

Suction toothbrush use for dependent adults with dysphagia: A pilot examiner blind randomized clinical trial

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ABSTRACT

Background: Aspiration pneumonia (AP) is a serious risk for dependent adults in long term care (LTC), especially for those with swallowing dysfunction. **Hypothesis:** To test whether a suction toothbrush reduces the incidence of aspiration pneumonia in dependent adults with dysphagia. **Methods:** This pilot examiner blind parallel group randomized control trial invited all dysphagic residents from one LTC facility to participate (protocol ref. #H2007:051). Caregivers were trained in mouth care using a suction toothbrush. Twenty-two participants were examined at baseline, received scaling and root planing (SRP), and were randomly assigned to equally sized suction or manual toothbrush groups. Participants then received twice daily mouth care for one year from trained caregivers. Oral health parameters were reassessed after one month, and pneumonia outcomes were monitored for one year. **Results:** The 22 consenting participants averaged 54.3 years of age and included 12 females (54.5%). The following changes between baseline and 1 month examination were statistically significant ($p < 0.05$): plaque index 2.9 to 1.0; calculus index 1.1 to 0.2; pocket bleeding index 5.9 to 1.7; gingival index 1.7 to 0.9; and probing depth 3.3 mm to 2.6 mm. Of the 19 participants available at 1 year, six (31.6%) had experienced a total of 62 days with pneumonia with a mean of 3.3 days per subject. Study participants showed significantly lower pneumonia rates than did the general long term care population (1.2 versus 3.4 pneumonia days per 1,000 patient days) although no additional benefit was obtained with the suction toothbrush compared to the manual toothbrush. **Conclusion:** This study showed that SRP and daily mouth care improves oral health and reduces pneumonia rates in adults with dysphagia. The suction toothbrush produced results equivalent to those achieved with a manual toothbrush.

RÉSUMÉ

Contexte: La pneumonie par aspiration (PA) est un risque sérieux pour les adultes qui dépendent de soins de longue durée (SLD), notamment ceux qui ont des troubles de déglutition. **Hypothèse:** Vérifier si une brosse à dents à ventouse réduit l'incidence de la pneumonie par aspiration chez les adultes à charge atteints de dysphagie. **Méthodes:** Pour cet essai d'examen pilote à double insu, randomisé et contrôlé chez des groupes parallèles, on a invité à participer tous les résidents dysphasiques d'un établissement de SLD (réf. Protocole #H2007:051). Les dispensatrices de soins ont été formées aux soins buccos avec la brosse à dents à ventouse. Vingt-deux participants qui ayant subi l'examen de base et reçu le curetage et le surfaçage (CSF), ont été affectés au hasard à des groupes de brosse à dents à ventouse ou manuelle. Les participants ont ensuite reçu des soins buccaux deux fois par jour pendant un an de la part de dispensatrices formées pour ces soins. Les paramètres de santé buccodentaire ont été réévalués après un mois et les résultats de pneumonie ont été suivis pendant un an. **Résultats:** Les 22 participants consentants avaient environ 54,3 ans et comprenaient 12 femmes (54,5 %). Les changements suivants entre l'examen de base et celui du mois suivant étaient statistiquement significatifs ($p < 0,05$) : l'indice de la plaque était 2,9 à 1,0; l'indice du calcul, 1,1 à 0,2 ; l'indice de saignement de la poche, 5,9 à 1,7 ; l'indice gingival, 1,7 à 0,9 ; et la profondeur du sondage, 3,3 mm à 2,6 mm. Parmi les 19 participants disponibles après un an, six (31,6 %) ont vécu 62 jours de pneumonie, avec une moyenne de 3,3 jours par sujet. Les participants de l'étude ont montré des taux significativement plus faibles de pneumonie que l'ensemble de population avec des soins de longue durée (1,2 versus 3,4 jours de pneumonie par 1 000 jours de patient) bien qu'aucun avantage additionnel n'aie été obtenu avec la brosse à dents à ventouse comparativement à la brosse à dents manuelle. **Conclusion:** Cette étude démontre que le CSF et les soins buccaux quotidiens améliorent la santé buccodentaire et réduisent les taux de pneumonie chez les adultes atteints de dysphagie. La brosse à dents à ventouse a donné des résultats équivalents à ceux obtenus par la brosse à dents manuelle.

