

牙齿缺失对吞咽功能影响的研究进展

李婉昕 张照欣 李强

口腔系统重建与再生全国重点实验室 口腔疾病国家临床医学研究中心
陕西省口腔疾病国际联合研究中心 空军军医大学口腔医院急诊与综合临床科 西安 710032

[摘要] 吞咽活动是机体维持生存及代谢平衡的重要基础，口腔系统完整健康的牙列则是顺利行使吞咽功能的前提。多种口腔疾病如牙周病、龋病、外伤和肿瘤等均可导致牙齿缺失。随着老龄化进程加速，牙齿缺失问题更加凸显，但牙齿缺失对吞咽功能的影响却常常被医生和患者忽视。牙齿缺失对食物咀嚼、食团运输、下颌骨位置锚定、口腔肌群协调等均造成负面影响，从而引起吞咽功能减退。本文对牙齿缺失与吞咽功能改变之间的联系，以及义齿修复对牙齿缺失患者吞咽功能的影响进行综述，以为口腔医生的临床决策提供理论指导。

[关键词] 牙齿缺失； 吞咽功能； 义齿修复

[中图分类号] R333.1 **[文献标志码]** A **[doi]** 10.7518/gjkq.2026622



本文链接

OSID 码

Research progress of the impact of tooth loss on swallowing function

Li Wanxin, Zhang Zhaoxin, Li Qiang

State Key Laboratory of Oral & Maxillofacial Reconstruction and Regeneration, National Clinical Research Center for Oral Diseases, Shaanxi International Joint Research Center for Oral Diseases, Dept. of General Dentistry & Emergency, School of Stomatology, The Fourth Military Medical University, Xi'an 710032, China

Supported by: Key Research and Development Program of Shaanxi Province (2024SF-YBXM-259); International Scientific and Technological Cooperation and Exchange Program of Shaanxi Province (2021KW-45)

Correspondence: Li Qiang, Email: lqaq726@163.com

[Abstract] Normal swallowing is a crucial activity for maintaining survival and metabolic balance in the body. A complete and healthy set of teeth is critical for the proper execution of swallowing functions. However, various oral diseases such as periodontal disease, dental caries, trauma, and tumors can lead to tooth loss. In recent years, the acceleration of the aging process has rendered the issue of tooth loss among the population increasingly prominent. However, the effect of tooth loss on swallowing function is often overlooked by clinicians and patients. Previous studies have shown that tooth loss negatively affects various aspects of swallowing, including food mastication, bolus transport, mandibular positioning, and the coordination of oral muscle groups, leading to swallowing hypofunction. This article reviews existing data to clarify the correlation between tooth loss and swallowing disorders and evaluates the therapeutic effects of prosthetic restoration on swallowing function in patients with tooth loss. The synthesized evidence aims to provide a theoretical foundation for evidence-based clinical decision-making in dentistry.

[Key words] tooth loss; swallowing function; prosthetic restoration

[收稿日期] 2025-02-23; **[修回日期]** 2026-03-31

[基金项目] 陕西省重点研发计划项目 (2024SF-YBXM-259); 陕西省国际科技合作计划项目 (2021KW-45)

[第一作者] 李婉昕, 医师, 硕士, Email: liwanxin@163.com

[通信作者] 李强, 副主任医师, 博士, Email: lqaq726@163.com

牙齿缺失是指口腔内一颗或多颗天然牙脱落或被拔除, 导致牙列不完整的状况^[1]。口腔内健康且具备咬合功能的牙齿是保证机体正常进食及消化的重要器官, 牙周病、龋病、外伤和肿瘤等多种原因均可导致牙齿脱落^[2-4], 由此引起的牙列缺

