

Association between oral feeding versus enteral feeding and cerumen impaction in older hospitalized adults: A retrospective cohort study

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Abstract

Background: Chewing involves jaw movements that propel cerumen along the ear canal. This mechanism may be reduced in dysphagia, especially for older individuals who are enterally fed. Those patients may be at a higher risk for cerumen impaction and may require longer hospital stays. Examining the relationship between diet type, cerumen impaction, and hospital stay duration was the focus of the present study.

Methods: We performed a retrospective cohort study (not registered) among 114 hospitalized older adults. Data were collected on diet type: (1) oral feeding (individuals fed a solid diet or a pureed diet) or (2) enteral feeding (individuals fed via a feeding tube). The results of an otoscopy that quantified cerumen were recorded, as well as hospital stay duration.

Results: In a mediation analysis, a hospital stay of >1 month was associated with an increased risk of enteral feeding, which in turn, increased the risk of cerumen impaction. Analysis indicated that the link between longer hospitalization and a more severe level of cerumen impaction was fully mediated by diet type (enteral feeding).

Conclusions: Enteral feeding seems to be a risk factor for cerumen impaction, rather than merely hospitalization length, in our sample of geriatric patients. These results highlight the importance of continuous monitoring by ear, nose, and throat specialists, as well as regular auditory assessments for patients who are enterally fed for early detection and treatment of cerumen impaction. Particular attention should be paid to cases of prolonged hospitalization, which is associated with the severity of dysphagia.

KEYWORDS

cerumen impaction, diet type, dysphagia, enteral feeding, length of hospitalization

In recent years, dysphagia has been referred to as a geriatric syndrome because of its high prevalence among older adults, ranging from 10% to 33%.¹⁻⁴ Its prevalence is higher among the geriatric hospitalized patient population,⁵ specifically among individuals with a longer hospital stay.⁶ Several medical conditions that are prevalent in older age may contribute to dysphagia occurrence in this population. For example, gastroesophageal reflux disease or certain types of cancer.⁷

The severity of dysphagia can vary widely, ranging from minor discomfort or occasional difficulties to more serious consequences. These may include dehydration, malnutrition, aspiration pneumonia, choking, and mortality.⁸ Effective dysphagia management depends on identifying the cause and customizing interventions to address individual challenges.⁹ This commonly involves dietary modifications,¹⁰ compensatory maneuvers and rehabilitative exercises, medications, or in some cases, surgical procedures to correct structural abnormalities.

In cases of severe dysphagia, enteral feeding may be considered as an alternative means of providing nutrition, using a feeding tube (eg, nasogastric tube or gastrostomy tube).¹¹ Although this approach ensures nutrition intake, it comes with its own set of challenges. Common negative implications of enteral feeding include weight loss, nutrient deficiencies, and tube-related infections.¹² In individuals who are enterally fed, chewing and related jaw movements (the opening and closing movement of the mandible) are lacking. The absence of chewing may lead to various consequences, such as dry mouth or xerostomia, increased risk of dental decay, and gum disease.¹³

One potential consequence of enteral feeding that has received less attention is its effect on cerumen production and impaction. The production of cerumen is a normal biological process. Cerumen moisturizes the skin of the external auditory canal and protects it from infection, providing a barrier against the intrusion of water and foreign bodies. Cerumen impaction, however, may lead to conductive hearing loss, above and beyond presbycusis.^{14,15} Hearing loss and auditory input degradation impair spoken communication,¹⁶⁻¹⁸ with severe implications for social interactions, depression, and cognitive decline, especially in older adults.^{19,20} Cerumen impaction is also related to complaints of dizziness, pain, itching, odor, and ear fullness.²¹ Untreated cerumen impaction may result in a perforated eardrum and ear infections.²²

The formation of cerumen impaction is a very common condition in the geriatric population (aged >65 years), and its prevalence ranges between 33% and 65%.^{23,24} This high prevalence may be associated with anatomical changes in the ear canal.²⁵ Cerumen impaction is even more common in patients in frail health, associated with a reduced ability to clean one's own ears. Frail health was also found to predispose older adults to increased cerumen production.²⁶ Such patients with medical complexity may have a longer stay in geriatric hospitalization services; thus, diagnosis and treatment of cerumen impaction may be delayed.^{24,26}

In individuals who are enterally fed, the aural self-cleaning mechanism may be disrupted because of a lack of chewing and

swallowing jaw movements.²⁴ These jaw movements typically propel cerumen along the ear canal, from the ear's interior toward the outer ear.^{27,28} Indeed, normal chewing habits were associated with a reduced risk of the forming of cerumen prop—an accumulation of cerumen that blocks the ear canal and causes symptoms and/or prevents assessment of the ear.^{29,30} Therefore, the primary aim of our retrospective cohort study was to compare oral feeding (solid or pureed diet) with enteral feeding (tube feeding) and their association with cerumen impaction levels as determined by the Sullivan scale³¹ in hospitalized geriatric patients with dysphagia. We hypothesized that enteral nutrition (ie, the absence of chewing and swallowing) is associated with increased cerumen impaction in the external auditory canal as determined by the Sullivan scale compared with oral feeding.

