Effect of Ultrasonic Cleaner Combined with Denture Cleanser on Removable Denture Microbiome in Community-dwelling Elderly: A Randomized Controlled Clinical Trial.

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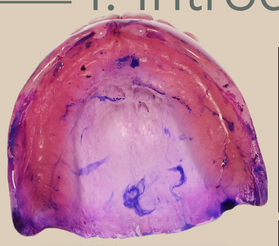
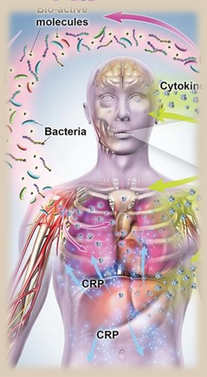
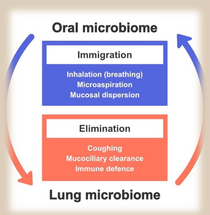
1. Introduction







- Among a community-dwelling elders in Hong Kong, approximately **HALF** had unclean dentures.[1]
- The Microbial Index of Pathogenic Bacteria **(MIP)** was found to be **higher** in the unclean denture group.[2]
- There was a significantly **higher prevalence** of **respiratory pathogens** residing on unclean than clean dentures.[3]
- Systematic review: A high burden of **respiratory pathogens** residing on dentures.[4]
- Systematic review: Unclean dentures & denture wearing at night were associated with **pneumonia**.

2. Methods

Objective: To compare the changes in removable denture microbiomes and the Microbial Index of Pathogenic Bacteria between the intervention and control groups.

Prospective, Single-blind, Parallel-arm, Controlled Clinical Trial (ChiCTR2300071365) & (IRB Ref: UW23-037)

Assessed for eligibility (56 community-dwelling elders recruited)

Pre-intervention (2 weeks)

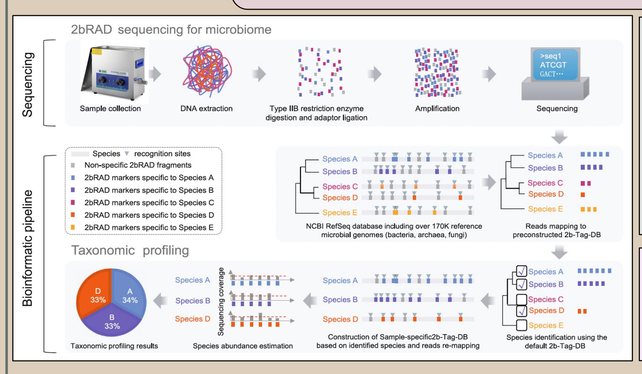
Block Randomisation (SNOSE) – Baseline data (P > 0.05)

Allocated to Intervention Arm
Arm 1 (n = 28)

Allocated to Control Arm
Arm 2 (n = 28)

Educational leaflets & demonstrations

Outcome measures (Baseline & 3-month)



2bRAD-M Metagenomic Sequencing

Denture Microbiome:
- Alpha and Beta diversity
- Relative abundance
- LEfSe analysis

MIP: Chinese Center for Disease Control & Prevention

5. Conclusions

- Denture biofilm samples after ultrasonic cleaning with chemical cleanser intervention harbour ecologically less complex and less anaerobic biofilms while reducing pathogenic microbiome.
- The use of an ultrasonic cleaner in conjunction with a denture cleanser is recommended for maintaining optimum denture hygiene, which contributes to overall oral and systemic health among older adults.

References

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2. Lim TW, Huang S, Jiang Y, Zhang Y, Burrow MF, McGrath C. Characterization of pathogenic microbiome on removable prostheses with different levels of cleanliness using 2bRAD-M metagenomic sequencing. J Oral Microbiol. 2024;16:2317059.
3. Lim TW, Huang S, Zhang Y, Burrow MF, McGrath C. A comparison of the prevalence of respiratory pathogens and opportunistic respiratory pathogenic profile of clean and unclean removable dental prostheses. J Dent. 2024. In Press
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3. Results

