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Original Article

Effect of a Multi-Channel Oral Irrigator on Oral Hygiene Improvement in Older Adult Residents of Long-Term Care Facilities: A Pilot Study

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ABSTRACT

Objectives: This pilot study aimed to explore the feasibility and preliminary effects of a multi-channel oral irrigator (COMORAL, SMDsolutions, Seoul, Korea) in improving oral hygiene among older adult residents in long-term care facilities. **Methods:** 25 adults aged ≥65 years residing in the Gangdong Silver Care Center (Gangdong-gu, Seoul, Korea) completed the 4-week intervention and were included in the final analysis. Participants used the multi-channel oral irrigator twice daily, and oral hygiene indices including the Simplified Oral Hygiene Index (OHI-S), Patient Hygiene Performance index (PHP), the Winkel Tongue Coating Index (WTCI), and tongue dryness were measured at baseline, 2 weeks, and 4 weeks. Turbidity and residual scores of the collected oral irrigated water were also analyzed. **Results:** Significant improvements were observed in the OHI-S (2.29 ± 1.07 → 1.71 ± 1.03, $p = 0.001$), DI-S (1.46 ± 0.62 → 0.97 ± 0.59, $p < 0.001$), PHP (2.33 ± 1.15 → 1.64 ± 1.13, $p = 0.007$), and WTCI (7.92 ± 3.25 → 4.00 ± 3.42, $p < 0.001$). CI-S and tongue dryness score showed no significant changes. Turbidity and residual levels of irrigated water did not differ significantly across time points. **Conclusions:** The multi-channel oral irrigator was associated with improvements in oral hygiene indicators, suggesting its potential utility as a non-invasive and efficient oral care tool for older adults with limited self-care ability in long-term care facilities. These findings suggest that the device may help support more standardized and feasible oral hygiene care in long-term care settings.

Keywords: Aged, Dental plaque index, Long-Term care facilities, Multi-Channel oral irrigator, Oral hygiene

1. Introduction

The worldwide population of older people is growing at an unprecedented rate, creating multiple challenges for healthcare organizations across the globe [1]. As more people live into older age, better oral healthcare is needed to support improved health outcomes for seniors. Oral hygiene is not merely a matter of local comfort, it is closely linked to systemic health, nutritional status, and quality of life [2]. Older adults who do not maintain proper oral hygiene may develop systemic health problems, including malnutrition, aspiration pneumonia, cardiovascular disease, and diabetes mellitus [3-5]. These conditions may be explained by mechanisms such as aspiration of oral pathogens, dissemination of oral bacteria, and chronic inflammatory responses [6-8]. Aspiration pneumonia is one of the most common causes of death and illness among frail older adults [9], but studies indicate that good oral hygiene will considerably reduce the risk of aspiration pneumonia [10,11].

Residents of long-term care facilities face difficulties in maintaining oral hygiene for various reasons. In addition

to operational and physiological constraints within the facility, residents struggle with self-care due to major issues such as reduced manual dexterity and developed cognitive impairment [12]. At the same time, the high workload and restricted work hours force caregivers to dedicate their time to feeding patients, giving medications, and helping with personal hygiene, rather than performing oral care duties. The accumulation of food debris, dental plaque, and tongue coating results in oral discomfort and bad breath, while it also increases the chances of developing respiratory infections and systemic inflammation [13,14]. Research on long-term care facilities indicates that the majority of residents are not receiving adequate treatment for their oral health needs. The study shows that three out of four nursing home residents who maintain their natural teeth will develop poor oral hygiene [15]. The same research study found that older adults in institutions experienced two additional problems: poor denture hygiene and dry mouth symptoms, which they reported to themselves [15].