Whereas the link between chewing movements and cerumen migration has been established,^{27,28} the specific relationship between enteral feeding, hospital stay duration, and cerumen impaction in geriatric patients remains unexplored. Several studies support positive relationships indirectly.³²⁻³⁴ The increased length of hospital stay may be attributed to the need to treat other related medical conditions like infection and reduced mobility from associated dizziness. To address this knowledge gap, our secondary study aim was to investigate the potential mediating role of enteral feeding in the relationship between hospital stay duration and cerumen impaction in geriatric patients.

By examining these relationships, our study seeks to provide new insights into the potential unintended consequences of enteral feeding on ear health in geriatric patients. This information could have significant implications for the care and management of hospitalized older adults, potentially informing practices to prevent or mitigate cerumen impaction in this vulnerable population. Furthermore, our findings may contribute to a more comprehensive understanding of the interplay between feeding methods, hospital stay duration, and health in geriatric care.

METHODS

Design

We performed a retrospective cohort study on 114 hospitalized older adults.

Study procedure

Our exposure of interest was oral feeding, defined as a solid or pureed diet, and our comparator was enteral feeding, defined as tube feeding (eg, nasogastric tube or gastrostomy tube). The main goal of the current study was to test the link between diet type and cerumen impaction. Our secondary goal was to test the complex relationship between diet type and length of hospitalization with cerumen impaction.

Our primary outcome was cerumen impaction level, defined by the Sullivan scale (assessing the existence of cerumen in the external

auditory canal and the severity of impaction)³¹ and determined following an otoscopic examination rated by an experienced audiologist. In the first step, we tested how the different variables were related to the cerumen impaction. In the second step, a mediation model, diet type ($\times 2$: oral feeding vs enteral feeding) served as a mediator between length of hospitalization ($\times 2$: <1 month vs ≥ 1 month) and level of cerumen impaction. Based on the aforementioned literature, we hypothesized that oral feeding and a shorter length of hospitalization would be associated with a lower level of cerumen impaction compared with enteral feeding and a longer length of hospitalization.

Ethics

The procedures performed in this study were approved by the local institutional review board (Dorot Geriatric Medical Rehabilitative Center #03-2023). Data collection was conducted between January and April 2023; during January and February, the methodological framework was developed, and verification was conducted to ensure that data on swallowing status and diet type were systematically documented in patient records. The comprehensive review of these records, in conjunction with otoscopic examinations, was performed for all patients during March and April.

Participants

In an a priori power analysis,³⁵ a sample of 105 participants was the minimal requirement for 0.85 power (odds ratio [OR] = 1.75; Pr_{H0} = 0.5). Accounting for attrition, additional participants were recruited. Medical records of 114 patients were retrospectively evaluated. The sample consisted of all patients hospitalized at a medical center for rehabilitation and geriatrics during the data collection period, for whom an otoscopic examination was conducted. Because of the guidelines of the hospital's Infection Prevention Unit, otoscopic examinations were not performed in cases where patients had a known outer ear infection, such as candidiasis. All were hospitalized patients in different units (Rehabilitation, Nursing, and Mechanically Ventilated Patients Departments).

Patients were excluded if they had an ear infection (preventing otoscopy examination) or had a recorded change in feeding regimen during hospitalization and were included only if they met the age-range criterion, 65–95 years (mean = 78.7 years; SD = 7.8 years).

Based on the diet type recorded in their medical files on the day of the otoscopic examination, participants were categorized into two groups: (1) oral feeding ($n = 69$; 60.5%)—individuals fed a solid diet ($n = 58$; 50.9%) or a pureed diet ($n = 11$; 9.6%)—and (2) enteral feeding—individuals fed via a feeding tube ($n = 45$; 39.5%). During the 4 months of data collection, no transition between feeding regimens that affected the allocation of participants to the two study groups was recorded; two patients in the enteral feeding group transitioned from using a nasogastric tube to a percutaneous endoscopic gastrostomy feeding tube, and two patients in the oral feeding group progressed from a pureed diet to a solid (regular) diet.

Tools and materials

Medical records

Participants' medical files were reviewed on the day of the otoscopic examination to document the patients' diet type and retrospectively calculate their length of hospital stay (in months) tracing back from the day of the examination to their admission date.