Key words: oral health, oral hygiene, mouth care, aspiration pneumonia, deglutition disorders, dysphagia, caregivers, dependent adults, long term care

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BACKGROUND

The state of poor oral health of dependent adults and the elderly residing in long term care (LTC) facilities is well documented in the literature.^{1–6} Yet, positive change in this area of nursing practice has been difficult to implement, and caregivers—laden with heavy care needs and other challenges—seem at a loss to improve this area of patient care. The resulting oral disease epidemic among Canada's growing population of older adults presents a significant healthcare challenge and health concern, especially with increasing evidence of the correlation between poor oral health and systemic conditions such as cardiovascular disease, diabetes mellitus, and respiratory diseases.^{7–10} The most significant oral–systemic association that impacts the health of this population is aspiration pneumonia—the leading cause of death and second leading reason for hospitalization from LTC.^{11–13} Caused primarily by the inhalation of oropharyngeal secretions colonized with pathogenic bacteria, aspiration pneumonia is responsible for more than 200,000 cases and over 15,000 deaths per year in the United States alone.¹⁴ A recent report by the Manitoba Centre for Health Policy ranked respiratory infections as the most significant and leading quality of care issue in personal care homes in Manitoba, counting 8,000 cases across 122 not for profit care homes over the past five years.¹⁵ The estimated direct cost per hospitalized case of simple pneumonia and pleurisy in 2005–06 in Manitoba was \$2,827, representing total costs of over \$7 million.¹⁵ These statistics, while alarming, present an intriguing problem that warrants investigation to improve the oral and overall health outcomes of this population.

Poor oral hygiene and conditions that alter the microflora of the oral cavity have been associated with an increased risk for aspiration pneumonia among institutionalized adults.^{14,16–23} Those with weakened immune systems,²⁴ poor management of oral pharyngeal secretions and reduced oral clearance,²⁵ impaired cough reflex sensitivity,²⁶ and dysphagia^{13,25} appear to be at greatest risk. Results of a systematic review by Azarpazhooh and Leake²⁷ confirm previous results by Scannapieco²⁸ that rates of pneumonia among high risk populations were reduced by interventions that improve oral hygiene. Yet, mouth care is often neglected or inadequately performed by nurses, nursing assistants and residential care aides with many caregivers reporting limited or no mouth care training as part of their formal and continuing education.^{2,28–31} Important barriers reported by caregivers, which may also impede their ability to provide daily mouth care, include: time constraints, lack of mouth care supplies, difficulty in brushing others' teeth, lack of cooperation by residents, and strong feelings about the unpleasantness of the task.^{2,30,32–34} Clearly, not all barriers to oral health for residents in LTC are easily removed. Along with raising awareness of the importance of oral health through caregiver training and with addressing other systemic barriers, innovative interventions are needed to facilitate effective plaque removal, and to lower the risk for respiratory infections among this population. A number of researchers have reported significant reductions in oral bacteria and improved oral health using mouth care tools involving suction.^{35,36} The *Plak Vac*® reusable suction toothbrush was identified by nurse managers as a potential tool