损对口腔健康乃至全身健康会产生不同程度的负面影响,显著降低人们的生活质量^[5-6]。随着全球人口预期寿命的延长和老龄人口的增加,牙齿缺失问题更加凸显并成为社会公共卫生事业的潜在威胁^[7-8]。研究调查显示,欧美国家的老年人群牙齿缺失患病率达到70%以上^[9],我国老年人群牙齿缺失患病率高达81.7%,且其中36.8%的缺牙患者未修复缺失牙^[10]。牙齿缺失后,口腔各种功能如发音、咀嚼、颞下颌关节功能及吞咽功能甚至面部美观均会受到影响^[11-12]。其中,吞咽是口腔颌系统所承担的最基本且至关重要的生理功能之一,也是机体摄取食物的关键环节,人类每天进行600~2 400次吞咽活动^[13]。而牙齿缺失对吞咽功能的具体影响及其对身体健康程度的潜在威胁却常被医患忽视。近年来,随着吞咽医学和康复医学的发展,学者已开始关注牙齿缺失对吞咽功能的影响,亦对修复缺失牙改善吞咽功能进行了初步探索。本研究对牙齿在正常吞咽中的作用、牙齿缺失对吞咽口腔期的影响、义齿修复对吞咽功能的影响等进行综述,以期对口腔医生的临床决策提供理论指导。

1 牙齿在正常吞咽中的作用

口腔是消化系统的重要组成部分,通过咀嚼、吞咽、发音等生理功能保障人体基本生存需求和身体健康。通过进食摄取外源性营养物质是人体维持正常生理活动最为原始且难以替代的方式,因此,吞咽是口腔所承担的最基本且至关重要的生理功能之一。咀嚼、食团运输和吞咽是协同运作的联动环节^[14],这些环节一起组成了进食的完整过程^[15]。充分的咀嚼是安全吞咽的前提,而咀嚼能力主要取决于咀嚼功能单元,即口腔内的牙齿数量^[16-17]。一方面,牙齿对食团的充分研磨结合唾液的湿润作用可以使进食过程正常运行;另一方面,食团的研磨过程又对牙周组织产生机械刺激以进行自我清洁,因此牙列的完整与进食及吞咽密切相关^[18]。

根据食团所在位置,吞咽行为可分为口腔期、咽期和食管期。口腔期又分为两个子阶段^[19]:1)口腔准备阶段,即食物通过牙齿咀嚼研磨形成食团,食团被唾液充分润湿后,便由舌体定位并即将向咽部移动运输^[20];2)口腔转运阶段,即食团经过舌体的前后向挤压动作向口腔后部移动,到

达咽部,随后在咽部相关肌群的收缩下进入食管^[21-23]。不难看出,牙列的完整对吞咽活动的口腔期起到决定性的作用,进而影响整个吞咽行为。牙齿缺失可对吞咽口腔期的不同阶段产生影响,使进食过程中吞咽前行为及吞咽行为的协调性受到破坏。

2 牙齿缺失对吞咽口腔期的影响

2.1 牙齿缺失对吞咽口腔期口腔准备阶段的影响

口腔准备阶段是指食物进入口腔,通过牙齿的颌运循环咀嚼至合适的形状并被定位于舌部恰当的位置,便于后期安全有效地吞咽。Okamoto等^[24]调查了3 663名独立生活的老年人剩余牙齿数量、咬合力和吞咽之间的关系,结果表明,最大咬合力与剩余牙齿数量存在正相关性,吞咽障碍发生率与剩余牙齿数量减少存在正相关性。咀嚼功能单元数量的减少会影响老年人的咀嚼和吞咽功能^[25],主要表现为咀嚼效率降低,口腔准备阶段中食物研磨和食物运输的时长增加^[26]。牙齿缺失导致进食过程中食团形成困难。缺失的牙齿数量越多,咀嚼后产生的食团尺寸越大^[27],导致其难以被顺利有效地输送到咽部以进行随后的吞咽动作。牙齿缺失引起咀嚼不充分所致的食团体积增加,也可能导致在吞咽过程中阻塞气道,增加窒息的发生率^[28-29]。一项前瞻性队列研究将受试者按照剩余牙齿数量分为0~12、13~22、23~26、27~32颗牙组别,结果表明前两组发生呛咳、窒息等吞咽问题的风险明显升高^[30]。Cichero^[31]研究发现,口内牙齿数量少的老年人更有可能在日常进食过程中受到咀嚼功能下降和吞咽困难的困扰,是进食时发生窒息的高危人群。