Dysphagia was identified based on a comprehensive swallowing evaluation conducted by a speech-language pathologist upon patient admission. The results of these evaluations are documented in the patient's medical files, guiding appropriate dietary and feeding interventions throughout hospitalization. This process ensured that each patient received the most suitable diet to mitigate aspiration risks and other complications associated with dysphagia. In the Mechanically Ventilated Patients Department, most patients are in a vegetative state and are unable to undergo swallowing tests. Because of their level of consciousness, these patients receive enteral feeding.

Otoscopic examination

The otoscopic equipment used in the study was introduced for routine use at the hospital in March 2023. Consequently, each patient already hospitalized at that time (with the duration of hospitalization ranging from <1 month to more than a year) underwent an otoscopic examination between March and April. The otoscopic examination was conducted by an experienced audiologist to assess the existence of cerumen in the external auditory canal, and the severity of impaction, using a handheld otoscope (Welch Allyn). The audiologist rated the otoscopic examination findings using the Sullivan scale³¹ (see Supporting Information S1: Methods A). After the data collection period and the completion of the study, otoscopic examinations were incorporated as a standard part of the hospital's admission procedure for all new patients (yet, because of a shortage of manpower, these examinations are conducted within the first week of hospitalization).

Statistical analysis

Data were analyzed using SPSS Statistics, version 27. The outcome factor was cerumen impaction ($\times 3$, an ordinal variable: no/minor, partial, complete). The main predictor was diet type ($\times 2$, a dichotomous variable: solid or pureed diet, oral feeding, vs enteral feeding). We also inspected the effect of length of hospitalization ($\times 2$, a dichotomous variable: <1 month vs ≥ 1 month) and controlled for the effect of sex ($\times 2$, a dichotomous variable: male vs female) and age (continuous variable: 65–95 years old). We performed a chi-square test to compare sex distribution and a t test to compare mean age between the two diet type groups. In the first step, we conducted an ordinal logistic regression model to assess the unique and combined association of the different variables with cerumen impaction. In this model, all variables (age, diet type, length of hospitalization, and sex)

were entered simultaneously to account for their potential confounding effects on each other. In the second step, we tested a mediation model, in which diet type was the mediator between length of hospitalization and cerumen impaction. Analyses were assessed at a two-sided alpha level of 0.05.

RESULTS

The current sample ($n = 114$) consisted of 54 men (47.4%) and 60 women (52.6%). Half of the participants were hospitalized for <1 month ($n = 57$), and the other half were hospitalized for >1 month. This time period was chosen not only because it splits the participant pool but also because it reflects patients' medical status. Full demographic and clinical data on the participants are available in Table 1, indicating that sex distribution (chi-square) and mean age (t test) did not differ between the two diet type groups. Additional clinical data on a subsample of the participants ($N = 72$) are available in Supporting Information S2: Results A. Three of the patients from the Mechanically Ventilated Patients Department died during the data collection period (after their files were coded), but because of the retrospective nature of the study, it did not affect the results.

Table 2 reports the levels of cerumen impaction based on the Sullivan scale,³¹ and Table 3 presents the total grades and corrected blockage scores that were used for analysis. Table 4 indicates that the two diet type groups differ significantly in the distribution of corrected blockage scores ($\chi^2[2] = 11.48$; $P = 0.003$). Approximately half (49%) of the enteral feeding group had complete blockage, vs only 20% of the oral feeding group. In contrast, only 18% of the enteral-feeding group had no/minor obstruction, vs 39% of the oral feeding group. Similarly, participants with a length of hospitalization <1 month had lower odds

of a higher level of cerumen impaction compared with those with a shorter stay ($\chi^2[2] = 6.52$; $P = 0.04$). However, the level of cerumen impaction was not significantly affected by sex ($\chi^2[2] = 0.97$; $P = 0.62$), or by age ($F_{6,107} = 0.48$; $P = 0.82$).

An ordinal logistic regression model assessing the relationship of all these factors together on cerumen impaction was statistically significant ($\chi^2[4] = 13.30$; $P = 0.01$; with pseudo- R^2 [Nagelkerke] =

TABLE 3 Sullivan scale total grades^a and corrected blockage scores^b across the study sample.

Scales	N
Total grade ^a	0
0	19
1	3
2	13
3	10
4	21
5	12
6	36
Corrected blockage score ^b	
1—No/minor obstruction; a total grade of 0, 1, 2	35
2—Partial obstruction; a total grade of 3, 4, or 5	43
3—Complete blockage; a total grade of 6	36

^aThe sum of the grades for both ears, ranging from 0 (indicating that both ears were graded 0) to 6 (indicating that both ears were graded 3).

^bConverted corrected blockage scores were calculated to facilitate data analysis.

TABLE 1 Clinical characteristics of the study sample.