Conventional oral cleaning methods, including manual toothbrushing and cleaning with sponge swabs or gauze, are highly dependent on caregiver technique and cooperation. In residents with partially missing teeth or dementia, are often insufficient to achieve thorough plaque removal. In addition, there is no consistency in the traditional approach, and hence the cleaning quality differs across the caregivers and institutions. Oral hygiene management in long-term care facilities therefore requires approaches that are not only effective but also feasible, reproducible, and less dependent on individual caregiver techniques. Recent studies have shown that oral care in these settings is frequently hindered by limited staff education, insufficient dental support, time constraints, and difficulties in caring for residents with cognitive impairment [12]. Furthermore, updated reviews have suggested that oral health improvement in long-term care facilities depends on implementation strategies that can be integrated into routine care by non-dental staff [16,17]. Therefore, there is a need for oral hygiene approaches that are practical, standardized, and suitable for caregiver-assisted use in long-term care settings.

Recently, water-based oral hygiene devices, such as oral irrigators, have been increasingly used [18]. However, conventional single-channel oral irrigators discharge irrigated water directly outside the oral cavity, requiring a sink or a dedicated washing environment. This structural limitation restricts their use among older adults with limited mobility and residents of long-term care facilities.

To overcome these limitations, a multi-channel oral irrigator (MCOI) incorporating simultaneous water jet delivery and aspiration has recently been introduced. The MCOI enables concurrent irrigation and removal of waste fluid and debris, eliminating the need for a dedicated washing environment and increasing feasibility for individuals with impaired mobility or difficulties in performing oral hygiene independently.

Clinical evidence supporting MCOI has been reported across various patient populations. In post-stroke rehabilitation patients, repeated application of MCOI over three sessions was associated with progressive improvements in tongue coating and dryness scores, while the irrigated oral rinse water became clearer with fewer residual particles [19]. The device proved both safe and usable according to a research study that monitored an advanced dementia patient with stroke complications [20]. MCOI brought about an instant decrease in oral malodor and users experienced better tongue hygiene within two days of use [20].

In summary, these research findings show that the MCOI system is a safer and more standardized way to perform oral hygiene for older adults who are unable to maintain oral hygiene. However, the existing evidence remains limited, as prior studies have mainly focused on short-term or immediate effects, rehabilitation settings, or individual case-based observations. In particular, little is known about the repeated use of MCOI in older adult residents of long-term care facilities, where oral hygiene is often delivered under caregiver-assisted and environmentally constrained conditions. Therefore, this pilot study aimed to evaluate the effects of a 4-week intervention using MCOI on oral hygiene indicators among older adult residents in long-term care facilities.

2. Materials and Methods

2.1. Study design

This study was designed as an exploratory pilot study to gather preliminary evidence regarding the feasibility of implementing the MCOI among older adults residing in long-term care facilities and its potential effects on oral hygiene following a 4-week intervention using the MCOI twice daily. The study was conducted at the Gangdong Silver Care Center between October and November 2025 after obtaining Institutional Review Board (IRB) approval from S Hospital (IRB No. 202510-WR-03).

2.2. Participants

Participants were adults aged ≥65 years residing in

the Gangdong Silver Care Center who were capable of providing informed consent, with additional consent obtained from their legal guardians. Exclusion criteria included severe tooth mobility, acute oral infection, significant psychiatric symptoms or cognitive impairment, dysphagia, or other medical conditions deemed unsuitable by the investigator. Of the 36 participants recruited, some were excluded due to failure to meet the selection criteria or difficulties in continuing the intervention, resulting in a final sample of 25 participants included in the analysis.

2.3. Intervention and measurements

Participants used the MCOI device, COMORAL® (SMDsolutions, Seoul, Korea), twice daily during the 4-week intervention period under caregiver supervision (Fig. 1A). Each irrigation session used 500 mL of water and lasted approximately 1 minute. During irrigation, participants positioned the WATERET inside the oral cavity and closed their lips. While seated and with the head slightly inclined forward, oral irrigation was initiated using a high-speed water jet, allowing oral cleansing to occur automatically through a synchronized aspiration mechanism (Fig. 1B). All participants maintained their routine toothbrushing frequency of three times per day throughout the study period.

