing position
Oral cleanliness	Observe appearance of teeth or dentures	☐ Clean, no food particles/tartar in the mouth or on artificial dentures	☐ Food particles/tartar in one or two places in the mouth or on artificial teeth
Total Score: _____			
Upper dentures labeled: Yes ___ No ___ None___			

Lower dentures labeled: Yes ___ No ___ None ___
Is your mouth comfortable? Yes _____ No _____
If no, explain: _____
Number of remaining natural teeth: _____
Additional comments:

2
☐ Enlarged and tender
☐ White or red patch; bleeding or ulcer for 2 weeks
☐ Red, smooth, white or red patch; ulcer for 2 weeks
☐ White or red patch, bleeding, hardness; ulcer for 2 weeks
☐ Swollen or bleeding gums, redness at border around 7 or more teeth, loose teeth; generalized redness or sores under artificial teeth
☐ Tissues parched and red, no saliva
☐ 4 or more decayed or broken teeth/roots; fewer than 4 teeth in either jaw
☐ More than 1 broken or missing tooth, or either denture missing or never worn
☐ 0-7 pairs of teeth in chewing position
☐ Food particles/ tartar in most places in the mouth or on artificial teeth

Table 4 Click here to access/download;Table;Table4-OHI-S.xlsx

Simplified Oral Hygiene Index (Debris index only) (C					
Patient ID:		Examiner:			Date:
Debris Index **Before** Tooth Brushing					
	Right Molar		Anterior		Left Molar
	Buccal (upper)	Lingual (lower)	Labial	Labial	Buccal (upper)
Upper		NA		NA	
Lower	NA		NA		NA
DI = (_____) + (_____) / (_____)					
DI = _____					
Debris Index **After** Tooth Brushing					
	Right Molar		Anterior		Left Molar
	Buccal (upper)	Lingual (lower)	Labial	Labial	Buccal (upper)
Upper		NA		NA	
Lower	NA		NA		NA
DI = (_____) + (_____) / (_____)					
DI = _____					
How to calculate:					
DI = (buccal scores) + (labial scores) + (lingual scores) / (Total number of examined surfaces)					

OHI-S)		
	Time:	
	Total	
Lingual (lower)	Buccal + Labial	Lingual
NA		NA
	Total	
Lingual (lower)	Buccal + Labial	Lingual
NA		NA

Table 5 Click here to access/download;Table;Table5-GOHAI-D06.xlsx

General Oral Health Assessment Index (GOHAI)				
Patient ID: **D-06**		Interviewer: **JS**		Date: **05/22/**
Answered by **√** Patient ☐ Caregiver				Time: **Mornin**
"In the past 3 months…" (Say this phrase at the beginning of each question):				
Question	Never (1)	Seldom (2)	Sometimes (3)	Often (4)
1 - How often did you limit the kinds or amounts of food you ate because of problems with your teeth or denture?	☐	☐	**√**	☐
2 - How often did you have trouble biting or chewing any kinds of food, such as a firm meat or apples?	☐	☐	☐	☐
3 - How often were you able to swallow comfortably?	☐	☐	☐	**√**
4 - How often have your teeth or dentures prevented you from speaking the way you wanted?	**√**	☐	☐	☐
5 - How often were you able to eat anything without feeling discomfort?	☐	☐	☐	☐
6 - How often did you limit contact with people because of the condition of your teeth or denture?	**√**	☐	☐	☐
7 - How often were you pleased or happy with the looks of your teeth, gums or dentures?	☐	☐	☐	**√**
8 - How often did you use medication to relive pain or discomfort from around your mouth?	**√**	☐	☐	☐
9 – How often were you worried or concerned about the problems with your teeth, gums or dentures?	**√**	☐	☐	☐
10 - How often did you feel nervous or self-conscious because of problems with your teeth, gums or dentures?	**√**	☐	☐	☐
11 - How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures?	**√**	☐	☐	☐
12 – How often were your teeth or gums sensitive to hot, cold or sweets?	**√**	☐	☐	☐
Additional comments:				

2019
ıg
Always (5)
☐
√
☐
☐
√
☐
☐
☐
☐
☐
☐
☐

Radboud Oral Motor Inventory - Swallowing			
Patient ID:		Interviewer:	
Answered by ☐ Patient ☐ Care-giver			
"In the past 3 months…" (Say this phrase at the beginning of each question):			
Question	Best (1)	2	3
1- How many times do you choke (cough) when eating or drinking?	☐ I do not choke at all or not more than I used to.	☐ I choke about once a week.	☐ I choke almost daily.
2- Are you limited during drinking?	☐ I can drink liquids as easily as I used to.	☐ I can easily drink liquids, but I choke a little easier than I used to.	☐ I can drink safely only when I concentrate on it.
3- Are you limited during eating?	☐ I can eat as easily as I used to.	☐ I can eat everything, but it takes me longer than before.	☐ I have to avoid tough or hard solid foods (meat, peanuts, etc).
4- Do you have difficulty swallowing pills?	☐ I take my pills just like I used to.	☐ I have a little more difficulty swallowing my pills than I used to.	☐ I can take my pills only with applesauce or using a specific technique.
5- Does your swallowing difficulty limit your dining with others?	☐ Eating with others is no problem for me at all.	☐ I dine and drink with others, but I have to take my swallowing difficulty into account.	☐ I prefer eating in the presence of familiar people in familiar places.
6- Are you concerned about your difficulty swallowing?	☐ I do not experience difficulty.	☐ I have some difficulty swallowing, but I am not concerned about it.	☐ I am a little concerned about my difficulty swallowing.
7- How bothered are you as a result of your difficulty swallowing?	☐ I have no difficulty swallowing.	☐ My difficulty swallowing bothers me a little.	☐ I am othered by my difficulty swallowing, but it is not my top concern.
Additional Comments:			