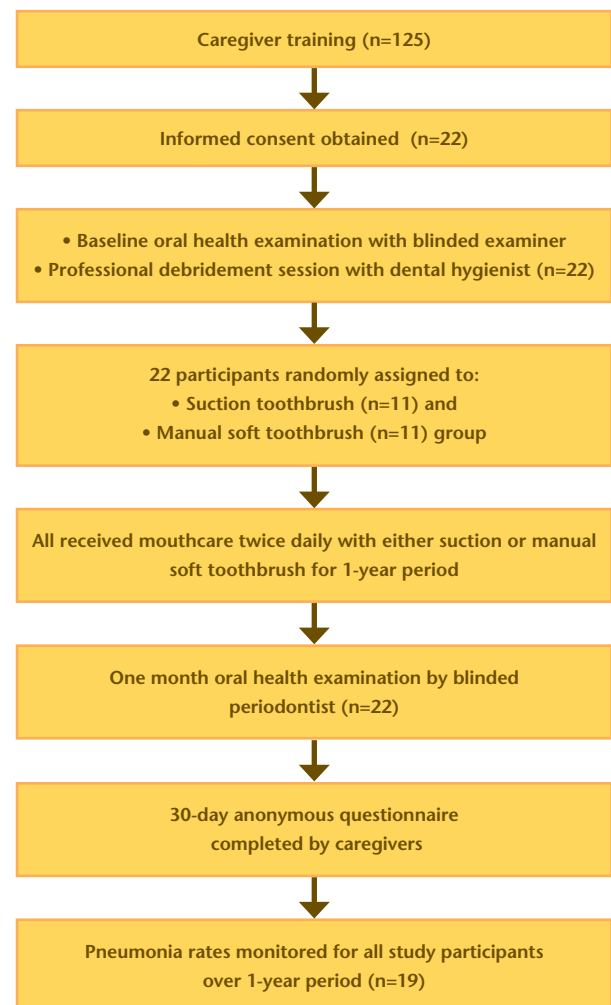
for managing daily dental plaque build up and oral secretions during a mouth care training session. Yet, its effectiveness had not been investigated in the research. Based on a request from nursing staff to help improve the oral health of their chronic care patients, we assembled an interdisciplinary team to investigate the effectiveness of a reusable suction toothbrush in improving the oral health parameters and in reducing aspiration pneumonia rates for individuals with dysphagia.

METHODS

Consent and ethical consideration

Prior to the start of the study, ethics approval was obtained from the University of Manitoba Biomedical Research Ethics Board on February 29, 2008 and assigned the protocol reference number H2007:051. Site approval was granted from Deer Lodge Centre. Clinical resource nurses (CRN) from each of the three chronic care program (CCP) units identified potential participants, who were then invited to enrol in the study by the site coordinator, a clinical nurse specialist (CNS). If applicable, the resident's a legally acceptable representative (LAR) was approached and invited to grant consent on behalf of the individual.

Figure 1. Study protocol



Study population

This study took place at Deer Lodge Centre, a 431 bed LTC and rehabilitation facility located in Winnipeg, Manitoba. Deer Lodge Centre operates 129 beds in its CCP that provides care to individuals requiring professional intervention or close medical supervision or both. The study protocol is illustrated in Figure 1.

Participant selection

Since the degree of pneumonia reduction could not be ascertained from the published literature, this pilot study invited all dysphagic residents from one LTC facility to participate. The sampling frame included thirty-seven residents with a medical diagnosis of oropharyngeal dysphagia, and who were residing in CCP units with access to wall suction. Individuals were excluded if they had fewer than three scoreable sextants of natural teeth, required sedation or antibiotic premedication for dental care, or who were under a “do not resuscitate” order.

Caregiver oral health training and 30-day questionnaire

Prior to the start of the study, 125 CCP caregivers participated in one of 22 three part oral health training sessions facilitated by the study dental hygienists. Caregiver training included:

- i. viewing a video on the reusable suction toothbrush;
- ii. attending a 30-minute oral health education session or viewing a video focused on mouth care, the study protocol, and wall unit suction operation, and
- iii. participating in a hands on mouth care skill development and coaching session for cooperative and care resistant residents.

Caregivers were invited to complete a voluntary questionnaire at the end of the thirty day period to provide feedback. Results of the caregiver questionnaire will be reported separately.

Examinations and debridement

A study dental examination tool was developed to gather demographic information and oral health parameters on six selected adult teeth: 1.6, 2.1, 2.4, 3.6, 4.1 and 4.4 for each participant.³⁷ If missing, the nearest adjacent tooth in

the respective sextant was used. If no adjacent tooth was present, no score was given for that sextant. Demographic variables collected included name, age, sex, date of birth, unit number, and from whom consent was obtained.