2.2 牙齿缺失对吞咽口腔期口腔转运阶段的影响

口腔转运阶段是指食团由口腔到达咽部的阶段,该阶段通过肌肉产生的压力驱动食物顺利向后传递和转运。食团在口腔内受到的压力主要由舌根与咽缩肌联合产生^[22,32]。在此过程中,牙列的咬合接触对下颌骨起到稳定作用,而下颌骨的稳定有助于各吞咽肌群之间的协调和有序激活^[33]。后牙缺失的患者因为无法获得稳定咬合,口腔内有序进行的食团转运会受到影响。前牙缺失的患者舌尖失去与前牙和腭前部的有效接触,一方面无法形成足够的反向推力^[34],另一方面导致舌骨的提升运动受到限制,从而不可避免地降低吞咽

效率。当上下牙列缺失伴随牙槽骨吸收时,舌体则难以在口腔中控制食团^[35],导致进食期间食团形成和运输不良。Yamamoto等^[36]研究认为,无牙颌患者进食时,食团的后向推送转运效率显著下降,吞咽储备能力降低,吞咽困难发生风险升高;同时咀嚼时食团分散在口腔和咽部,食团的分散碎片大量处于下咽部且长时间停留,也会增加吞咽困难的风险。以上因素综合影响导致无牙颌患者的吞咽过程持续时间更长^[37]。

牙齿缺失除了对固体食物的运输造成影响外,对液体食物的转运也存在影响,牙齿缺失数量越多,液体食物吞咽功能障碍程度就越高^[38]。Tamura等^[39]认为,液体食物在吞咽时需要更多部位的协调运作。液体的口腔转运阶段主要依靠舌的蠕动形成推力将液体推向咽部,而这种肌群活动需通过天然牙或修复体的咬合接触将下颌骨稳定到适当的位置,牙齿缺失将导致舌肌控制液体的能力下降,不仅影响液体的转运效率,吞咽时液体被吸入气道的风险也会增加。咬合支持的丧失,使受试者的吞咽运动协调性发生变化,无牙颌老年人吞咽液体发生误吸的可能性明显增加^[40],发生误吸的患者发生肺炎的可能性约为吞咽功能正常者的4倍^[41],这极大地影响了缺牙患者的生存质量。一项随访5年的研究^[42]显示,老年人每脱落一颗牙,吞咽功能异常的发生风险增加8%。牙齿数量的减少会造成机体的肌肉含量降低,基本生理功能受损,身体机能障碍和体质虚弱,这与咀嚼不充分造成的吞咽困难及营养摄入受阻有直接相关性^[43]。

3 义齿修复牙齿缺失对吞咽功能的影响

针对缺牙患者尤其是无牙颌患者,临床通常使用佩戴义齿的方式恢复咬合以改善咀嚼效率,但佩戴义齿对吞咽功能的影响尚无明确结论。有研究表明,佩戴全口活动义齿对于吞咽功能有积极影响^[39-40,44-47],主要表现在降低误吸风险^[40]、稳定吞咽运动^[48]、稳定舌-腭接触^[49]、改善食团运输动力学缩短运输时间^[36,46-47]等方面。但也有研究^[50]表明,佩戴活动义齿可能对吞咽功能有负面影响,活动义齿覆盖腭黏膜的大部分区域,而黏膜内密集分布着大量的机械感受器,义齿覆盖会引起多种生理和功能障碍,如呕吐反射和舌腭接触不良。另外,佩戴义齿会延长咀嚼后的口腔转运时间并