Radboud Oral Motor Inventory - Saliva			
"In the past 3 months…" (Say this phrase at the beginning of each question):			
Question	Best (1)	2	3
1- Do you experience loss of saliva during the day?	☐ I do not lose saliva during the day and do not feel accumulation of saliva in my mouth.	☐ I do not lose saliva, but I feel accumulation of saliva in my mouth.	☐ I lose some saliva in the corners of my mouth or on my chin.
2- How often do you experience increased amounts or loss of saliva?	☐ Less than once a day.	☐ Occasionally: on average, once or twice a day.	☐ Frequently: 2 to 5 times a day.
3- Do you experience loss of saliva during the night?	☐ I do not experience loss of saliva during the night at all.	☐ My pillow sometimes gets wet during the night.	☐ My pillow regularly gets wet during the night.
4- Does your (loss of) saliva impair your eating and drinking?	☐ No, my (loss of) saliva does not impair my eating or drinking.	☐ Yes, my (loss of) saliva occasionally impairs my eating or drinking.	☐ Yes, my (loss of) saliva frequently impairs my eating or drinking.
5- Does your (loss of) saliva impair your speech?	☐ No, my (loss of) saliva does not impair my speech.	☐ Yes, my (loss of) saliva occasionally impairs my speech.	☐ Yes, my (loss of) saliva frequently impairs my speech.
6- What do you have to do to remove saliva?	☐ I do not have to remove saliva.	☐ I always carry a handkerchief to remove possible saliva.	☐ I daily use 1 or 2 handkerchiefs to remove some saliva.
7- Does the loss of saliva limit you in contacts with others?	☐ My loss of saliva does not limit me in contacts with others.	☐ I have to pay attention, but that does not bother me.	☐ I have to pay more attention because I know that others could see me losing saliva.
8- Does your loss of saliva limit you in doing activities inside or outside your home (work, hobbies)?	☐ My (loss of) saliva does not limit me in activities.	☐ I have to pay attention when I am busy, but that does not bother me.	☐ I have to pay more attention, which is rather effortful.

9- How bothered are you as a result of your (loss of) saliva?	☐ I hardly notice loss of saliva.	☐ Feeling more saliva or losing it bothers me a little.	☐ I am bothered by my loss of saliva, but it is not my priority concern.
Additional Comments:			

Date:
Time:

4	Worse (5)
☐ I choke about 3 times a day or during every meal.	☐ I choke more than 3 times a day or multiple times during meals.
☐ To drink safely, I need to use a special cup or technique.	☐ I can drink safely only when I take thickened liquids.
☐ I can eat only soft or easy chewable food.	☐ I have to use supplemental or non-oral feeding.
☐ Swallowing my pills is a struggle nowadays.	☐ I cannot swallow pills anymore and need another way of taking medication.
☐ I eat only at home and in the presence of familiar people.	☐ I can eat only at home and with the assistance of a skillful caregiver.
☐ I am becoming more concerned about my difficulty swallowing.	☐ I am very much concerned about my difficulty swallowing.
☐ My difficulty swallowing bothers me a lot because it is very limiting.	☐ My difficulty swallowing is the worst aspect of my disease.

4	Worse (5)
☐ I lose saliva on my clothes.	☐ I lose saliva on my clothes, but also on books or on the floor.
☐ Very often: 6 to 10 times a day.	☐ Almost constantly.
☐ My pillow always gets wet during the night.	☐ Every night my pillow and other bedclothes get wet.
☐ Yes, my (loss of) saliva very often impairs my eating or drinking.	☐ Yes, my (loss of) saliva always impairs my eating or drinking.
☐ Yes, my (loss of) saliva very often impairs my speech.	☐ Yes, my (loss of) saliva always impairs my speech.
☐ I daily need more than 2 handkerchiefs to remove saliva.	☐ I need to remove saliva so frequently that I always keep tissues near me or use a towel to protect my clothes.
☐ I try to avoid contact when I know that I lose saliva.	☐ I notice that others avoid having contact with me because I lose saliva.
☐ My loss of saliva limits me in being active.	☐ Due to my loss of saliva, important activities are no longer possible for me.

☐ My loss of saliva bothers me a lot because it is very limiting.	☐ Losing saliva is the worst aspect of my disease.