Oral hygiene outcomes were assessed by a single trained examiner at baseline, 2 weeks, and 4 weeks using the same standardized procedures at each time point. Dental plaque accumulation and overall oral hygiene status were evaluated using the Simplified Oral Hygiene Index (OHI-S) and the Patient Hygiene Performance (PHP) index, and each score was calculated according to the respective assessment criteria. Higher OHI-S scores indicate greater accumulation of debris and calculus and, therefore, poorer oral hygiene status, whereas higher PHP index scores indicate greater residual dental plaque and poorer oral hygiene performance. Tongue coating was evaluated using the Winkel Tongue Coating Index (WTCI), with higher scores indicating more severe tongue coating. Tongue dryness was assessed using an observational score modified by the investigators based on the WTCI framework, with higher scores indicating more severe dryness of the tongue surface. In addition, oral irrigated water expelled immediately after irrigation was collected in a designated container and evaluated at baseline, 2 weeks, and 4 weeks. Turbidity and residue were subjectively rated on a 3-point scale, and objective turbidity was measured simultaneously using a turbidity meter. The objective turbidity value was recorded as the reading displayed 30 seconds after the irrigated water was placed into the turbidity meter. Higher subjective scores and objective turbidity values indicate greater amounts of residual debris and a higher degree of cloudiness in the expelled irrigated water.

2.4. Statistical analysis

Data were analyzed using SPSS software (IBM SPSS Statistics 21.0 for Windows; SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean ± standard deviation (SD). Normality was assessed using the Shapiro-Wilk test, and the outcome variables were found to violate the assumption of normality. Therefore, changes in outcome measures across the three time points (baseline, 2 weeks, and 4 weeks) were analyzed using the Friedman test, a non-parametric method for repeated measures. Statistical significance was defined as $p < 0.05$.

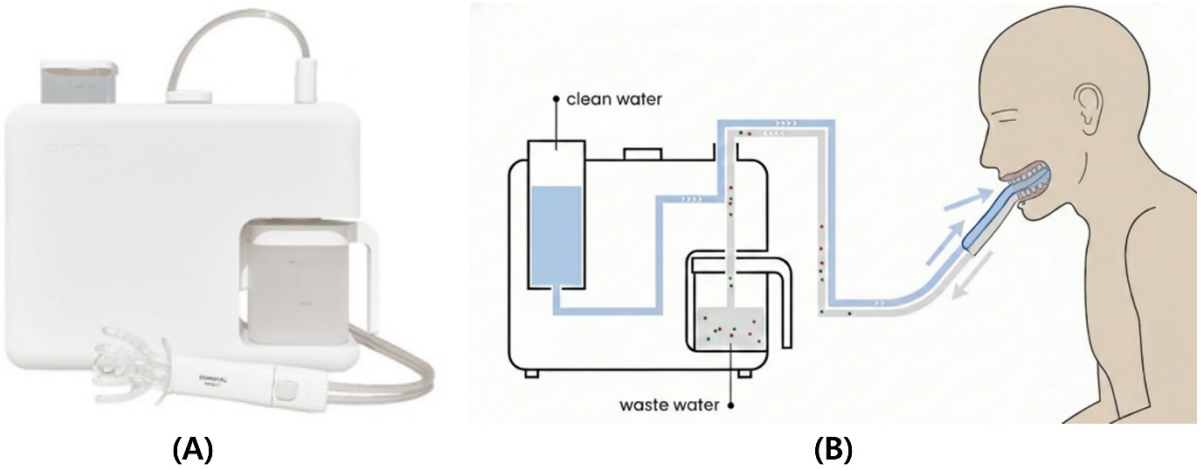

Fig. 1. Overview of the MCOI device COMORAL® (SMDsolutions, Seoul, Korea)
(A) External appearance of the unit, including the integrated clean-water supply, waste-water collection system, and a mouthpiece in the mouth. (B) Diagrammatic representation of device operation during use, illustrating continuous irrigation of the oral cavity with clean water and concurrent suction of waste-water.