降低吞咽效率。这可能是由于佩戴义齿导致口腔内肌群功能失调或口内感知功能变化^[51]。佩戴不合适的义齿(特别是全口义齿),可能会干扰患者的牙齿咬合接触。咬合接触不足会降低咀嚼性能,引起肌肉疲劳,并导致吞咽活动障碍^[46,52]。

随着技术的发展和理念的更迭,牙齿缺失患者可选的修复方式及设计方案亦多种多样。研究^[53]发现,种植支持式义齿修复无牙颌,患者吞咽功能障碍明显减少,吞咽时误吸和呛咳发生频次降低,口腔内食物后送能力改善。对无牙颌患者佩戴活动义齿与佩戴下颌种植覆盖义齿的舌骨运动和吞咽情况进行比较,发现尽管两种修复方式均未造成吞咽过程中明显的误吸和呛咳发生,但佩戴下颌种植覆盖义齿后舌骨前向位移及最大前移位置持续时间均明显增加,更利于食团通过食管^[54]。对于牙列缺失患者,种植修复可通过改善咀嚼效率及舌骨运动,有利于吞咽生理活动的顺利完成;对于牙列缺损患者,固定义齿则对吞咽功能改善显著。除了提升咀嚼效率,固定义齿对口内肌群功能的恢复亦存在积极作用。由于固有口腔的界限被打破,舌体位置及运动轨迹缺乏有效约束,由此产生的舌压降低是导致吞咽困难的原因之一。Tashiro等^[55]研究表明,牙齿缺失与舌压降低具有显著相关性,而固定义齿修复缺牙后,舌压降低的程度将得到极大改善。

研究^[56]表明,固定义齿修复患者的食物粉碎率最高,而全口吸附性义齿或覆盖义齿修复患者的食物粉碎率较低。以天然牙支持的固定义齿修复和种植体支持的固定义齿修复是最常用的固定修复方式,这两种修复方式之间对吞咽功能的影响是否存在差异,尚需要进一步探讨。若患者不具备固定修复的条件,应设计合理的活动义齿,以有利于保持口腔和义齿的清洁,清洁的口腔环境对降低呛咳和误吸所致的吸入性肺炎至关重要。对于缺牙患者,无论何种修复方式,都应注重义齿的设计和后期维护,以改善患者对义齿的适应性和口腔吞咽功能。

4 总结与展望

牙齿作为口颌系统的重要组成部分,对吞咽行为的顺利进行发挥着举足轻重的作用。牙齿缺失对吞咽功能具有负面影响,可导致进食过程中咀嚼不充分、肌群活动受限,吞咽活动风险加大,

尤其对老年人群生活质量的影响更不容小觑。早期发现并积极干预,改善牙齿缺失人群的吞咽功能,对于延长老年人群的健康预期寿命具有不可忽视的重要意义。设计合理的义齿修复牙齿缺失,对恢复口腔咀嚼功能、上下颌位置关系及肌群活动,最终利于吞咽顺利完成具有积极意义。在未来,牙齿缺失对吞咽影响的潜在调控机制、余留牙齿数量的可归因比例、牙齿在牙弓中的位置及不同牙列缺损类型对吞咽功能的影响尚需要进一步明确。