Brief Oral Health Status Examination (BOHSE)			
Patient ID:	Examiner:		Date:
Answered by ☐ Patient ☐ Care-giver			Time:
Category	**Measurement**	**0**	**1**
Lymph Nodes	Observe and feel	☐ No enlargement	☐ Enlarged, not tender
Lips	Observe, feel tissue and ask patient, family or staff (e.g. primary caregiver)	☐ Smooth, pink and moist	☐ Dry, chapped or red at corners
Tongue	Observe, feel tissue and ask patient, family or staff (e.g. primary caregiver)	☐ Normal roughness, pink and moist	☐ Coated, smooth, patchy, severely fissured or some redness
Tissue inside cheek, floor and roof of mouth	Observe, feel tissue and ask patient, family or staff (e.g. primary caregiver)	☐ Pink and moist	☐ Dry, shiny, rough red, or swollen
Gums between teeth and/or under artificial teeth	Gently press gums with tip of tongue blade	☐ Pink, small indentations; firm, smooth and pink under artificial teeth	☐ Redness at border around 1-6 teeth; one red area or sore spot under artificial teeth
Saliva (effect on tissue)	Touch tongue blade to center of tongue	☐ Tissue moist, saliva free flowing and watery	☐ Tissues dry and sticky
Condition of natural teeth	Observe and count number of decayed or broken teeth	☐ No decayed or broken teeth/roots	☐ 1-3 decayed or broken teeth/roots
Condition of artificial teeth	Observe and ask patient, family or staff (e.g. primary caregiver)	☐ Unbroken teeth, worn most of the time	☐ 1 broken/missing tooth, or worn for eating or cosmetics only
Pairs of teeth in chewing position (natural or artificial)	Observe and count pairs of teeth in chewing position	☐ 12 or more pairs in chewing position	☐ 8-11 pairs of teeth in chewing position

Oral cleanliness	Observe appearance of teeth or dentures	☐ Clean, no food particles/tartar in the mouth or on artificial dentures	☐ Food particles/tartar in one or two places in the mouth or on artificial teeth

Total Score: _____
Upper dentures labeled: Yes ___ No ___ None___
Lower dentures labeled: Yes ___ No ___ None ___
Is your mouth comfortable? Yes _____ No _____
If no, explain: _____
Number of remaining natural teeth: _____
Additional comments:

2
☐ Enlarged and tender
☐ White or red patch; bleeding or ulcer for 2 weeks
☐ Red, smooth, white or red patch; ulcer for 2 weeks
☐ White or red patch, bleeding, hardness; ulcer for 2 weeks
☐ Swollen or bleeding gums, redness at border around 7 or more teeth, loose teeth; generalized redness or sores under artificial teeth
☐ Tissues parched and red, no saliva
☐ 4 or more decayed or broken teeth/roots; fewer than 4 teeth in either jaw
☐ More than 1 broken or missing tooth, or either denture missing or never worn
☐ 0-7 pairs of teeth in chewing position

☐ Food particles/ tartar in most places in the mouth or on artificial teeth

Simplified Oral Hygiene Index (Debris index o					
Patient ID:		Examiner:			Date:
Debris Index **Before** Tooth Brushing					
	Right Molar		Anterior		Left Molar
	Buccal (upper)	Lingual (lower)	Labial	Labial	Buccal (upper)
Upper		NA		NA	
Lower	NA		NA		NA
DI = (_____) + (_____) / (_____)					
DI = _____					
Debris Index **After** Tooth Brushing					
	Right Molar		Anterior		Left Molar
	Buccal (upper)	Lingual (lower)	Labial	Labial	Buccal (upper)
Upper		NA		NA	
Lower	NA		NA		NA
DI = (_____) + (_____) / (_____)					
DI = _____					
How to calculate:					
DI = (buccal scores) + (labial scores) + (lingual scores) / (Total number of examined surfaces					

nly)		
	Time:	
	Total	
Lingual (lower)	Buccal + Labial	Lingual
NA		NA
	Total	
Lingual (lower)	Buccal + Labial	Lingual
NA		NA
)		

Table 6 Click here to access/download;Table;Table6-ROMP-D06.xlsx

Radboud Oral Motor Inventory - Swallowing			
Patient ID: **D-06**		Interviewer: **JS**	
Answered by **√** Patient ☐ Caregiver			
"In the past 3 months…" (Say this phrase at the beginning of each question):			
Question	Best (1)	2	3
1- How many times do you choke (cough) when eating or drinking?	**√ I do not choke at all or not more than I used to.**	☐ I choke about once a week.	☐ I choke almost daily.
2- Are you limited during drinking?	**√ I can drink liquids as easily as I used to.**	☐ I can easily drink liquids, but I choke a little easier than I used to.	☐ I can drink safely only when I concentrate on it.
3- Are you limited during eating?	☐ I can eat as easily as I used to.	☐ I can eat everything, but it takes me longer than before.	☐ I have to avoid tough or hard solid foods (meat, peanuts, etc).
4- Do you have difficulty swallowing pills?	☐ I take my pills just like I used to.	☐ I have a little more difficulty swallowing my pills than I used to.	**√ I can take my pills only with applesauce or using a specific technique.**
5- Does your swallowing difficulty limit your dining with others?	**√ Eating with others is no problem for me at all.**	☐ I dine and drink with others, but I have to take my swallowing difficulty into account.	☐ I prefer eating in the presence of familiar people in familiar places.
6- Are you concerned about your difficulty swallowing?	**√ I do not experience difficulty.**	☐ I have some difficulty swallowing, but I am not concerned about it.	☐ I am a little concerned about my difficulty swallowing.
7- How bothered are you as a result of your difficulty swallowing?	**√ I have no difficulty swallowing.**	☐ My difficulty swallowing bothers me a little.	☐ I am othered by my difficulty swallowing, but it is not my top concern.
Additional Comments:			

