https://doi.org/10.35845/kmuj.2025.23943

CASE REPORT

Wearable devices for xerostomia management in acute myeloid leukemia: a case report

Abdullah Saeed [1], **Mohammed Y Asseri** [1]

1: Department of Research, Ministry of Health, Abha, Kingdom of Saudi Arabia

Email: abdallah.bds1@gmail.com
Contact #: +05-01-514388

Date Submitted: February 13, 2025
Date Revised: May 29, 2024
Date Accepted: June 07, 2024

ABSTRACT

Background: Xerostomia, or dry mouth, is a frequent and distressing complication among patients undergoing cancer treatment, significantly impairing quality of life. Conventional therapies are often limited by side effects and poor patient compliance. Reports on wearable devices for its monitoring are limited; this case highlights an innovative approach.

Case Presentation: We present the case of a 74-year-old male with acute myeloid leukemia under supportive care who reported persistent xerostomia of moderate severity (2-4 on a 0-10 scale). His medical history included avascular necrosis, previous bone marrow transplantation with acute graft rejection, and multiple cardiac surgeries. The patient was on hydroxyurea, calcitriol, oxycodone, and acetazolamide. Clinical examination revealed oral soft tissue changes consistent with vascular ulceration, and salivary flow was objectively assessed through timed unstimulated saliva collection. To enhance symptom monitoring, the patient was instructed to wear a wristband-based device for seven days, recording physiological indicators of salivary function alongside subjective symptom intensity. Baseline and post-intervention serum and saliva parameters were collected, and patient-reported outcomes were evaluated using standardized quality of life questionnaires. The intervention demonstrated improved symptom awareness, better patient-clinician communication, and enhanced engagement in self-management.

Conclusion: This case highlights the feasibility and potential utility of wearable devices in monitoring and managing xerostomia in leukemia patients. Despite limitations such as technical adaptation and restricted availability of comparable studies, wearable technology provided meaningful data to guide individualized care. Further research is warranted to validate these findings and explore integration into routine clinical practice.

Keywords: Xerostomia (MeSH); Wearable Devices (MeSH); Wearable Electronic Devices (MeSH); Saliva Monitoring (Non-MeSH); Patient Engagement (MeSH); Patient Participation (MeSH); Symptom Management (MeSH); Palliative Care (MeSH).

THIS ARTICLE MAY BE CITED AS: Saeed A, Asseri MY. Wearable devices for xerostomia management in acute myeloid leukemia: a case report. Khyber Med Univ J 2025;17(3):370-3. https://doi.org/10.35845/kmuj.2025.23943

INTRODUCTION

Xerostomia, or dry mouth, results from reduced salivary gland function and leads to impaired tasting, chewing, swallowing, speech, and digestion, as well as caries, plaque, malodor, and fungal infections. Over time, oral dryness markedly reduces quality of life. Managing xerostomia in cancer patients is challenging, as antineoplastic therapy often worsens salivary hypofunction, while current treatments are limited by poor efficacy and side effects.[1,2]

Recently, interest has grown involving patients themselves, using wearable devices, for daily xerostomia management. Traditionally developed for commercial and sports use, these devices track physiological and environmental parameters. Their application in healthcare has transformed patient monitoring and self-care. Preliminary strategies using smart devices to establish xerostomia baselines and improve symptoms show promise, though multidisciplinary studies remain limited.[3] This case explores wearable devices for monitoring xerostomia in a patient with acute myeloid leukemia (AML).