Characteristics	Total sample	Oral feeding	Enteral feeding	Group difference
N	114	69	45 (nasogastric tube: 32, PEG: 13)	
Sex, M, F		32, 37	22, 23	$\chi^2(1) = 0.07$; $P = 0.79$
Age, mean (SD), years		77.8 (7.6)	80.1 (8.1)	$t(112) = 1.54$; $P = 0.13$
Length of hospital stay, n				
<1 month	57	48	9	$\chi^2(1) = 26.77$; $P < 0.001$
≥1 month	57	21	36	

Abbreviations: F, female; M, male; PEG, percutaneous endoscopic gastrostomy.

TABLE 2 Otoloscopic examination results by ear—Level of cerumen impaction according to the Sullivan scale³¹ across the study sample.^a

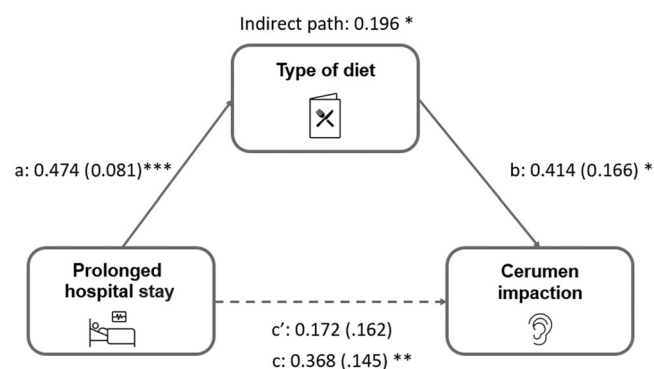
	0—Cerumen absent or present in a minimal amount	1—Nonocclusive minor amount present	2—Nonocclusive moderate amount present	3—Occlusive major amount present
Right ear	24	16	29	43
Left ear	23	16	27	46

^aTesting could not be conducted on four ears because of a collapse of the external auditory canal.

TABLE 4 Distribution of corrected blockage scores for the two study groups.

	Corrected blockage score, % (n)		
	1—No/minor obstruction	2—Partial obstruction	3—Complete blockage
Oral feeding	39 (27)	41 (28)	20 (14)
Enteral feeding	18 (8)	33 (15)	49 (22)

$$\chi^2(2) = 11.48; P = 0.003$$

**FIGURE 1** The mediation model (logistic binary regression) shows that the relationship between a prolonged hospital stay and cerumen impaction (path c) is mediated by diet type (paths a and b). * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

0.12). In this model, only the effect of diet type was significant ($B = -0.964$; $SE = 0.423$; $P = 0.02$; 95% CI, -1.792 to -0.135), whereas length of hospitalization, age, and sex were not found to be significant predictors of cerumen impaction (all $P > 0.25$). In other words, this hints that the effect of length of hospitalization on cerumen impaction was related to the effect of diet type.

In the second step, we tested a mediation model in which diet type is the mediator between length of hospitalization and cerumen impaction. Figure 1 illustrates a mediation model (logistic binary regression) showing that the relationship between prolonged hospital stay and cerumen impaction is mediated by diet type. Specifically, a longer hospital stay is significantly associated with a higher likelihood of receiving an enteral feeding diet (path $a = 0.47$ [$P < 0.001$]; $OR = 9.14$ [$P < 0.001$]). In turn, an enteral feeding diet is significantly linked to a higher level of cerumen impaction (path $b = 0.41$ [$P = 0.01$]; $\beta = 0.31$ [$P < 0.001$]). The direct effect of the length of hospital stay on cerumen impaction (longer hospitalization leads to a higher level of cerumen impaction; $\beta = 0.23$; $P = 0.01$) becomes nonsignificant when accounting for diet type (Path $c' = 0.17$; $P = 0.29$), suggesting that diet type fully mediates this relationship. The indirect effect through diet type is significant (0.20 ; $P < 0.05$), indicating that most of the influence of prolonged hospitalization on cerumen impaction operates through its effect on diet type. Indeed, ~19.6% of the total effect of length of hospitalization on cerumen impaction was

mediated by diet type. The mediating effect was confirmed using the Sobel test³⁶ ($z = 2.29$ [0.09]; $P = 0.02$).

In simpler terms, patients who are hospitalized for a longer period are more likely to be receiving an enteral diet, which then increases their risk of developing cerumen impaction. That is, the enteral diet appears to be a key factor in greater cerumen buildup and impaction.

DISCUSSION

The current study provides evidence that severe dysphagia that requires tube feeding diets mediates the relationship between prolonged hospitalization and increased risk of cerumen impaction. In other words, patients hospitalized for more than a month had significantly higher odds of receiving nonchewable tube feeding diets (enteral feeding) than regular or pureed diets (oral feeding), as compared with those hospitalized for <1 month. Importantly, enteral feeding was associated with higher levels of cerumen impaction. When controlling for diet type (enteral feeding vs oral feeding) in the mediation model, the direct relationship between hospitalization length and cerumen impaction was no longer significant, indicating full mediation.