Date: **05/22/09**
Time: **Morning**

4	Worse (5)
☐ I choke about 3 times a day or during every meal.	☐ I choke more than 3 times a day or multiple times during meals.
☐ To drink safely, I need to use a special cup or technique.	☐ I can drink safely only when I take thickened liquids.
√ I can eat only soft or easy chewable food.	☐ I have to use supplemental or non-oral feeding.
☐ Swallowing my pills is a struggle nowadays.	☐ I cannot swallow pills anymore and need another way of taking medication.
☐ I eat only at home and in the presence of familiar people.	☐ I can eat only at home and with the assistance of a skillful caregiver.
☐ I am becoming more concerned about my difficulty swallowing.	☐ I am very much concerned about my difficulty swallowing.
☐ My difficulty swallowing bothers me a lot because it is very limiting.	☐ My difficulty swallowing is the worst aspect of my disease.

Table 7 Click here to access/download;Table;Table7-BOHSE-D06.xlsx

Brief Oral Health Status Examination (BOHSE)			
Patient ID: **D-06**	**JMS**		Date: **05/22/2019**
Answered by **√** Patient ☐ Caregiver			Time: **Morning**
Category	**Measurement**	**0**	**1**
Lymph Nodes	Observe and feel	**√ No enlargement**	☐ Enlarged, not tender
Lips	Observe, feel tissue and ask patient, family or staff (e.g., primary caregiver)	**√ Smooth, pink and moist**	☐ Dry, chapped or red at corners
Tongue	Observe, feel tissue and ask patient, family or staff (e.g., primary caregiver)	**√ Normal roughness, pink and moist**	☐ Coated, smooth, patchy, severely fissured or some redness
Tissue inside cheek, floor and roof of mouth	Observe, feel tissue and ask patient, family or staff (e.g., primary caregiver)	**√ Pink and moist**	☐ Dry, shiny, rough, red, or swollen
Gums between teeth and/or under artificial teeth	Gently press gums with tip of tongue blade	☐ Pink, small indentations; firm, smooth and pink under artificial teeth	**√ Redness at border around 1-6 teeth; one red area or sore spot under artificial teeth**
Saliva (effect on tissue)	Touch tongue blade to center of tongue and floor of mouth	**√ Tissue moist, saliva free flowing and watery**	☐ Tissues dry and sticky
Condition of natural teeth	Observe and count number of decayed or broken teeth	☐ No decayed or broken teeth/roots	**√ 1-3 decayed or broken teeth/roots**
Condition of artificial teeth	Observe and ask patient, family or staff (e.g., primary caregiver)	**√ Unbroken teeth, worn most of the time**	☐ 1 broken/missing tooth, or worn for eating or cosmetics only
Pairs of teeth in chewing position (natural or artificial)	Observe and count pairs of teeth in chewing position	☐ 12 or more pairs in chewing position	**√ 8-11 pairs of teeth in chewing position**
Oral cleanliness	Observe appearance of teeth or dentures	☐ Clean, no food particles/tartar in the mouth or on artificial dentures	**√ Food particles/tartar in one or two places in the mouth or on artificial teeth**

Total Score: **4**
Upper dentures labeled: Yes ___ No **√** None___
Lower dentures labeled: Yes ___ No **√** None ___
Is your mouth comfortable? Yes **√** No _____
If no, explain: _____
Number of remaining natural teeth: **24**
Additional comments:

2
☐ Enlarged and tender
☐ White or red patch; bleeding or ulcer for 2 weeks
☐ Red, smooth, white or red patch; ulcer for 2 weeks
☐ White or red patch, bleeding, hardness; ulcer for 2 weeks
☐ Swollen or bleeding gums, redness at border around 7 or more teeth, loose teeth; generalized redness or sores under artificial teeth
☐ Tissues parched and red, no saliva
☐ 4 or more decayed or broken teeth/roots; fewer than 4 teeth in either jaw
☐ More than 1 broken or missing tooth, or either denture missing or never worn
☐ 0-7 pairs of teeth in chewing position
☐ Food particles/ tartar in most places in the mouth or on artificial teeth