3. Results

A total of 25 participants were included in the final analysis, with a mean age of 87.0 ± 5.5 years. The sample consisted of 23 females and 2 males, reflecting the typical characteristics of older adults residing in long-term care facilities. The mean number of MCOI uses during the intervention period was 34.08 ± 4.68, with a range of 21 to 39 uses. The Friedman test revealed significant changes in several oral hygiene parameters over time (Table 1).

The OHI-S significantly decreased from 2.29 ± 1.07 at baseline to 1.78 ± 0.89 at 2 weeks and 1.71 ± 1.03 at 4 weeks (χ^2 = 14.67, p = 0.001, W = 0.29, Fig. 2). Within the OHI-S components, DI-S decreased from 1.46 ± 0.62 at baseline to 0.94 ± 0.53 at 2 weeks and 0.97 ± 0.59 at 4 weeks (χ^2 = 15.10, p < 0.001, W = 0.30). In contrast, CI-S did not demonstrate a significant change over time, with mean values remaining similar at baseline (0.83 ± 0.66), 2 weeks (0.83 ± 0.66), and 4 weeks (0.74 ± 0.73) (χ^2 = 5.56, p = 0.342, W = 0.11).

The PHP index decreased from 2.33 ± 1.15 at baseline to 1.59 ± 0.92 at 2 weeks and 1.64 ± 1.13 at 4 weeks, showing a significant change over time (χ^2 = 6.33, p = 0.007, W = 0.13, Fig. 3). The WTCI also demonstrated a significant reduction, decreasing from 7.92 ± 3.25 at baseline to 4.92 ± 3.82 at 2 weeks and 4.00 ± 3.42 at 4 weeks (χ^2 = 23.02, p < 0.001, W = 0.46, Fig. 4).

Tongue dryness scores changed from 3.20 ± 3.07 at baseline to 2.36 ± 2.71 at 2 weeks and 2.72 ± 3.13 at 4 weeks; however, these changes were not statistically significant (χ^2 = 0.90, p = 0.634, W = 0.02).

Analysis of oral irrigated water parameters showed no significant differences across time points. The subjective residue score changed from 2.08 ± 0.49 at baseline to 1.92 ± 0.76 at 2 weeks and 1.92 ± 0.57 at 4 weeks (χ^2 = 0.95, p = 0.508, W = 0.02), and the subjective turbidity score

Table 1. Changes in Oral Hygiene and Oral Irrigated Water Parameters (n=25)

Variable	Baseline	2 Weeks	4 Weeks	χ^2	W	p-value
OHI-S	2.29 ± 1.07	1.78 ± 0.89	1.71 ± 1.03	14.67	0.29	0.001**
DI-S	1.46 ± 0.62	0.94 ± 0.53	0.97 ± 0.59	15.10	0.30	<0.001**
CI-S	0.83 ± 0.66	0.83 ± 0.66	0.74 ± 0.73	5.56	0.11	0.342
PHP Index	2.33 ± 1.15	1.59 ± 0.92	1.64 ± 1.13	6.33	0.13	0.007**
WTCI	7.92 ± 3.25	4.92 ± 3.82	4.00 ± 3.42	23.02	0.46	<0.001**
Tongue dryness	3.20 ± 3.07	2.36 ± 2.71	2.72 ± 3.13	0.90	0.02	0.634
Residue	2.08 ± 0.49	1.92 ± 0.76	1.92 ± 0.57	0.95	0.02	0.508
Turbidity	2.08 ± 0.64	1.92 ± 0.76	1.84 ± 0.69	3.68	0.07	0.285
Turbidity meter	23.87 ± 28.74	26.59 ± 29.92	23.89 ± 27.45	0.56	0.01	0.745

Values are presented as mean ± SD. Overall comparisons were performed using the Friedman test. Effect sizes are presented as Kendall's W. All variables are expressed as scores, except turbidity meter, which is presented in NTU.
*p < 0.05, **p < 0.01.