The following clinical parameters were assessed for each participant: teeth remaining, modified plaque index,³⁸ calculus index,³⁹ pocket bleeding index,⁴⁰ gingival index,⁴¹ and probing pocket depth. A single examiner periodontist carried out the baseline and 1-month dental examinations using a mouth mirror, Shepherd’s hook explorer, and World Health Organization double ended periodontal probe. Standard infection control practices were followed for all procedures. Three dental hygienists performed periodontal debridement after the baseline examination for each study participant, to a maximum limit of one hour, based on resident need and level of cooperation.

Unit set up

The principal investigator used a computer generated random number list to randomly assign participants to one of two interventions—the Oral-B Advantage Plus® soft manual toothbrush (control) or Plak-Vac® reusable suction toothbrush (test) groups. A study toothbrush, non foaming toothpaste (Biotene™), water based mouth moisturizer (Biotene Oral Balance™), wall mounted toothbrush/product holder, digital pre-set timer, and weekly tooth brushing chart were made available in each participant’s room.

Mouth care implementation

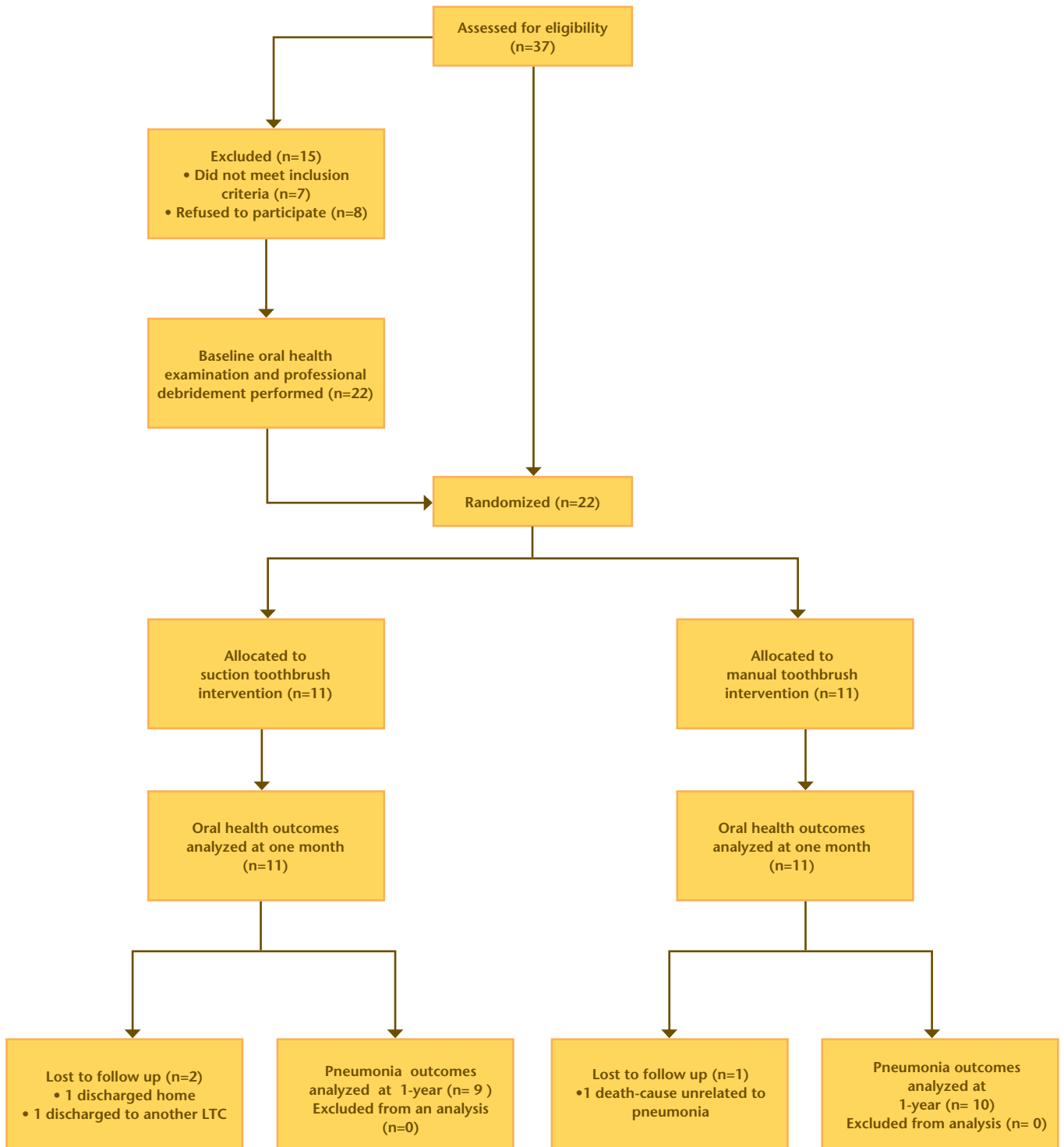
The study protocol called for each resident to receive or perform two minutes of timed mouth care twice daily, with each mouth care session recorded on the weekly tooth brushing chart. Study staff visited the units periodically—about twice weekly—to encourage caregiver participation, replace tooth brushing charts, and replenish mouth care products as needed. Study participants were re-examined at 1-month by the study dentist, who was blinded to each resident’s mouth care regimen. Data were collected on each of the oral health parameters examined at baseline.