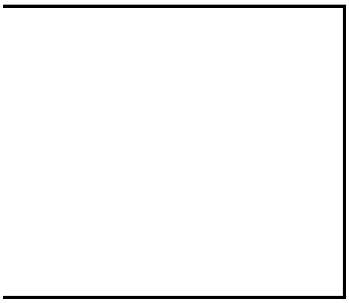


Table 8 Click here to access/download;Table;Table8-OHI-S-D06.xlsx

Simplified Oral Hygiene Index (Debris index only) (C					
Patient ID: **D-06**		Examiner: **JMS**			Date: **05/22/20**
Debris Index **Before** Tooth Brushing					
	Right Molar		Anterior		Left Molar
	Buccal (upper)	Lingual (lower)	Labial	Labial	Buccal (upper)
Upper	**3**	NA	**1**	NA	**3**
Lower	NA	**2**	NA	**2**	NA
DI = (9) + (4) / (6)					
DI = 2.17					

OHI-S)		
19	Time: **Morning**	
	Total	
Lingual (lower)	Buccal + Labial	Lingual
NA	**7**	NA
2	**2**	**4**

Table of Materials

Click here to access/download;Table of Materials;60553_JoVE Materials.xlsx

Name of Material/Equipment	Company	Catalog Number
Hurriview Plaque Indicating Snap-n-Go Swabs	Henry Schein	916553
Non-latex examination gloves	VWR	76246-462
Small flashlight or pen light (Energizer LED Pen Flashlight)	VWR	500033-336
Sterile, individually wrapped tongue depressor	VWR	500011-108

Comments/Description

any vendor will do; optional if you use only tongue depressor to touch the mouth

any vendor will do; unnecessary, but helpful
any vendor will do

1 Alewife Center #200
Cambridge, MA 02140
tel. 617.945.9051
www.jove.com

ARTICLE AND VIDEO LICENSE AGREEMENT

Title of Article: Oral health assessment by lay personnel for older adults

Author(s): Natalia S. Rozas, June M. Sadowsky, Jordyn Stanek, Cameron B. Jeter

Item 1: The Author elects to have the Materials be made available (as described at http://www.jove.com/publish) via:

☒ Standard Access ☐ Open Access

Item 2: Please select one of the following items:

☒ The Author is **NOT** a United States government employee.

☐ The Author is a United States government employee and the Materials were prepared in the course of his or her duties as a United States government employee.

☐ The Author is a United States government employee but the Materials were NOT prepared in the course of his or her duties as a United States government employee.

ARTICLE AND VIDEO LICENSE AGREEMENT

1. **Defined Terms.** As used in this Article and Video License Agreement, the following terms shall have the following meanings: "**Agreement**" means this Article and Video License Agreement; "**Article**" means the article specified on the last page of this Agreement, including any associated materials such as texts, figures, tables, artwork, abstracts, or summaries contained therein; "**Author**" means the author who is a signatory to this Agreement; "**Collective Work**" means a work, such as a periodical issue, anthology or encyclopedia, in which the Materials in their entirety in unmodified form, along with a number of other contributions, constituting separate and independent works in themselves, are assembled into a collective whole; "**CRC License**" means the Creative Commons Attribution-Non Commercial-No Derivs 3.0 Unported Agreement, the terms and conditions of which can be found at: http://creativecommons.org/licenses/by-nc-nd/3.0/legalcode; "**Derivative Work**" means a work based upon the Materials or upon the Materials and other pre-existing works, such as a translation, musical arrangement, dramatization, fictionalization, motion picture version, sound recording, art reproduction, abridgment, condensation, or any other form in which the Materials may be recast, transformed, or adapted; "**Institution**" means the institution, listed on the last page of this Agreement, by which the Author was employed at the time of the creation of the Materials; "**JoVE**" means MyJove Corporation, a Massachusetts corporation and the publisher of The Journal of Visualized Experiments; "**Materials**" means the Article and / or the Video; "**Parties**" means the Author and JoVE; "**Video**" means any video(s) made by the Author, alone or in conjunction with any other parties, or by JoVE or its affiliates or agents, individually or in collaboration with the Author or any other parties, incorporating all or any portion of the Article, and in which the Author may or may not appear.

2. **Background.** The Author, who is the author of the Article, in order to ensure the dissemination and protection of the Article, desires to have the JoVE publish the Article and create and transmit videos based on the Article. In furtherance of such goals, the Parties desire to memorialize in this Agreement the respective rights of each Party in and to the Article and the Video.

3. **Grant of Rights in Article.** In consideration of JoVE agreeing to publish the Article, the Author hereby grants to JoVE, subject to **Sections 4** and **7** below, the exclusive, royalty-free, perpetual (for the full term of copyright in the Article, including any extensions thereto) license (a) to publish, reproduce, distribute, display and store the Article in all forms, formats and media whether now known or hereafter developed (including without limitation in print, digital and electronic form) throughout the world, (b) to translate the Article into other languages, create adaptations, summaries or extracts of the Article or other Derivative Works (including, without limitation, the Video) or Collective Works based on all or any portion of the Article and exercise all of the rights set forth in (a) above in such translations, adaptations, summaries, extracts, Derivative Works or Collective Works and(c) to license others to do any or all of the above. The foregoing rights may be exercised in all media and formats, whether now known or hereafter devised, and include the right to make such modifications as are technically necessary to exercise the rights in other media and formats. If the "Open Access" box has been checked in **Item 1** above, JoVE and the Author hereby grant to the public all such rights in the Article as provided in, but subject to all limitations and requirements set forth in, the CRC License.