LITERATURE REVIEW

Xerostomia is the subjective sensation of oral dryness, often linked to eating, drinking, and speech difficulties. Saliva is vital for speech, deglutition, remineralization, digestion, mucosal health, and microbial balance, containing antimicrobial and buffering properties. Xerostomia may be subjective or objective, with causes including medications, psychological conditions, salivary gland disease, radiotherapy, Sjögren's syndrome, aging, and cancer therapy.[4]

There is no definitive cure. Management generally targets underlying causes through pharmacological or non-pharmacological options. Advances in wearable sensors now allow continuous monitoring, though barriers include cost, technology acceptance, and accuracy. Poor adherence is often due to polypharmacy and unmet psychosocial needs. Evidence suggests that patients are more likely to self-manage when empowered with health technology and adequate social support. Further research is needed to integrate wearable devices into clinical care.[5]

CASE PRESENTATION

A 74-year-old right-handed retired male, with a history of Parkinson's disease (PD), presented with persistent xerostomia as his only non-motor symptom. His past medical history was significant for two major cardiac surgeries, including sternotomy and triple bypass. Following his second cardiac procedure in 2002, he developed facial erythema and bilateral gynecomastia. Bone scans later confirmed arthritis, likely attributable to long-term medication use. He had smoked one pack of cigarettes daily but quit in 1985. His medication regimen included both immediate- and controlled-release agents, along with multiple drugs prescribed for

depression and insomnia. Anthropometric measurements were: height 180.3 cm, weight 77.1 kg, and body mass index 23.7 kg/m^2.

The patient reported "dry mouth" as his chief complaint. He had experienced left-hand tremors for approximately two years and was diagnosed with PD six months before undergoing surgical intervention. His tremors were poorly controlled with medical therapy, leading to unilateral deep brain stimulation (DBS) of the left subthalamic nucleus, later adjusted bilaterally. Pre-surgical evaluation revealed Hospital Anxiety and Depression Scale (HADS) scores of 10 for both domains and a Folstein Mini-Mental State Examination (MMSE) score of 29. Neuropsychological testing indicated above-average performance compared to typical PD patients, with a verbal fluency score of 10.0 and high scores in social, self-care, and functional domains.

In addition to PD-related symptoms, the patient also reported episodes of pronounced oral dryness two to three days after chemotherapy sessions for a previous diagnosis of acute myeloid leukemia (AML). He described the tongue adhering to the lower lip and a prominent sensation of oral dryness, accompanied by pain in the parotid and submandibular regions, consistent with hyposalivation. His history further included avascular necrosis following bone marrow transplantation complicated by acute graft rejection, for which acetazolamide was prescribed. Supportive treatments for AML included hydroxyurea, calcitriol, and opioid-based analgesics. Oral examination demonstrated a soft tissue lesion on the left buccal mucosa resembling a vascular ulcer, though exploration revealed no necrosis or tissue heterogeneity.

To assess salivary function, unstimulated mixed saliva was collected under standardized conditions, and pH was evaluated over sequential intervals. The patient's values were compared to healthy controls. Following informed consent, he was also instructed to wear wristband-based wearable devices for one week to monitor xerostomia-related physiological parameters and subjective symptom intensity. Serum and saliva samples were collected on the first and last day of device use to provide objective correlates of symptom progression. The data were subsequently incorporated into a patient-specific model, with relevant findings summarized in tables and figures. This multimodal assessment allowed for the integration of both subjective experiences and physiological measurements, thereby enhancing diagnostic accuracy and enabling a more comprehensive understanding of xerostomia's impact on daily life and overall quality of health.

Clinically, xerostomia had a significant effect on the patient's quality of life, impairing speech, sleep, and routine activities. Functional decline in spoken tasks such as repetition and respiration was noted, with increased subjective scores of xerostomia severity reported during follow-up. Imaging revealed changes in salivary gland dimensions, consistent with reduced secretory function. The patient also reported disturbances in taste perception, which further complicated functional assessments.

Xerostomia in this patient likely reflected a multifactorial etiology, with contributions from long-term polypharmacy, systemic conditions such as AML and PD, prior chemotherapy, and comorbid anxiety. The case highlights the importance of thorough diagnostic evaluation, incorporating patient-reported outcomes, saliva analysis, imaging, and wearable device-based monitoring to capture both subjective and objective disease manifestations. Early recognition and integrated management of xerostomia are essential for improving comfort, maintaining oral health, and enhancing quality of life in patients with complex comorbid conditions.