Pneumonia rates of study residents were tracked by the centre’s infection control nurse (ICN), utilizing the existing

Table 1. Demographics of study participants.

| | Manual soft toothbrush group at 1 month | Manual soft toothbrush group at 1 year | Suction toothbrush group at 1 month | Suction toothbrush group at 1 year |
|-----------------------------------|---|--|-------------------------------------|------------------------------------|
| No. of participants | 11 | 10 | 11 | 9 |
| Gender | 3 male 8 female | 3 male 7 female | 7 male 4 female | 5 male 4 female |
| Age - Male (Standard Deviation) | 45.0 (2.0) | 45.0 (2.0) | 56.3 (16.9) | 52.6 (19.0) |
| Age - Female (Standard Deviation) | 60.0 (15.9) | 60.9 (16.9) | 46.3 (8.8) | 46.3 (8.8) |

Figure 2. Stages of participants' movement through the study.



infection surveillance report system in place at Deer Lodge Centre. Additionally, the ICN performed chart audits on study residents to determine if chest X-rays were taken or

if antibiotics were administered. The pneumonia outcome recorded and reported in this study represents the number of days for which a diagnosis of pneumonia remained

Table 2. Outcome variable changes from baseline to 1 month follow up end scores.

| Variable | Baseline exam (Standard Deviation) | 1 month follow up exam (Standard Deviation) |
|-------------------------------------|------------------------------------|---|
| Modified plaque index ²⁵ | 2.9 (0.76) | 1.0 (0.21)** |
| Calculus index ²⁶ | 1.1 (0.55) | 0.2 (0.15)** |
| Pocket bleeding index ²⁷ | 5.9 (8.88) | 1.7 (4.58)* |
| Gingival index ²⁸ | 1.7 (0.35) | 0.9 (0.28)** |
| Probing depth | 3.3 (0.43) | 2.6 (0.39)** |

* p<0.05; **p<0.001

current—between initial diagnosis and final resolution.

Statistical methods and analyses

Data entry and analyses were performed by the authors and a University of Manitoba staff biostatistician using Epidata 3.1 and SPSS 16.0 for Windows. Frequency distributions were used to summarize data and potential associations between variables. The following statistical tests were applied:

- i. Chi-square to analyze categorical data,
- ii. Fischer's exact test to analyze categorical data with low cell size,
- iii. ANOVA and paired T-test to analyze the relationship between continuous and categorical variables,
- iv. Pearson correlation coefficient to analyze two continuous variables, and
- v. The Mann-Whitney test to analyze continuous data where assumptions of normal distribution are violated.