1 Alewife Center #200
Cambridge, MA 02140
tel. 617.945.9051
www.jove.com

ARTICLE AND VIDEO LICENSE AGREEMENT

4. **Retention of Rights in Article.** Notwithstanding the exclusive license granted to JoVE in **Section 3** above, the Author shall, with respect to the Article, retain the non-exclusive right to use all or part of the Article for the non-commercial purpose of giving lectures, presentations or teaching classes, and to post a copy of the Article on the Institution's website or the Author's personal website, in each case provided that a link to the Article on the JoVE website is provided and notice of JoVE's copyright in the Article is included. All non-copyright intellectual property rights in and to the Article, such as patent rights, shall remain with the Author.

5. **Grant of Rights in Video – Standard Access.** This **Section 5** applies if the "Standard Access" box has been checked in **Item 1** above or if no box has been checked in **Item 1** above. In consideration of JoVE agreeing to produce, display or otherwise assist with the Video, the Author hereby acknowledges and agrees that, Subject to **Section 7** below, JoVE is and shall be the sole and exclusive owner of all rights of any nature, including, without limitation, all copyrights, in and to the Video. To the extent that, by law, the Author is deemed, now or at any time in the future, to have any rights of any nature in or to the Video, the Author hereby disclaims all such rights and transfers all such rights to JoVE.

6. **Grant of Rights in Video – Open Access.** This **Section 6** applies only if the "Open Access" box has been checked in **Item 1** above. In consideration of JoVE agreeing to produce, display or otherwise assist with the Video, the Author hereby grants to JoVE, subject to **Section 7** below, the exclusive, royalty-free, perpetual (for the full term of copyright in the Article, including any extensions thereto) license (a) to publish, reproduce, distribute, display and store the Video in all forms, formats and media whether now known or hereafter developed (including without limitation in print, digital and electronic form) throughout the world, (b) to translate the Video into other languages, create adaptations, summaries or extracts of the Video or other Derivative Works or Collective Works based on all or any portion of the Video and exercise all of the rights set forth in (a) above in such translations, adaptations, summaries, extracts, Derivative Works or Collective Works and (c) to license others to do any or all of the above. The foregoing rights may be exercised in all media and formats, whether now known or hereafter devised, and include the right to make such modifications as are technically necessary to exercise the rights in other media and formats. For any Video to which this **Section 6** is applicable, JoVE and the Author hereby grant to the public all such rights in the Video as provided in, but subject to all limitations and requirements set forth in, the CRC License.

7. **Government Employees.** If the Author is a United States government employee and the Article was prepared in the course of his or her duties as a United States government employee, as indicated in **Item 2** above, and any of the licenses or grants granted by the Author hereunder exceed the scope of the 17 U.S.C. 403, then the rights granted hereunder shall be limited to the maximum rights permitted under such statute. In such case, all provisions contained herein that are not in conflict with such statute shall remain in full force and effect, and all provisions contained herein that do so conflict shall be deemed to be amended so as to provide to JoVE the maximum rights permissible within such statute.

8. **Protection of the Work.** The Author(s) authorize JoVE to take steps in the Author(s) name and on their behalf if JoVE believes some third party could be infringing or might infringe the copyright of either the Author's Article and/or Video.

9. **Likeness, Privacy, Personality.** The Author hereby grants JoVE the right to use the Author's name, voice, likeness, picture, photograph, image, biography and performance in any way, commercial or otherwise, in connection with the Materials and the sale, promotion and distribution thereof. The Author hereby waives any and all rights he or she may have, relating to his or her appearance in the Video or otherwise relating to the Materials, under all applicable privacy, likeness, personality or similar laws.

10. **Author Warranties.** The Author represents and warrants that the Article is original, that it has not been published, that the copyright interest is owned by the Author (or, if more than one author is listed at the beginning of this Agreement, by such authors collectively) and has not been assigned, licensed, or otherwise transferred to any other party. The Author represents and warrants that the author(s) listed at the top of this Agreement are the only authors of the Materials. If more than one author is listed at the top of this Agreement and if any such author has not entered into a separate Article and Video License Agreement with JoVE relating to the Materials, the Author represents and warrants that the Author has been authorized by each of the other such authors to execute this Agreement on his or her behalf and to bind him or her with respect to the terms of this Agreement as if each of them had been a party hereto as an Author. The Author warrants that the use, reproduction, distribution, public or private performance or display, and/or modification of all or any portion of the Materials does not and will not violate, infringe and/or misappropriate the patent, trademark, intellectual property or other rights of any third party. The Author represents and warrants that it has and will continue to comply with all government, institutional and other regulations, including, without limitation all institutional, laboratory, hospital, ethical, human and animal treatment, privacy, and all other rules, regulations, laws, procedures or guidelines, applicable to the Materials, and that all research involving human and animal subjects has been approved by the Author's relevant institutional review board.