Long hospitalization and its association with dysphagia

Prolonged hospitalization has various negative effects on geriatric patients, such as a higher risk of frailty (ie, increased vulnerability) and functional decline.^{37,38} Prolongation of hospital stay has been associated with the development of hospital-acquired conditions; the longer the hospital stay, the higher the risk of hospital-acquired infections, pressure injuries, falls, and delirium.³⁹ In addition, longer hospitalization has been associated with the development or worsening of cognitive deficits and emotional state in older adults.^{40,41}

The current findings add to this knowledge by confirming the existence of a relationship between long hospitalization and swallowing disorders and specifically, the presence of severe dysphagia. The link can be reciprocal, as severe dysphagia typically involves reintubation, surgical insertion of a feeding tube, and rehabilitation,⁴² increasing hospital length of stay. As such, dysphagia is considered a negative prognostic indicator.⁶

Based on these findings, we recommend the early detection of dysphagia in hospitalized geriatric patients, especially in those with comorbid conditions that pose a high risk. For these patients, the treatment plan should encompass a thorough evaluation, prompt intervention through suitable therapies, and precautions against aspiration.⁴³

The effect of dysphagia on cerumen impaction

The current study is novel in demonstrating an association between dysphagia and cerumen impaction in geriatric patients. Our findings add to the indirect link that is indicated in the literature. Rawool²⁹

found that children with feeding and swallowing disorders had higher odds (22.1%) of excessive cerumen compared with typically developing children. Fransman⁴⁴ found a positive relationship between a reduced ability to chew due to the absence of back (molar) teeth and chronic earwax obstruction in a group of individuals with learning disabilities (mean age of ~50 years). Widuri³⁰ aimed to determine whether chewing habits influence the degree of cerumen obstruction in patients with impacted cerumen and compared individuals with normal chewing habits (defined as 20–33 times per mouthful) and individuals with abnormal chewing habits (whose frequency was defined as <20 times). The author showed that normal chewing habits were associated with a reduced risk of the forming of cerumen prop. Recently, Yamano et al⁴⁵ found that chewing movements during food mastication were directly related to ear canal movements, suggesting a possible mechanism for the link between chewing and natural cerumen propelling.

These findings contrast with those of Morley et al,²⁵ which failed to demonstrate the link between dysphagia and cerumen impaction in older adults. Morley and colleagues evaluated 51 nursing home residents, who were classified as “chewers” (receiving unrestricted or soft food diets) or “nonchewers” (receiving pureed or nothing-by-mouth diets). Otoscopy and tympanometry were used to assess cerumen impaction and ear canal occlusion. Interestingly, and in contrast to our results, no significant difference in cerumen accumulation was found between groups.

However, one must note that individuals who were fed a pureed diet were classified as orally fed in our study but as “nonchewers” in the study by Morley et al.²⁵ Only a single patient receiving “nil by mouth” was included in their “nonchewers” group. Typically, pureed diets consist of foods processed to one simple, smooth, thick consistency, eliminating the need for chewing and requiring minimal lip and tongue movement to initiate swallowing. We suggest that even these minimal swallowing movements may assist in the mechanism of cerumen removal. Indeed, a follow-up analysis indicates no difference in the distribution of level of corrected blockage scores between individuals who are fed a solid diet or a pureed diet ($\chi^2[2] = 0.40$; $P = 0.82$). Therefore, we maintain that patients with severe dysphagia who are enterally fed refrain from chewing or swallowing completely, thus allowing cerumen to build up over time.

A noteworthy subgroup in the current study consists of patients in the Mechanically Ventilated Patients Department. These patients, presenting with a variety of conditions (eg, acute respiratory failure, surgery, trauma, or severe infections), differ significantly from spontaneously breathing patients receiving enteral nutrition because of distinct physiological and anatomical factors related to airway management and respiratory function.⁴⁶ Patients undergoing mechanical ventilation typically have an endotracheal tube that bypasses the nasopharynx and oropharynx, disrupting normal swallowing and digestion. This can impair protective airway reflexes and increase the risk of aspiration during enteral feeding, leading to complications like pneumonia. Future research should investigate this unique population, with particular attention to additional factors such as the patient's positioning while lying.