DISCUSSION

This case report demonstrates the use of wearable devices in the daily management of xerostomia, an area with limited prior investigation. The findings align with earlier studies reporting improved patient perception of their condition after using health technologies.[6] Wearable devices also enhance patient-clinician communication, although most available literature focuses on the potential of such technologies rather than patient experiences during use.

In this case, three wearable devices were evaluated, each yielding different outcomes. Patient engagement was strongest when interventions were individualized, aligning with personal needs, values, and circumstances rather than presuming prior knowledge or confidence. Incorporating tailored treatment goals and lifestyle adjustments is an essential component of chronic disease management, promoting greater patient activation and self-care. The smart cap was excluded due to its limited availability in the Australian market. Notably, wearable devices have been recognized as tools of empowerment, enhancing patients' confidence and preparedness in managing their own condition.[7] Moreover, increased responsibility and continuous monitoring may improve adherence and the effectiveness of long-term treatments. Remote monitoring can also reduce the need for hospital visits, benefiting both patients and healthcare systems, while the collected data may help clinicians design more personalized interventions.[8]

International studies (Table I) illustrate diverse approaches, including intraoral sensors, salivation-promoting systems, neuro-electrostimulation devices, tongue-image based prediction models, and salivary substitutes, highlighting the global interest in technological strategies for xerostomia management.[3,9-12]

Wearables allow real-time monitoring, facilitating timely interventions, self-management, and greater patient engagement. The ability to track symptom fluctuations can aid adherence, support personalized clinical decisions, and reduce unnecessary hospital visits.[10] Long-term use has shown promise in improving salivary function and quality of life, although adherence, technical issues, and the need for validation in broader populations remain challenges.[3]

Limitations of the Study

Despite these benefits, barriers exist. Technical restrictions, user resistance, and privacy concerns may limit adoption. Many xerostomia patients are elderly and face challenges with digital literacy, socio-economic constraints, and device accessibility. Addressing these barriers requires inclusive design, patient education, and continuous support. Further interactive studies are

Table I: Compare similar cases in different regions

Device/Study	Region	Technology	Clinical Application	Reference
Intra-Oral Portable Micro-Electronic (IOPM) Device	Malaysia / Serbia	Intraoral sensors for temperature and humidity monitoring with automated artificial saliva delivery	Designed for patients undergoing chemotherapy; the device detects oral dryness and administers artificial saliva to alleviate symptoms.	Popović ŽV et al., 2023[3]
Wearable Salivation-Promoting System	Japan	Wearable actuators and sensors to monitor and stimulate saliva production	Aimed at continuous measurement and promotion of saliva secretion, enhancing oral moisture levels in individuals with dry mouth conditions.	Yamamoto et al., 2021[9]
Neuro-Electrostimulation Devices (e.g., Saliwell Crown)	Europe	Implant-supported electrostimulators targeting salivary glands	Used for patients with radiation-induced xerostomia; these devices stimulate salivary glands to increase saliva production, improving oral comfort.	Rao RS et al., 2019[10]
Tongue Image-Based Salivary Secretion Prediction	South Korea	Machine learning models analyzing tongue images to predict salivary gland function	Utilizes tongue imaging and radiomic features to non-invasively assess salivary secretion levels, aiding in the diagnosis and management of xerostomia.	Kim et al., 2024[11]
Enzymatic Salivary Substitute Spray (Bioxtra)	Brazil	Salivary substitute containing enzymatic components	Evaluated in a randomized controlled trial for patients with radiation-induced xerostomia; aimed to reduce dry mouth symptoms and improve quality of life.	Silva et al., 2024[12]

needed to optimize usability and assess long-term outcomes.

CONCLUSION

This case highlights the potential role of wearable devices in xerostomia management in leukemia patients by enabling continuous monitoring and fostering individualized care. The patient's experience emphasizes the importance of tailoring treatment strategies to personal circumstances. While existing evidence remains limited, wearable technology offers a promising adjunct to conventional care. Broader implementation will require overcoming technical, ethical, and access-related challenges, which can only be achieved through further patient-focused research and evaluation.