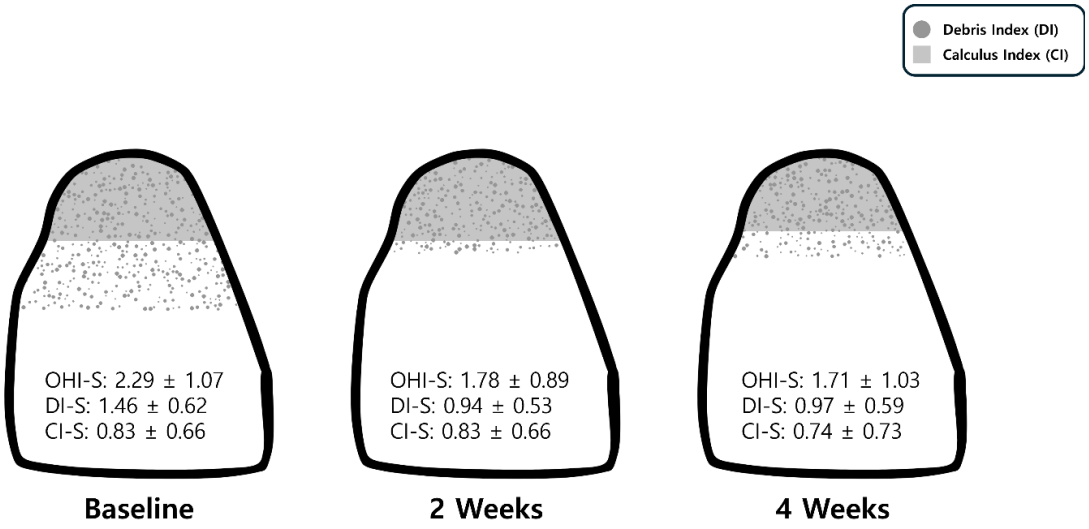

Fig. 2. Changes in the OHI-S observed over the 4-week intervention period. Significant time effects were observed for OHI-S (χ^2 = 14.67, p = 0.001, W = 0.29) and DI-S (χ^2 = 15.10, p < 0.001, W = 0.30). No significant changes were observed in CI-S (χ^2 = 5.56, p = 0.342, W = 0.11).