Clinical implications and recommendations

According to the current results, patients receiving an enteral diet are more likely to experience cerumen impaction if their hospitalization is prolonged. These findings highlight the importance of considering a patient's diet type when addressing the risk factors for cerumen impaction during a hospital stay. Early diagnosis and multidisciplinary management are critical in enhancing the quality of life for individuals dealing with dysphagia.⁸ Healthcare providers may need to pay special attention to geriatric patients receiving enteral diets, ensuring that their ear care is adequately managed to prevent cerumen impaction, especially if their hospitalization is expected to be prolonged. This is of clinical importance because excessive or impacted cerumen in older adults is typically underdiagnosed and likely undertreated. On the one hand, older patients are often unaware that they have cerumen impaction or that removal of the impaction may improve their hearing.²⁴ On the other hand, cerumen removal is not always carried out in hospital settings.⁴⁷

Adopting screening protocols, routine ear examinations, and cerumen removal, especially upon hospital admission, could potentially reduce hospitalization stays and improve outcomes in this population. Diet modifications and cerumen impaction prevention should be considered in long-term inpatients, especially for patients expected to have restricted diets for more than a month.

From the clinical perspective, our findings support the need to raise awareness of chewing exercises especially in geriatric wards and for patients receiving long-term enteral feeding. These exercises provide some opportunities for chewing or stimulating the jaw muscles that could not only help mitigate impaction risk (propelling cerumen along the ear canal) but also assist in maintaining oral-motor health. There are several activities and products that can help stimulate the jaw muscles and/or provide opportunities for chewing, such as silicone chew toys designed for adults, gum guards or bite strips designed for jaw muscle strengthening (often used by athletes), and oral-motor tools. Some professionals recommend specific chewing exercises to improve jaw muscle strength and function (eg, jaw massage, jaw stretching, and yawning).⁴⁸ These exercises should be done under the guidance of a healthcare provider. Using these methods may help prevent cerumen impaction for individuals with dysphagia.

The mediating role of diet type also has implications for community-dwelling adults with chewing or swallowing difficulties. Dentition status, mild or moderate dysphagia, and other conditions that limit oral intake could predispose individuals to cerumen impaction through similar mechanisms as seen in hospitalized patients receiving tube feeding. Future research should further investigate this in other age ranges and across cultures (as indicated in oral-motor movement^{49–52}).

Caveats

The nature of the current study, conducted within a real-world clinical setting, leads to some limitations that are typical of field studies. The use of a retrospective design, despite providing valuable

insights into the association between enteral feeding and cerumen impaction, does not allow for the establishment of causality. This retrospective nature also excluded the possibility of gaining audiometric data. However, the link between cerumen impaction and hearing loss has been well established.¹⁴ Additionally, the categorization of patients into oral feeding and enteral feeding was a necessary simplification to facilitate analysis. This approach, although it streamlines the examination of dietary effects on cerumen accumulation, might not capture all nuances of patient dietary management. Factors such as the nutrition content of the diet, the physical act of chewing, and the overall management of the patient's feeding regimen are not captured within this dichotomous framework. Future studies may wish to focus on the potential effects of these factors.

As mentioned, patients with changing feeding regimens during hospitalization were excluded. However, transitions in feeding regimens could have occurred before the hospitalization (ie, at home, in previous hospitalizations), affecting our findings. Future studies may control this factor as well. We also acknowledge that factors beyond our current scope, such as hydration status, patient mobility and frailty, and metabolic conditions, may play a role in cerumen impaction risk. The exclusion of these variables reflects the practical constraints of researching in a dynamic, clinical environment. Further research that considers a wider array of influencing factors is called for.

SUMMARY

This study sheds light on an underrecognized consequence of prolonged enteral feeding in hospitalized patients, demonstrating that the type of diet a patient consumes (and especially enteral feeding) plays a role in how prolonged hospitalization affects the risk of developing cerumen impaction. Simple steps to provide jaw motion stimulation and monitor cerumen buildup may help prevent associated negative implications.

AUTHOR CONTRIBUTIONS

Asil Mansour: Conceptualization; Investigation; Project administration; Writing—review and editing; Data curation. **Boaz M. Ben-David:** Writing—original draft; Writing—review and editing; Formal analysis. **Ady Sasson:** Investigation; Methodology; Writing—review and editing; Supervision. **Jalal Farraj:** Investigation; Methodology; Validation; Writing—review and editing; Supervision. **Anwar Mansour:** Conceptualization; Methodology; Writing—review and editing; Supervision. **Yehonatan Roth:** Writing—review and editing. **Michal Icht:** Writing—original draft; Writing—review and editing; Visualization; Conceptualization.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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REFERENCES