利益冲突声明:作者声明本文无利益冲突。

5 参考文献

- [1] Gomes Filho VV, Gondinho BVC, Silva-Junior MF, et al. Tooth loss in adults: factors associated with the position and number of lost teeth[J]. *Rev Saude Publica*, 2019, 53: 105.
- [2] Al-Shammari KF, Al-Ansari JM, Al-Melh MA, et al. Reasons for tooth extraction in Kuwait[J]. *Med Princ Pract*, 2006, 15(6): 417-422.
- [3] Caldas AF Jr, Marcenés W, Sheiham A. Reasons for tooth extraction in a Brazilian population[J]. *Int Dent J*, 2000, 50(5): 267-273.
- [4] Wiener RC, Shen C, Findley PA, et al. The association between diabetes mellitus, sugar-sweetened beverages, and tooth loss in adults[J]. *J Am Dent Assoc*, 2017, 148(7): 500-509.e4.
- [5] Chalub LLFH, Ferreira RC, Vargas AMD. Influence of functional dentition on satisfaction with oral health and impacts on daily performance among Brazilian adults: a population-based cross-sectional study[J]. *BMC Oral Heal*, 2017, 17: 112.
- [6] Lamster IB, Asadourian L, del Carmen T, et al. The aging mouth: differentiating normal aging from disease[J]. *Periodontol* 2000, 2016, 72(1): 96-107.
- [7] McKenna G, Allen PF, O'Mahony D, et al. Impact of tooth replacement on the nutritional status of partially dentate elders[J]. *Clin Oral Invest*, 2015, 19(8): 1991-1998.
- [8] Slade GD, Akinkugbe AA, Sanders AE. Projections of US edentulism prevalence following 5 decades of decline[J]. *J Dent Res*, 2014, 93(10): 959-965.
- [9] Borg-Bartolo R, Roccuzzo A, Molinero-Mourelle P, et al. Global prevalence of edentulism and dental caries in middle-aged and elderly persons: a systematic review and Meta-analysis[J]. *J Dent*, 2022, 127: 104335.
- [10] 陆海霞,陶丹英,卢展民,等.第四次全国口腔健康流行病学调查——背景和方法[C]//2018年中华口腔医学会第十八次口腔预防医学学术年会论文汇编.北京:中华口腔医学会口腔预防医学专业委员会,2018.
Lu HX, Tao DY, Lu ZM, et al. The fourth national oral health epidemiological survey—background and methodology[C]//Collection of papers from the 18th Annual Meeting of the Chinese Society of Preventive Dentistry, 2018. Beijing: the Committee of Preventive Dentistry, Chinese Stomatological Association, 2018.
- [11] Lopez-Jornet P, Saura-Perez M, Llevat-Espinosa N. Effect of oral health dental state and risk of malnutrition in elderly people[J]. *Geriatr Gerontol Int*, 2013, 13(1): 43-49.
- [12] Tanaka T, Takahashi K, Hirano H, et al. Oral frailty as a risk factor for physical frailty and mortality in community-dwelling elderly[J]. *J Gerontol A Biol Sci Med Sci*, 2018, 73(12): 1661-1667.
- [13] Carvajal R, Miralles R, Cauvi D, et al. Superior orbicularis oris muscle activity in children with and without cleft lip and palate[J]. *Cleft Palate Craniofac J*, 1992, 29(1): 32-37.
- [14] Palmer JB, Rudin NJ, Lara G, et al. Coordination of mastication and swallowing[J]. *Dysphagia*, 1992, 7(4): 187-200.
- [15] Thexton AJ. Mastication and swallowing: an overview[J]. *Br Dent J*, 1992, 173(6): 197-206.
- [16] Helkimo E, Carlsson GE, Helkimo M. Chewing efficiency and state of dentition[J]. *Acta Odontol Scand*, 1978, 36(1): 33-41.
- [17] Naka O, Anastassiadou V, Pissiotis A. Association between functional tooth units and chewing ability in older adults: a systematic review[J]. *Gerodontology*, 2014, 31(3): 166-177.
- [18] Furuta M, Yamashita Y. Oral health and swallowing problems[J]. *Curr Phys Med Rehabil Rep*, 2013, 1(4): 216-222.
- [19] Miller AJ. Deglutition[J]. *Physiol Rev*, 1982, 62(1):