RESULTS

Study participants

Demographics of the study participants are featured in Table 1, with Figure 2 illustrating the flow of participants through the study. Baseline and 1-month follow up examinations were completed in two consecutive days at the site dental clinic for nineteen subjects (87%), while the remaining three residents were examined on their respective units.

Three participants (14%) were lost during the 1-year follow up period. One participant died at four months of causes not related to pneumonia; one was discharged to a different LTC facility at five months, and one was discharged home at six months. None of these participants had been diagnosed with pneumonia at any period between the start of the study and the point at which they were lost from the study.

Participants received a mean of 3.2 (SD 0.9) units of debridement by a dental hygienist after the initial baseline examination. While twenty participants (90.9%) were totally dependent on others for daily mouth care, two were able to perform this activity independently. The randomized allotment process resulted in eleven

participants being assigned to the test group using the reusable suction toothbrush and eleven to the control group using the manual soft toothbrush. The two groups did not differ significantly with regard to sex, age, number of remaining teeth, or any of the baseline oral parameters measured.

Baseline examination results

Results of the baseline examination are featured in Table 2. At baseline, participants averaged 23.3 (SD 6.1) remaining teeth. Plaque levels were generally high, with calculus a common finding reflecting a relative absence of effective daily mouth care and generally poor periodontal health.

One month follow up examination results

At one month, 100 per cent of participants were found to have improved modified plaque index,²⁵ calculus index,²⁶ and gingival index²⁸ scores. As shown in Table 2, the degree of improvement for each of these parameters was statistically significant (p<0.001). Mean probing depth scores were found to have improved for 21 of the 22 subjects (95.5%) from 3.3 mm to 2.6 mm, to a statistically significant (p<0.001) degree for the group (Table 2). The mean pocket bleeding index²⁷ at 1-month was significantly reduced (p<0.05) where 17 subjects (78%) improved, 4 (19%) remained the same, and 1 (5%) became worse. The degree of improvement by test and control participants did not differ significantly (p>0.05) for any oral health parameter. It is noteworthy that, following a single session of professional debridement and implementation of appropriate daily mouth care, substantial improvements in all parameters were achieved at one month.

Pneumonia outcomes

At the end of the one year followup period, 6 of the 19 remaining study participants (32%) experienced a total of 62 days during which they were diagnosed with pneumonia—pneumonia diagnosis days. The mean number of pneumonia diagnosis days was 3.3 days (SD 5.4) per subject, ranging from 6 to 16 days in duration.

On bivariate analysis, significantly more females (p<0.05 Fisher's exact test) developed pneumonia than did males

Table 3. Significant correlations between pneumonia and continuous variables.

| | Days pneumonia diagnosis | |
|-----------------------------|--------------------------|--------|
| Baseline Mean probing depth | Pearson correlation | -.436* |
| | Sig. (2-tailed) | .042 |
| 1-Month Mean bleeding index | Pearson correlation | .462* |
| | Sig. (2-tailed) | .030 |

* Correlation significant at the 0.05 level (2-tailed)

(54.5% versus 0.0% respectively). On ANOVA, the number of pneumonia diagnosis days was also significantly higher ($p < 0.05$) for females (5.6 days, SD 6.1) than for males (0.0 days).

Contrary to expectation, participants who developed pneumonia showed significantly lower ($p < 0.05$) probing pocket depths (2.9 mm, SD 0.3) at baseline than did participants without pneumonia (3.4 mm, SD 0.4). However, individuals who developed pneumonia showed less improvement in probing depths (0.74 mm versus 0.42 mm) following initial debridement and implementation of a new daily mouth care protocol. This difference approached but did not reach statistical significance ($p = 0.07$).

Participants who developed pneumonia showed significantly higher ($p < 0.05$) bleeding index scores at their 1-month follow up examinations (3.5%, SD 8.5) compared with participants without pneumonia (1.0%, SD 1.8). Anecdotally, the individual who experienced the longest bout of pneumonia (16 days) had the highest bleeding index score at 1-month (20.8%).