1. Barczy SR, Sullivan PA, Robbins J. How should dysphagia care of older adults differ? Establishing optimal practice patterns. *Semin Speech Lang.* 2000;21(4):0347-0364.
2. Cho SY, Choung RS, Saito YA, et al. Prevalence and risk factors for dysphagia: a USA community study. *Neurogastroenterol Motil.* 2015;27(2):212-219.
3. Clavé P, Shaker R. Dysphagia: current reality and scope of the problem. *Nat Rev Gastroenterol Hepatol.* 2015;12(5):259-270.
4. Patel DA, Krishnaswami S, Steger E, et al. Economic and survival burden of dysphagia among inpatients in the United States. *Dis Esophagus.* 2018;31(1):dox131.
5. Melgaard D, Rodrigo-Domingo M, Mørch M. The prevalence of oropharyngeal dysphagia in acute geriatric patients. *Geriatrics.* 2018;3(2):15.
6. Altman KW, Yu GP, Schaefer SD. Consequence of dysphagia in the hospitalized patient: impact on prognosis and hospital resources. *Arch Otolaryngol Head Neck Surg.* 2010;136(8):784-789.
7. Adkins C, Takakura W, Spiegel BMR, et al. Prevalence and characteristics of dysphagia based on a population-based survey. *Clin Gastroenterol Hepatol.* 2020;18(9):1970-1979.e2.
8. Crary MA, Groher ME. *Dysphagia: Clinical Management in Adults and Children.* Elsevier Health Sciences; 2016.
9. Logemann JA. Dysphagia: evaluation and treatment. *Folia Phoniatr Logop.* 1995;47(3):140-164.
10. Icht M, Bergerzon-Bitton O, Kachal J, Goldsmith R, Herzberg O, Endevelt R. Texture-modified foods and thickened fluids used in dysphagia: Israeli standardised terminology and definitions. *J Hum Nutr Diet.* 2018;31(6):742-746.
11. Heyland DK, Cahill NE, Dhaliwal R, Sun X, Day AG, McClave SA. Impact of enteral feeding protocols on enteral nutrition delivery: results of a multicenter observational study. *JPEN J Parenter Enteral Nutr.* 2010;34(6):675-684.
12. Blumenstein I. Gastroenteric tube feeding: techniques, problems and solutions. *World J Gastroenterol.* 2014;20(26):8505.
13. Kumar A, Almotairy N, Merzo JJ, et al. Chewing and its influence on swallowing, gastrointestinal and nutrition-related factors: a systematic review. *Crit Rev Food Sci Nutr.* 2023;63(33):11987-12017.
14. Katz J, Chasin M, English KM, Hood LJ, Tillery KL, eds. *Handbook of Clinical Audiology.* 7th ed. Wolters Kluwer Health; 2015.
15. Subha ST, Raman R. Role of impacted cerumen in hearing loss. *Ear Nose Throat J.* 2006;85(10):650-653.
16. Ben-David BM, Chambers CG, Daneman M, Pichora-Fuller MK, Reingold EM, Schneider BA. Effects of aging and noise on real-time spoken word recognition: evidence from eye movements. *J Speech Lang Hear Res.* 2011;54(1):243-262.
17. Dor YI, Algom D, Shakuf V, Ben-David BM. Age-related changes in the perception of emotions in speech: assessing thresholds of prosody and semantics recognition in noise for young and older adults. *Front Neurosci.* 2022;16:846117.
18. Nitsan G, Wingfield A, Lavie L, Ben-David BM. Differences in working memory capacity affect online spoken word recognition: evidence from eye movements. *Trends Hear.* 2019;23:1-12.
19. Arlinger S. Negative consequences of uncorrected hearing loss—a review. *Int J Audiol.* 2003;42(suppl 2):2S17-2S20.
20. Heinrich A, Gagne JP, Viljanen A, Levy DA, BM Ben-David, Schneider BA. Effective communication as a fundamental aspect of active aging and well-being: paying attention to the challenges older adults face in noisy environments. *Soc Inq Well Being.* 2016;2(1):51-69.
21. McCarter DF, Courtney AU, Pollart SM. Cerumen impaction. *Am Fam Physician.* 2007;75(10):1523-1528.
22. Burkhart CN, Kruge MA, Burkhart CG, Black C. Cerumen composition by flash pyrolysis-gas chromatography/mass spectrometry. *Otol Neurotol.* 2001;22(6):715-722.