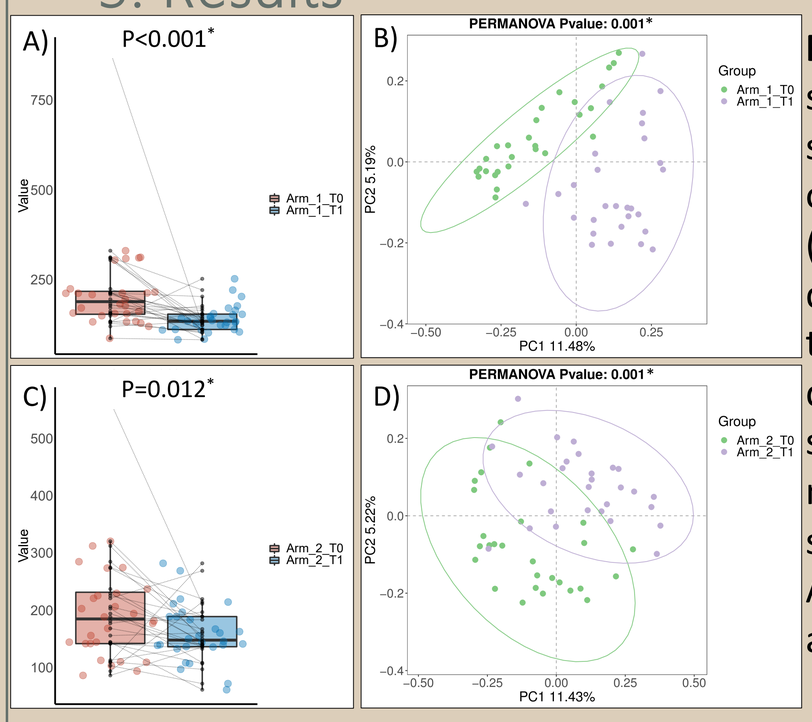

Fig. 1A - D. Arms 1 and 2 showed a statistically significant reduction in overall microbial richness (Chao 1 index). The beta diversity analysis, using the Jaccard qualitative distance matrix, revealed significant differences in microbial community structures within both Arms at baseline and after 3-month.

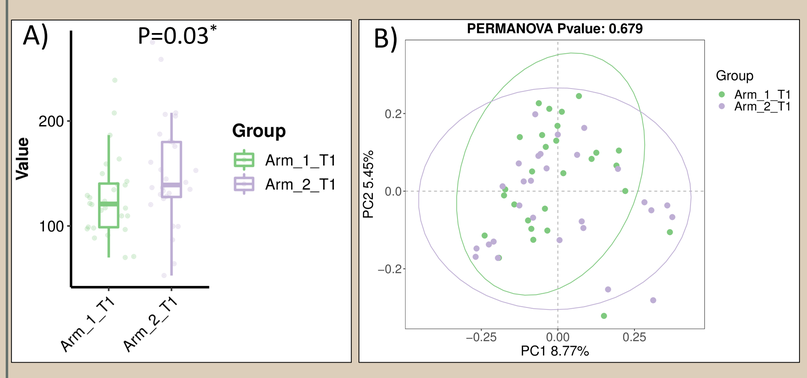

Fig. 2A - B. The Arm 1 showed a significant decrease in Chao 1 index compared to the Arm 2 after 3 months. The beta diversity, based on the Jaccard distance matrix, showed no difference.

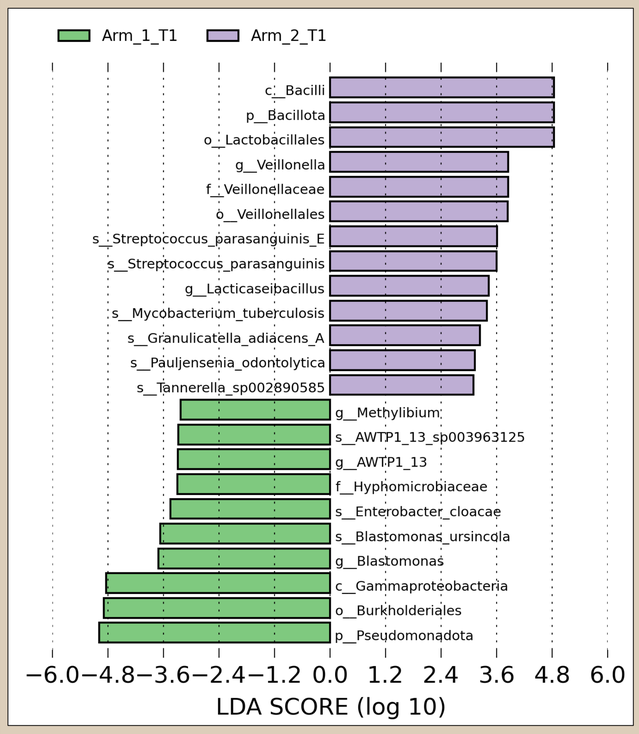

Fig. 3. The microbial communities at the species level were compared between Arm 1 and Arm 2 after 3 months using LEfSe analysis [LDA score (log 10) > 3]. Removable dentures could serve as a reservoir for opportunistic respiratory pathogens, regardless of the type of intervention.

Table 1. The MIP was significantly reduced in the Arm 1, but no significant changes were found in the Arm 2 and between the two Arms.

MIP	Changes after 3 months Mean ± Standard Deviation	IntraArm (P-value)	InterArm (P-value)
Arm 1	0.326 ± 0.750	0.029*[a]	0.497[b]
Arm 2	0.096 ± 0.465	0.283[a]	

*Significant at $p < 0.05$; [a]Paired t-test; [b]Independent samples t-test

4. Discussion

- The existing evidence on using ultrasonic cleaners may not be generalizable due to limitations such as cost, size, and hygiene. In this study, we utilised an **affordable, portable, and personal** ultrasonic cleaner that enables effective denture cleaning at home.
- The combination of mechanical and chemical cleaning can **effectively reduce opportunistic pathogens**, this finding is consistent with Nishi et al.[5]
- Notably, the role of **keystone taxa**, which can be defined as low abundant but ecologically significant taxa should not be underestimated.[2,6]
- Future studies should be designed for elderly residents in long-term care facilities, particularly for those with **physical and mental impairments**.