As shown in Table 3, 2-tailed Pearson correlation coefficient analysis showed statistically significant ($p < 0.05$)

association between the number of pneumonia diagnosis days and both baseline mean probing depth and 1-month bleeding index scores. Test and control participants did not differ significantly on any other investigated parameter, that is number of teeth, age, plaque, calculus, or gingivitis index scores.

General versus study population

As previously mentioned, this institution routinely monitors pneumonia rates as part of its quality assurance program, and reports these results as the number of pneumonia days per 1,000 patient days. Other residents of the institution who were not participants in the study (general population) were not offered the professional debridement and daily mouth care protocol. For the time period covering the conduct of this study, study participants had a significantly lower ($p < 0.05$) pneumonia rate (1.2 days/1,000 patient days, SD 0.8) on the Mann–Whitney test than did the general population residing in the same area of the institution (3.4 days/1,000 patient days, SD 1.3).

Table 4. Pneumonia rate by sex and type of toothbrush assigned.

| | | Manual soft toothbrush group at 1 month | Manual soft toothbrush group at 1 year | Suction toothbrush group at 1 month |
|--------|---------------|---|--|-------------------------------------|
| Sex | Assignment | No pneumonia Number (%) | Pneumonia Number (%) | Total Number |
| Male | Suction brush | 5 (100%) | 0 (0%) | 5 |
| | Manual brush | 3 (100%) | 0 (0%) | 3 |
| | Total | 8 | 0 | 8 |
| Female | Suction brush | 2 (50%) | 2 (50%) | 4 |
| | Manual brush | 3 (50%) | 4 (50%) | 7 |
| | Total | 5 | 6 | 11 |

$p > 0.05$ (Fisher’s exact test)

Suction (test) versus manual (control) toothbrush

The 1-year pneumonia incidence for participants in the suction toothbrush group was 18.2 per cent (2 of 11 subjects) compared with a 36.4 per cent incidence (4 of 11 subjects) in the manual toothbrush group. This difference was not statistically significant ($p=0.318$) on Fisher's exact test. When assessed for the total number of days spent with a diagnosis of pneumonia, it was determined that participants in the suction toothbrush group averaged 1.1 (SD 2.4) days with pneumonia compared with 4.6 days (SD 6.5) for participants in the manual toothbrush group. This difference approached but did not quite reach statistical significance on ANOVA ($p=0.116$). A retrospective power analysis revealed that this pilot study had a power of only 35 per cent, and that a sample size of 34 subjects would have been required for the observed differences to be statistically significant.

However, when these apparent differences in pneumonia rates were assessed while controlling for participant gender, it became obvious that the relationship between pneumonia and toothbrush group was being confounded by the uneven distribution of males and females in test and control groups. Despite the fact that there was no statistically significant association between subject sex and the toothbrush group to which they were randomly assigned, Table 4 clearly shows that any observed relationship is purely the result of variable confounding. The rate at which males developed pneumonia was zero per cent in the suction and manual toothbrush groups. However, the rate at which females developed pneumonia was 50.0 per cent in both the suction and manual toothbrush groups. There was no difference in pneumonia rate attributable to whether daily care was provided by a suction toothbrush or a manual toothbrush. The pneumonia rates were identical in the two groups when assessed separately for males and females.

DISCUSSION

Similar to the results reported by other researchers^{1,2,17,21,29,30} this study also found evidence that the oral health needs were not being met for dependent adults in LTC. This was true for both daily mouth care and use of professional dental services. Upon baseline examination, high levels of plaque and calculus were evident. Not surprisingly, high degrees of bleeding, gingivitis and periodontitis were also found, creating a very plausible pathogenesis link to aspiration pneumonia. It is little wonder that respiratory infections have been identified as the leading problematic quality indicator in LTC¹⁵ and cited as a major concern at this centre.