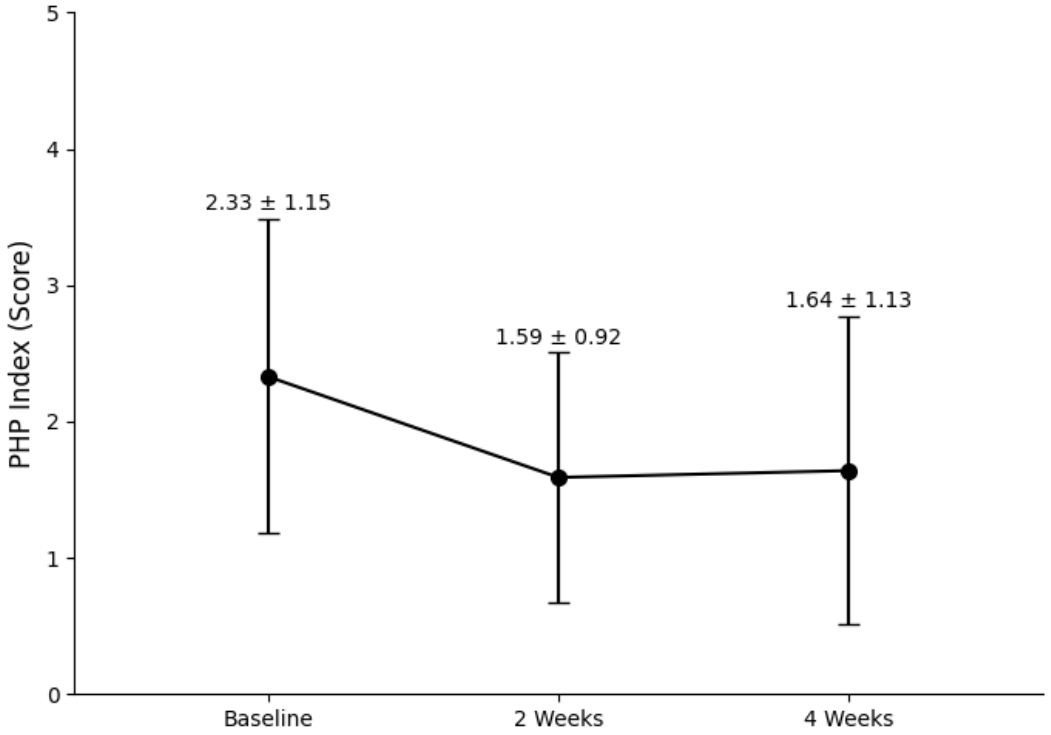

Fig. 3. Changes in the PHP Index over the 4-week intervention period, showing mean scores (± standard deviation) at baseline, 2 weeks, and 4 weeks (χ^2 = 6.33, p = 0.007, W = 0.13).

Fig. 4. Changes in the Winkel Tongue Coating Index (WTCI) over the 4-week intervention period, illustrated by color-coded tongue maps representing mean scores (± standard deviation) at baseline, 2 weeks, and 4 weeks (χ^2 = 23.02, p < 0.001, W = 0.46).

decreased from 2.08 ± 0.64 to 1.92 ± 0.76 and 1.84 ± 0.69, respectively (χ^2 = 3.68, p = 0.285, W = 0.07). Objective turbidity meter values did not demonstrate a significant change over time, with mean values remaining similar at baseline (23.87 ± 28.74 NTU), 2 weeks (26.59 ± 29.92 NTU), and 4 weeks (23.89 ± 27.45 NTU) (χ^2 = 0.56, p = 0.745, W = 0.01).

4. Discussion

This pilot clinical study showed significant improvements in several oral hygiene indicators such as OHI-S, DI-S, WTCI, and PHP Index after 4 weeks of MCOI use in older adult residents of a long-term care facility. However, because this study used a single-group pre-post design without a control group, observed improvements cannot be attributed solely to the MCOI. It remains possible that the changes were partially influenced by the passage of time, increased caregiver attention during the study period, repeated oral assessments, or a research participation effect.

Nevertheless, the direction of change observed in the present study is broadly consistent with previous reports on MCOI. Prior studies have shown immediate or short-term improvements in plaque accumulation, tongue coating, oral malodor, and oral hygiene-related parameters following MCOI use in rehabilitation and neurologically vulnerable populations [19-22]. Although those studies do not eliminate all sources of bias, the consistency of findings

across different settings supports the possibility that the MCOI contributed to the observed improvements in the present study. In a preliminary single-blind clinical trial, Karm et al. (2025) reported that, after restricting oral hygiene activities for 24 hours prior to MCOI use, a single application of the device resulted in an immediate reduction of approximately 25% in plaque accumulation compared with baseline [21]. These findings provide supportive context for the present results, although definitive conclusions regarding causality cannot be drawn from the current study design.

During the intervention period, no aspiration-related adverse events or complications were reported in this study. This finding provides preliminary evidence regarding the safety of device use in long-term care facility settings with respect to aspiration-related concerns. Aspiration pneumonia is known to occur not merely due to aspiration itself, but rather when pathogenic microorganisms from the oral cavity are aspirated into the lower respiratory tract [23]. Previous studies reporting that MCOI use may contribute to maintaining a healthier oral microbial ecology suggest a potential role in mitigating risks associated with the aspiration of pathogenic oral contents [22].