23. Moore AM, Voytas J, Kowalski D, Maddens M. Cerumen, hearing, and cognition in the elderly. *J Am Med Dir Assoc*. 2002;3(3):136-139.
24. Schwartz SR, Magit AE, Rosenfeld RM, et al. Clinical practice guideline (update): earwax (cerumen impaction). *Otolaryngol Head Neck Surg*. 2017;156(S1):S1-S29.
25. Morley H, Panak V, Mulders WHAM, Goulios H, Martini A, Langdon C. Non-chewing diets and cerumen impaction in the external ear canal in a residential aged care population. *Australas J Ageing*. 2020;39(2):131-136.
26. Mahoney DF. Cerumen impaction prevalence and detection in nursing homes. *J Gerontol Nurs*. 1993;19(4):23-30.
27. Alberti PWRM. Epithelial migration on the tympanic membrane. *J Laryngol Otol*. 1964;78(9):808-830.
28. Horton GA, Simpson MTW, Beyea MM, Beyea JA. Cerumen management: an updated clinical review and evidence-based approach for primary care physicians. *J Prim Care Commun Health*. 2020;11:1-5.
29. Rawool VW. Prevalence of auditory problems in children with feeding and swallowing disorders. *J Speech Lang Hear Res*. 2017;60(5):1436-1447.
30. Widuri A. The influence of chewing habits on the degree of impacted cerumen. *Mutiara Medika J Kedokteran Kesehatan*. 2021;21(1):1-6.
31. Sullivan RF. Video otoscopy in audiologic practice. *J Am Acad Audiol*. 1997;8(6):447-467.
32. Amelia EJ. Presentation of illness in older adults: if you think you know what you're looking for, think again. *AORN J*. 2006;83(2):372-389.
33. Topuz MF. Assessment of diagnosis and treatment of geriatric patients in otorhinolaryngology. *J Surg Med*. 2020;4(6):496-500.
34. Williams SP, Curnow TL, Almeyda R. Lessons learnt from the diagnosis and antimicrobial management of necrotising (malignant) otitis externa: our experience in a tertiary referral centre. *B-ENT*. 2014;10(2):99-104.
35. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;39(2):175-191.
36. Sobel ME. Asymptotic confidence intervals for indirect effects in structural equation models. *Sociol Methodol*. 1982;13:290-312.
37. Song Y, Wu Z, Huo H, Zhao P. The impact of frailty on adverse outcomes in geriatric hip fracture patients: a systematic review and meta-analysis. *Front Public Health*. 2022;10:890652.
38. Suesada MM, Martins MA, Carvalho CRF. Effect of short-term hospitalization on functional capacity in patients not restricted to bed. *Am J Phys Med Rehabil*. 2007;86(6):455-462.
39. Sheng WH, Wang JT, Lu DCT, Chie WC, Chen YC, Chang SC. Comparative impact of hospital-acquired infections on medical costs, length of hospital stay and outcome between community hospitals and medical centres. *J Hosp Infect*. 2005;59(3):205-214.
40. Binder EF, Robins LN. Cognitive impairment and length of hospital stay in older persons. *J Am Geriatr Soc*. 1990;38(7):759-766.
41. Wong RY, Miller WC. Adverse outcomes following hospitalization in acutely ill older patients. *BMC Geriatr*. 2008;8:10.
42. Macht M, Wimbish T, Bodine C, Moss M. ICU-acquired swallowing disorders. *Crit Care Med*. 2013;41(10):2396-2405.
43. Cichero JA, Heaton S, Bassett L. Triaging dysphagia: nurse screening for dysphagia in an acute hospital. *J Clin Nurs*. 2009;18(11):1649-1659.
44. Fransman D. Can removal of back teeth contribute to chronic earwax obstruction? *Brit J Learn Disabil*. 2006;34(1):36-41.
45. Yamano T, Nishi K, Omori F, Kajii T. Effects of food properties and aging on external auditory canal movements associated with mastication. *Cureus*. 2023;15(11):e49475. doi:10.7759/cureus.49475
46. Handoko A, Gemawan T, Putra DZ, et al. Nutrition and mechanical ventilation: a review article. *J Kedokteran*. 2023;12(4):411-419.
47. Newman D. Assessment of hearing loss in elderly people: the feasibility of a nurse administered screening test. *J Adv Nurs*. 1990;15(4):400-409.
48. Clark HM. Neuromuscular treatments for speech and swallowing: a tutorial. *Am J Speech Lang Pathol*. 2003;12(4):400-415.
49. Ben-David BM, Licht M. The effect of practice and visual feedback on oral-diadochokinetic rates for younger and older adults. *Lang Speech*. 2018;61(1):113-134.
50. Chu SY, Lee J, Barlow SM, Ben-David B, Lim KX, Foong JH. Oral-diadochokinetic rates among healthy Malaysian-Mandarin speakers: a cross linguistic comparison. *Int J Speech-Lang Pathol*. 2021;23(4):419-429.
51. Licht M, Ben-David BM. Evidence-based clinical recommendations for the administration of the Sequential Motion Rates task. *Commun Disord Quart*. 2018;39(3):442-448.
52. Licht M, Ben-David BM. Evaluating rate and accuracy of real words vs. non-words diadochokinetic productions from childhood to early adulthood in Hebrew speakers. *J Commun Disord*. 2021;92:106112.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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