The 1-month results of this pilot, examiner blind randomized clinical trial allow us to draw two separate observations.

i. First, that professional debridement, caregiver training, and implementation of a unit specific daily mouth care regimen can lead to improvements in oral health parameters, and to substantial reductions in oral health risk factors for aspiration pneumonia. Therefore, continued efforts in this direction are urgently needed.

ii. Second, in dependent adults with dysphagia, a

suction toothbrush design is able to produce equivalent oral health improvements to those found with a soft manual toothbrush. This finding provides additional support for use of a suction toothbrush as a viable, effective alternative to that of a manual soft toothbrush for adults at high risk of aspiration pneumonia.

Although no previous studies have examined the effectiveness of a reusable suction toothbrush in reducing the incidence of pneumonia, results of this study are consistent with previous research investigating innovative toothbrush designs incorporating suction.^{35,36} Combining a powered toothbrush, suction and an antibacterial agent delivery system, Sumi et al.³⁵ reported improved gingival and plaque levels in frail dependent elderly individuals. The study design did not allow assessment of the independent effects of using a powered brush, suction, or an antimicrobial agent. Researchers Ferozali, Johnson and Cavagnaro³⁶ reported improved oral health parameters as well as reductions in pathogenic bacterial counts for subjects who had received intermittent suctioning during mouth care using a commercial one-use suction toothbrush.

After one year of follow up, pneumonia rates improved for the study population when compared to the general institutional population who did not receive the initial professional debridement and improved daily mouth care that was made available to study participants. These findings further support the conclusion of a recent systematic review that pneumonia rates among high risk populations are reduced by interventions to improve oral hygiene.²⁷ This knowledge has important implications for LTC in Canada. With pneumonia associated with high mortality and morbidity rates among dependent older adults in LTC,¹¹⁻¹³ decision makers can take steps to improve this diagnostic quality indicator.^{15,42}

The original purpose of this study was to determine whether or not pneumonia rates could be improved in individuals with dysphagia by using a suction toothbrush design that eliminated plaque, debris, saliva, and toothpaste residue during the process of daily mouth care. In the 1 year follow up period, non significant ($p>0.05$) improvements were documented in the incidence of pneumonia and in the number of pneumonia diagnosis days experienced by participants assigned to the suction toothbrush group. However, on more detailed analysis, this apparent reduction was completely explained by the unequal distribution—of male and female participants—that occurred during random subject assignment. This confounding occurred despite the fact that the test and control groups did not differ significantly ($p>0.05$) by gender. While the findings of this study suggest no advantage to using a suction toothbrush to reduce pneumonia, there were design and use characteristics that caregivers preferred. Details regarding caregiver experience and preferences will be the topic of a separate paper.

This study has several limitations, including a small sample size, recruiting all participants from a single LTC facility, and having a relatively short period of one year to evaluate pneumonia outcomes. Generalizing the findings of this study to other facilities and residents living in LTC is not possible due to the differences in caregivers' oral

health knowledge and training, staff turnover rates, and the variability of resident demographics.

CONCLUSIONS

Effective daily mouth care remains an unresolved problem in LTC, with high levels of plaque and food debris, inflammation, and oral disease challenging individuals' oral health, quality of life and ability to stave off life threatening infections such as aspiration pneumonia.^{1,2,17,21,27,28} This is especially alarming as the profile of dependent adults is changing in Canada towards an older, more frail, and more care dependent resident population with complex medical conditions.⁴³ Effective mouth care protocols, training, and interventions that offer ease of use and encourage compliance are therefore urgently needed to help address this problem.

Our study found that caregiver education and hands on training as well as implementation of a daily mouth care protocol with clearly established guidelines and caregiver accountability were effective means for improving the oral health of this population of dependent adults with dysphagia. A single session of professional debridement combined with adequate daily mouth care, regardless of study toothbrush type, were effective means for improving oral health and for reducing the pneumonia rate for this population of dependent adults with dysphagia in LTC. Importantly, study participants experienced better aspiration pneumonia outcomes than did other residents of the institution.

Finally, we conclude that while there was no oral health or aspiration pneumonia rate advantage for using a suction toothbrush over the manual soft toothbrush for this population, the suction toothbrush does hold promise in increasing caregiver compliance and success in maintaining dependent adults' oral health and quality of life.

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