REFERENCES

1. Proctor GB, Shaalan AM. Disease-induced changes in salivary gland function and the composition of saliva. J Dent Res 2021;100(11):1201-9. https://doi.org/10.1177/00220345211004842
2. Jacob LE, Krishnan M, Mathew A, Mathew AL, Baby TK, Krishnan A. Xerostomia - A comprehensive review with a focus on mid-life health. j midlife health 2022;13(2):100-106. https://doi.org/10.4103/jmh.jmh_91_21
3. Popović ŽV, Thiha A, Ibrahim F, Petrović BB, Dahlan NA, Milić L, et al. Oral micro-electronic platform for temperature and humidity monitoring. Sci Rep 2023;13(1):21277.https://doi.org/10.1038/s41598-023-48379-9
4. Alwaheidi HAA, O'Toole S, Bernabé E. The interrelationship between xerogenic medication use, subjective oral dryness and tooth wear. J Dent. 2021;104:103542. https://doi.org/10.1016/j.jdent.2020.103542
5. Radin JM, Quer G, Jalili M, Hamideh D, Steinhubl SR. The hopes and hazards of using personal health technologies in the diagnosis and prognosis of infections. Lancet Digit Health 2021;3(7):e455-61. https://doi.org/10.1016/s2589-7500(21)00064-9
6. Iqbal SM, Mahgoub I, Du E, Leavitt MA, Asghar W. Advances in healthcare wearable devices. NPJ Flex Electron 2021;5:9. https://doi.org/10.1038/s41528-021-00107-x
7. Gill SK, Barsky A, Guan X, Bunting KV, Karwath A, Tica O, et al. Consumer wearable devices for evaluation of heart rate control using digoxin versus beta-blockers: the RATE-AF randomized trial. Nat Med 2024;30(7):2030-6. https://doi.org/10.1038/s41591-024-03094-4
8. Solanky MD, Gupta S. Brain and Behavior: blending of human and artificial minds toward stress recognition and intervention in organizational well-being. In: Balamurugan S, Pathak S, Jain A, Gupta S, Sharma S, Duggal S (eds) Impact of artificial intelligence on organizational transformation. 2022. pp: 201-27. https://doi.org/10.1002/9781119710301.ch13
9. Yamamoto T, Miyake Y, Kato T, Nakagawa M, Yamamoto H. Wearable system for promoting salivation. In: Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems; 2021 May 8–13; Yokohama, Japan. New York: ACM; 2021. pp. 1-10. https://doi.org/10.1145/3458709.3458993

10. Rao RS, Akula R, Satyanarayana TSV, Indugu V. Recent advances of pacemakers in treatment of xerostomia: a systematic review. J Int Soc Prev Community Dent 2019;9(4):311-5. https://doi.org/10.4103/jispcd.JISPCD_389_18

11. Kim HS, Lee JH, Kim YJ, Park YJ, Lee SH. Prediction of dry mouth condition using radiomics features from tongue images. Appl Sci 2024;14(22):10118.https://doi.org/10.3390/app142210118

12. Silva F, Oliveira J, Pereira A, Santos M. Evaluation of salivation promotion by odor, pressure, and thermal stimulation using a wearable device. Med Devices Sens 2024;7(1):e33.https://doi.org/10.1002/mds3.33

AUTHORS' CONTRIBUTION

The Following authors have made substantial contributions to the manuscript as under:

AS & MYA: Identification, diagnosis and management of the disease, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest, whether financial or otherwise, that could influence the integrity, objectivity, or validity of their research work.

GRANT SUPPORT AND FINANCIAL DISCLOSURE

Authors declared no specific grant for this research from any funding agency in the public, commercial or non-profit sectors

DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request

ETHICAL CONSIDERATION

This case report was conducted in accordance with institutional ethical standards. Informed consent was obtained from the patient, for the publication of anonymized clinical details. All identifying information has been removed to maintain patient confidentiality.

KMUJ web address: www.kmuj.kmu.edu.pk
Email address: kmuj@kmu.edu.pk