Beyond these potential implications for aspiration-related risk, the present findings may also be meaningful in everyday clinical and caregiving practice in long-term care facilities. Oral hygiene in these settings is often provided under time constraints and depends heavily on caregiver assistance, which can make thorough and consistent oral cleaning difficult to achieve. In this context, the observed improvements in OHI-S, DI-S, PHP, and WTCI suggest that repeated use of MCOI may support more efficient removal of oral debris and tongue coating during routine care. Although caregiver burden and time efficiency were not directly measured in this study, the device may have practical value by simplifying the oral care process, reducing technique-dependent variability, and supporting more structured oral hygiene management for dependent older adults.

For older adult residents in long-term care facilities, consistent oral hygiene management may be difficult due to their poor cognitive and physical conditions and various environmental difficulties in caregivers. Additionally, it is difficult to implement the guidelines properly for oral hygiene management because of these limitations. According to the research of Weening-Verbree et al. (2013), the evidence-based implementation strategies are needed to improve oral health for the older adult residents in long-term care facilities [24]. Therefore, in order to improve oral hygiene in long-term care facilities, an approach that reflects environmental factors is likely to be needed to provide consistent and sustainable oral care services.

From a convergence research perspective, MCOI may have both technological and service implications. Its integrated irrigation-suction system represents a technical innovation designed for oral cleansing under practical care constraints, while its potential incorporation into caregiver-assisted routines suggests service value in supporting more standardized and feasible oral care in long-term care facilities.

This study has several limitations. First, as a pilot study, the sample size was limited and no control group was included. Therefore, it is difficult to establish a clear causal relationship between MCOI use and the observed improvements in oral hygiene indicators. Some of the improvements may have been influenced by non-specific factors, such as natural changes over time, increased caregiver attention during the intervention period, repeated observation and assessment, or a research participation effect. Accordingly, the findings should be interpreted as preliminary associations rather than definitive evidence of intervention efficacy. Second, subjective measurement items such as visual assessment of turbidity and residue may have introduced perceptual bias. However, objective turbidity meter measurements were also included to complement the subjective ratings. Third, due to cognitive impairment in dementia participants, direct usability assessment was impossible, and evaluations were conducted based on proxy reports from caregivers' perspectives. Despite certain limitations, caregivers agreed that the MCOI system simplified the oral care process and reduced patient resistance compared to the previously performed manual toothbrushing or gauze cleaning.

Future studies should employ a randomized controlled design with an appropriate comparison group, such as usual oral care, to better distinguish device-specific effects from time-related or caregiver-related influences. In addition, long-term outcomes, such as respiratory infection rates and nutritional status, should be evaluated. Further research is warranted to determine whether the MCOI can be integrated as a standardized component of multidisciplinary care for older adults.

5. Conclusions

This pilot study suggests that MCOI use was associated with improvements in oral hygiene indicators among older adult residents in long-term care facilities.

For older adult residents in long-term care facilities, difficulties occur in performing voluntary oral hygiene due to their cognitive impairment and limited hand movement.

This increases the need for caregivers to perform oral hygiene management, which can lead to high workload. Therefore, a simple and reproducible oral hygiene management approach using the MCOI may help caregivers in long-term care facilities provide more standardized oral hygiene care.

However, because this study did not include a control group, a causal relationship between device use and the observed improvements cannot be clearly established. Larger controlled studies are needed to determine whether these improvements are attributable to the device itself rather than to time-related changes, increased caregiver attention, or research participation effects. These studies should also examine durability and implementation outcomes, such as patient compliance and caregiver burden. Finally, future studies should investigate whether improved oral health care leads to better systemic health outcomes.

Author Contributions

Conceptualization: CG Kim; Methodology: JW Park, CG Kim; Data Collection: JW Park, KI Jung; Data Analysis: CG Kim; Writing-original draft: JW Park, CG Kim; Writing-review & editing: JW Park, CG Kim

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Conflicts of Interest

The authors declare no conflict of interest.

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