11. **JoVE Discretion.** If the Author requests the assistance of JoVE in producing the Video in the Author's facility, the Author shall ensure that the presence of JoVE employees, agents or independent contractors is in accordance with the relevant regulations of the Author's institution. If more than one author is listed at the beginning of this Agreement, JoVE may, in its sole

1 Alewife Center #200
Cambridge, MA 02140
tel. 617.945.9051
www.jove.com

ARTICLE AND VIDEO LICENSE AGREEMENT

discretion, elect not take any action with respect to the Article until such time as it has received complete, executed Article and Video License Agreements from each such author. JoVE reserves the right, in its absolute and sole discretion and without giving any reason therefore, to accept or decline any work submitted to JoVE. JoVE and its employees, agents and independent contractors shall have full, unfettered access to the facilities of the Author or of the Author's institution as necessary to make the Video, whether actually published or not. JoVE has sole discretion as to the method of making and publishing the Materials, including, without limitation, to all decisions regarding editing, lighting, filming, timing of publication, if any, length, quality, content and the like.

12. **Indemnification.** The Author agrees to indemnify JoVE and/or its successors and assigns from and against any and all claims, costs, and expenses, including attorney's fees, arising out of any breach of any warranty or other representations contained herein. The Author further agrees to indemnify and hold harmless JoVE from and against any and all claims, costs, and expenses, including attorney's fees, resulting from the breach by the Author of any representation or warranty contained herein or from allegations or instances of violation of intellectual property rights, damage to the Author's or the Author's institution's facilities, fraud, libel, defamation, research, equipment, experiments, property damage, personal injury, violations of institutional, laboratory, hospital, ethical, human and animal treatment, privacy or other rules, regulations, laws, procedures or guidelines, liabilities and other losses or damages related in any way to the submission of work to JoVE, making of videos by JoVE, or publication in JoVE or elsewhere by JoVE. The Author shall be responsible for, and shall hold JoVE harmless from, damages caused by lack of sterilization, lack of cleanliness or by contamination due to the making of a video by JoVE its employees, agents or independent contractors. All sterilization, cleanliness or decontamination procedures shall be solely the responsibility of the Author and shall be undertaken at the Author's expense. All indemnifications provided herein shall include JoVE's attorney's fees and costs related to said losses or damages. Such indemnification and holding harmless shall include such losses or damages incurred by, or in connection with, acts or omissions of JoVE, its employees, agents or independent contractors.

13. **Fees.** To cover the cost incurred for publication, JoVE must receive payment before production and publication the Materials. Payment is due in 21 days of invoice. Should the Materials not be published due to an editorial or production decision, these funds will be returned to the Author. Withdrawal by the Author of any submitted Materials after final peer review approval will result in a US$1,200 fee to cover pre-production expenses incurred by JoVE. If payment is not received by the completion of filming, production and publication of the Materials will be suspended until payment is received.

14. **Transfer, Governing Law.** This Agreement may be assigned by JoVE and shall inure to the benefits of any of JoVE's successors and assignees. This Agreement shall be governed and construed by the internal laws of the Commonwealth of Massachusetts without giving effect to any conflict of law provision thereunder. This Agreement may be executed in counterparts, each of which shall be deemed an original, but all of which together shall be deemed to me one and the same agreement. A signed copy of this Agreement delivered by facsimile, e-mail or other means of electronic transmission shall be deemed to have the same legal effect as delivery of an original signed copy of this Agreement.

A signed copy of this document must be sent with all new submissions. Only one Agreement is required per submission.

CORRESPONDING AUTHOR

Name:	Cameron Jeter, Ph.D.
Department:	Diagnostic and Biomedical Sciences
Institution:	The Univ. of Texas Health Science Center at Houston
Title:	Associate Professor
Signature:	Cameron Jeter
Date:	7-8-19

Please submit a **signed** and **dated** copy of this license by one of the following three methods:

1. Upload an electronic version on the JoVE submission site
2. Fax the document to +1.866.381.2236
3. Mail the document to JoVE / Attn: JoVE Editorial / 1 Alewife Center #200 / Cambridge, MA 02140

Dear JoVE editors and reviewers,

Thank you for your guidance in revisions of the manuscript to meet journal guidelines. We carefully have met these stipulations. Thank you to the reviewers for their role in honing the clarity and utility of our protocol.

Editorial comments:

1. Please take this opportunity to thoroughly proofread the manuscript to ensure that there are no spelling or grammar issues. The JoVE editor will not copy-edit your manuscript and any errors in the submitted revision may be present in the published version.

   We have proofread and corrected a number of spelling and grammar errors.

2. Authors and affiliations: Please provide an email address for each author in the manuscript.

   We added the email addresses of all authors.

3. Keywords: Please provide no more than 12 keywords or phrases.

   We reduced our list of keywords and phrases to 12.