- 129-184.
- [20] Prinz JF, Lucas PW. Swallow thresholds in human mastication[J]. *Arch Oral Biol*, 1995, 40(5): 401-403.
- [21] Dodds WJ, Stewart ET, Logemann JA. Physiology and radiology of the normal oral and pharyngeal phases of swallowing[J]. *Am J Roentgenol*, 1990, 154(5): 953-963.
- [22] Kahrilas PJ, Lin SZ, Logemann JA, et al. Deglutitive tongue action: volume accommodation and bolus propulsion[J]. *Gastroenterology*, 1993, 104(1): 152-162.
- [23] Shapiro J. Evaluation and treatment of swallowing disorders[J]. *Compr Ther*, 2000, 26(3): 203-209.
- [24] Okamoto N, Tomioka K, Saeki K, et al. Relationship between swallowing problems and tooth loss in community-dwelling independent elderly adults: the fujiwara-kyo study[J]. *J Am Geriatr Soc*, 2012, 60(5): 849-853.
- [25] Hildebrandt GH, Dominguez B, Schork M, et al. Functional units, chewing, swallowing, and food avoidance among the elderly[J]. *J Prosthet Dent*, 1997, 77(6): 588-595.
- [26] Saitoh E, Shibata S, Matsuo K, et al. Chewing and food consistency: effects on bolus transport and swallow initiation[J]. *Dysphagia*, 2007, 22(2): 100-107.
- [27] Mishellany A, Woda A, Labas R, et al. The challenge of mastication: preparing a bolus suitable for deglutition[J]. *Dysphagia*, 2006, 21(2): 87-94.
- [28] Berzlanovich AM, Muhm M, Sim E, et al. Foreign body asphyxiation: an autopsy study[J]. *Am J Med*, 1999, 107(4): 351-355.
- [29] Berzlanovich AM, Fazenzy-Dörner B, Waldhoer T, et al. Foreign body asphyxia A preventable cause of death in the elderly[J]. *Am J Prev Med*, 2005, 28(1): 65-69.
- [30] Okamoto N, Morikawa M, Yanagi M, et al. Association of tooth loss with development of swallowing problems in community-dwelling independent elderly population: the fujiwara-kyo study[J]. *J Gerontol A Biol Sci Med Sci*, 2015, 70(12): 1548-1554.
- [31] Cichero JAY. Age-related changes to eating and swallowing impact frailty: aspiration, choking risk, modified food texture and autonomy of choice[J]. *Geriatrics (Basel)*, 2018, 3(4): 69.
- [32] Kahrilas PJ. Pharyngeal structure and function[J]. *Dysphagia*, 1993, 8(4): 303-307.
- [33] Hattori F. The relationship between wearing complete dentures and swallowing function in elderly individuals: a videofluorographic study[J]. *Kokubyo Gakkai Zasshi*, 2004, 71(2): 102-111.
- [34] Herring HW Jr, Akerly WB. Aid to correct tongue position in the mandibular complete denture[J]. *J Prosthet Dent*, 1981, 46(6): 676-677.
- [35] Imaizaki T, Nishi Y, Kaji A, et al. Roles of the artificial tooth arch during swallowing in edentates[J]. *J Prosthodont Res*, 2010, 54(1): 14-23.
- [36] Yamamoto H, Furuya J, Tamada Y, et al. Impacts of wearing complete dentures on bolus transport during feeding in elderly edentulous[J]. *J Oral Rehabil*, 2013, 40(12): 923-931.
- [37] Furuya J. Effects of wearing complete dentures on swallowing in the elderly[J]. *Kokubyo Gakkai Zasshi*, 1999, 66(4): 361-369.
- [38] Mituuti C, Bianco V, Bentim C, et al. Influence of oral health condition on swallowing and oral intake level for patients affected by chronic stroke[J]. *Clin Interv Aging*, 2014, 10: 29-35.
- [39] Tamura F, Mizukami M, Ayano R, et al. Analysis of feeding function and jaw stability in bedridden elderly[J]. *Dysphagia*, 2002, 17(3): 235-241.
- [40] Yoshikawa M, Yoshida M, Nagasaki T, et al. Influence of aging and denture use on liquid swallowing in healthy dentulous and edentulous older people[J]. *J Am Geriatr Soc*, 2006, 54(3): 444-449.
- [41] Pikus L, Levine MS, Yang YX, et al. Videofluoroscopic studies of swallowing dysfunction and the relative risk of pneumonia[J]. *AJR Am J Roentgenol*, 2003, 180(6): 1613-1616.
- [42] Logemann JA, Curro FA, Pauloski B, et al. Aging effects on oropharyngeal swallow and the role of dental care in oropharyngeal dysphagia[J]. *Oral Dis*, 2013, 19(8): 733-737.
- [43] Albani V, Nishio K, Ito T, et al. Associations of poor oral health with frailty and physical functioning in the oldest old: results from two studies in England and Japan[J]. *BMC Geriatr*, 2021, 21(1): 187.
- [44] Fukai K, Takiguchi T, Ando Y, et al. Critical tooth