4. Please revise the Protocol text to avoid the use of personal pronouns (e.g., I, you, your, we, our) or colloquial phrases.

   We eliminated all personal pronouns by using the imperative tense.

5. Please revise the Protocol to contain only action items that direct the reader to do something (e.g., "Do this," "Ensure that," etc.). The actions should be described in the imperative tense in complete sentences wherever possible. Avoid usage of phrases such as "could be," "should be," and "would be" throughout the Protocol. Any text that cannot be written in the imperative tense may be added as a "NOTE." Please include all safety procedures and use of hoods, etc. However, notes should be used sparingly and actions should be described in the imperative tense wherever possible. Please move the discussion about the protocol to the Discussion.

   We revised each step in the protocol to be in the imperative tense and included a few NOTEs.

6. 2.1: What are the inclusion/exclusion criteria of the patient?

   The inclusion/exclusion criteria are included as General Recommendation 1.7.

7. Please combine some of the shorter Protocol steps so that individual steps contain 2-3 actions and maximum of 4 sentences per step.

   Many short steps in the Protocol were combined, which we also think improved clarity.

8. Please include single line spacing between each numbered step or note in the protocol.

Single line spacing has been added in the Protocol.

9. After you have made all the recommended changes to your protocol section (listed above), please highlight in yellow up to 2.75 pages (no less than 1 page) of protocol text (including headers and spacing) to be featured in the video. Bear in mind the goal of the protocol and highlight the critical steps to be filmed. Our scriptwriters will derive the video script directly from the highlighted text.

Highlighted text has been adjusted to reflect our Protocol revisions.

10. Please highlight complete sentences (not parts of sentences). Please ensure that the highlighted steps form a cohesive narrative with a logical flow from one highlighted step to the next. The highlighted text must include at least one action that is written in the imperative voice per step. Notes cannot usually be filmed and should be excluded from the highlighting.

Highlighted text has been adjusted to reflect our Protocol revisions.

Reviewers' comments:

Reviewer #1:

Manuscript Summary:
The aim of the article is not clearly define in the introduction. Good assortment of most utilized questionnaires.

We agree that no clear objective statement was included in the Introduction. This is now added as the topic sentence of paragraph three, line 77.

Reviewer #2:

Manuscript Summary:
Assessment of oral health of older people by lay or non- dental professionals.

Major Concerns:

1. The manuscript does not cover all of the available, validated simple assessment procedures. For example the "Oral Health Assessment Tool" Chalmers et al Australia Dental Journal 2005; 50: 191-199. Which has been used extensively in nursing homes in Canada, Australia and elsewhere as a simple assessment tool which would meet the criteria of the area under protocol discussion.

As a method paper rather than a review paper, our objective is to narrow the list of available, simple oral health assessments to a concise yet comprehensive battery of oral health tools for the lay caregiver. Thus, the manuscript does not cover/recommend use of all the available, validated assessment tools. So that the reader knows of the Oral Health Assessment Tool, and why the Brief Oral Health Status Examination is comparable and selected instead, we add discussion of this tool (line 167). Of note, the OHAT is derived from the BOHSE. Chalmers published a review of oral health tools available in 2005 stating "the most comprehensive, validated and reliable assessment screening tool for use by nurses and carers with cognitively impaired institutionalized residents is the Brief Oral Health Status Examination." (Chalmers and Pearson, J Adv Nurs 2005)

2. The Tables are too extensive and complex and would require significant training and education to fully appreciate and use appropriately with a high degree of reliability by different users.

Tables 1-4 are the four oral health assessments included in our method, exactly replicated from their respective original publications. Thus, to maintain validity and reliability the listed questions/items should be included.

The set of tools presented here are for two primary purposes: 1) as a research battery across multiple patients for use by dental students or college undergraduate summer research students and 2) for oral health screening and possible referral of individual patients by caregivers to a dental professional. In this latter case, concern for reliability or false positives is not great, as the intent is to determine if an appointment with a physician or dentist is warranted.

3. The number of participants used in the evaluation (n=10) with 8 controls is insufficient to assess validity and reliability of the tools discussed and recommended in the protocol.

Because the original publications of each tool in our assessment established their respective validity and reliability (Greene, 1967; Atchison and Dolan, 1990; Kayser-Jones et al., 1995; Kalf et al., 2011), this was not our aim. That said, we include more patients in this revision, not only those in long-term care with and without dementia, but also community-dwelling controls and patients with Parkinson's disease.

4. The manuscript protocol does not suggest an education and training program which would be required by the users of the tools. This may be both extensive and unsustainable in the environment envisaged for the use of such tools.

Thank you for requesting more description of the training we provide. We have added this to the Protocol as Step 2. Training. The original manuscript includes, however, a major component of this training. Namely, the uniqueness of a publication in this journal (Journal of Visualized Experiments; JoVE) affords the authors the advantage of depicting the Protocol in a video accompanying the manuscript. Thus, whereas we authors are not present with the reader to train him or her, we can do so through the powerful combination of a JoVE paper and video.