- number without subjective dysphagia[J]. *Geriatr Gerontol Int*, 2011, 11(4): 482-487.
- [45] Furuta M, Komiya-Nonaka M, Akifusa S, et al. Interrelationship of oral health status, swallowing function, nutritional status, and cognitive ability with activities of daily living in Japanese elderly people receiving home care services due to physical disabilities[J]. *Comm Dent Oral Epid*, 2013, 41(2): 173-181.
- [46] Yoshida M, Masuda S, Amano J, et al. Immediate effect of denture wearing on swallowing in rehabilitation hospital inpatients[J]. *J Am Geriatr Soc*, 2013, 61(4): 655-657.
- [47] Gokce HS, Gokce SM, Akin E, et al. Effect of complete denture wearing on deglutition time: a cine-magnetic resonance imaging study[J]. *J Oral Rehabil*, 2012, 39(3): 198-209.
- [48] Yoshikawa M, Yoshida M, Nagasaki T, et al. Effects of tooth loss and denture wear on tongue-tip motion in elderly dentulous and edentulous people[J]. *J Oral Rehabil*, 2008, 35(12): 882-888.
- [49] Kondoh J, Ono T, Tamine K, et al. Effect of complete denture wearing on tongue motor biomechanics during swallowing in edentulous older adults [J]. *Geriatr Gerontol Int*, 2015, 15(5): 565-571.
- [50] Kodaira Y, Ishizaki K, Sakurai K. Effect of palate covering on bolus-propulsion time and its contributory factors[J]. *J Oral Rehabil*, 2006, 33(1): 8-16.
- [51] Son DS, Seong JW, Kim Y, et al. The effects of removable denture on swallowing[J]. *Ann Rehabil Med*, 2013, 37(2): 247-253.
- [52] Monaco A, Cattaneo R, Masci C, et al. Effect of ill-fitting dentures on the swallowing duration in patients using polygraphy[J]. *Gerodontology*, 2012, 29(2): e637-e644.
- [53] Berretin-Felix G, Machado WM, Genaro KF, et al. Effects of mandibular fixed implant-supported prostheses on masticatory and swallowing functions in completely edentulous elderly individuals[J]. *Int J Oral Maxillofac Implants*, 2009, 24(1): 110-117.
- [54] Ibrahim AM, Elgamel M, Abdel-Khalek EA. Hyoid displacement during swallowing function for completely edentulous subjects rehabilitated with mandibular implant retained overdenture[J]. *BMC Oral Heal*, 2024, 24(1): 914.
- [55] Tashiro K, Soutome S, Funahara M, et al. The relationship between dental findings and tongue pressure: a survey of 745 community-dwelling adults and elderly persons in Japan[J]. *Gerontology*, 2021, 67(5): 517-524.
- [56] Preoteasa E, Oncescu Moraru AM, Meghea D, et al. Food bolus properties in relation to dentate and prosthetic status[J]. *Healthcare*, 2022, 10(9): 1596.
- (本文编辑 李彩)