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Author(s)	**Au, Kar-yan; Cheung, Hiu-ching; Chung, Sze-man; Lai, Chi-fung; Leung, Ki-ki, Jessica; Leung, Yat-fung; Ng, Yuk-chun; Wah, Yat-shing, Jonathan; Wong, Chun-lung**
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Effectiveness of a denture hygiene intervention programme among institutionalized elders

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Group 4.1 (2014/15)

AU Kar Yan

CHEUNG Hiu Ching

CHUNG Sze Man

LAI Chi Fung

LEUNG Ki Ki Jessica

LEUNG Yat Fung

NG Yuk Chun

WAH Yat Shing Jonathan

WONG Chun Lung

Advisor

Prof. Colman McGrath

1.0 ABSTRACT

Objectives: To evaluate the effectiveness of a denture hygiene intervention programme in terms of improving denture cleanliness and denture stomatitis. **Methods**: Residents at seven elderly care homes were invited to participate in a denture hygiene programme. Clinical assessment of denture stomatitis was undertaken and denture cleanliness assessed: (i) qualitatively by the *Denture Cleanliness Index* ratings and (ii) quantitatively by planimetric assessments of plaque coverage from digital images using Adobe Photoshop[®]. Individual denture hygiene instruction was provided and denture cleanser (Polident[®]) supplied. Six weeks later assessments of denture stomatitis and denture cleanliness were undertaken. **Results:** Fifty-six participants were recruited; most had evidence of denture stomatitis (82.1%, 46) and 62.5% (35) of dentures were classified as '*very poorly cleaned*'. The mean percentage of plaque coverage was 28.11 (SD 19.64) and 37.5% (21) had evidence of plaque covering more than a third of the denture surface. Denture cleanliness was associated with denture stomatitis ($P<0.05$). Variations in denture stomatitis and denture cleanliness were evident in relation to socio-demographic factors and denture hygiene practices. The response rate to the denture hygiene programme was 91.1% (51). There were significant improvements in the prevalence of denture stomatitis ($P<0.01$) and *Denture Cleanliness Index* ratings ($P<0.05$).

However, no significant change in mean percentage of plaque coverage was evident (P>0.05).**Conclusion:** A 6-week denture hygiene intervention programme was effective at improving denture stomatitis and denture cleanliness among residents of elderly care homes. However, persistence of problems in denture cleanliness and denture stomatitis existed and this warrants further consideration.

Key words: Institutionalized elders, denture hygiene, denture stomatitis, intervention study

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2.0 INTRODUCTION

Tooth loss is common among older people in Hong Kong and is particularly among those living in residential care. Findings from the most recent territory-wide oral health survey in Hong Kong have reported that more than 80% of institutionalized elders have less than 20 teeth and that approximately one third are edentulous (Department of Health, 2011). The mean number of remaining teeth among institutionalized elders was reported to be 9.4. Most of them rely on dental prosthesis to manage this deficit of tooth loss, with more than 40% possessing some form of removable prostheses (denture).

Dentures, if not properly cared for, can act as a reservoir for an array of oral microorganisms including *Streptococci*, *Staphylococci*, and fungi such as *Candida* (VonFraunhofer and Loewy, 2009). This can lead to a number of infections within the mouth including denture stomatitis (Coulthwaite and Verran, 2007). Moreover, oral microbiota have also been implicated in a number of systemic problems including bacterial endocarditis, aspiration pneumonia, gastrointestinal infection and chronic obstructive pulmonary diseases (Müller, 2015). Thus, poorly cleaned dentures can have life threatening consequences.

Denture cleaning can be broadly classified into mechanical approaches, chemical approaches or a combination of both (Shay, 2000). A Cochrane systematic review has reported a lack of evidence as to the effectiveness of different denture cleaning methods (DeSouza et al., 2009). Regular mechanical cleaning has been suggested as the optimal method for controlling denture stomatitis and oral microbiota (Brondani et al., 2012). However, this mechanical cleaning methods can be problematic for older frail adults, as is typical in residential care homes; and to this end chemical cleanser agents have been advocated (Saarela et al., 2013).

It is important to consider and monitor denture hygiene and associated conditions related to denture wearing. Various assessments have been proposed including the *Denture Cleanliness Index* which broadly classifies denture hygiene based on visible plaque coverage and presence of calculus (Mylonas et al., 2014). However, this method is arguably relatively subjective. To this end, a relatively recent and novel approach has been to photograph and perform image analysis of stained plaque on dentures to derive planimetric assessment (area measurement) of surfaces covered by plaque (Couthwaite and Verran, 2009). This has implications for usage in supporting denture hygiene programme without the dentist having to be present and thus reducing manpower needs and potentially associated costs. In addition, it may

provide a standardized and arguably a more 'objective' assessment to compare outcomes over time between different denture cleaning methods.

There is a growing recognition of the dental needs of older people locally in Hong Kong owing to its ageing population and the acknowledged growing burden of oral diseases, particularly among institutionalized elders. To this end, the Government of Hong Kong SAR has introduced an elderly health care voucher scheme to subsidize older peoples' use of primary dental care services (www.hcv.gov.hk). Over 800 private dentists in Hong Kong have signed up to participate in the scheme. While provision of dental care is obviously a welcomed initiative, the hygiene maintenance of prosthesis provided is also important to consider. Our community healthy project is concerned with evaluating the effectiveness of a rather simple denture hygiene programme among elders living in residential care.

3.0 AIMS

Our community health project aimed:

1. To determine the prevalence of denture stomatitis among participants of the project; and to examine associations between denture stomatitis and existing denture hygiene practices, medical history and socio-demographic factors.

2. To determine dentures cleanliness (qualitatively and quantitatively) among participants of the project; and to examine associations between denture cleanliness and existing denture hygiene practices, medical history and socio-demographic factors.

3. To determine associations between denture stomatitis with qualitative and quantitative assessments of denture cleanliness.

4. To evaluate the effectiveness of a denture hygiene programme at reducing the prevalence of denture stomatitis among elders in residential care settings.

5. To evaluate the effectiveness of a denture hygiene programme at improving denture cleanliness (qualitative and quantitative assessments) among elders in residential care settings.

4.0 METHODS AND MATERIALS

4.1 Study design and sample

Our community health project was a prospective intervention study of denture hygiene over a 6-week period. The target population was residents in elderly care homes in the local vicinity, and invitation letters explaining the purpose of our project were sent to them and follow-up telephone calls were made (*Appendix 1*). From the onset we had estimated to recruit at least 50 participants who were living at the centres, possessed a full or extensive denture and were deemed fit and willing to participate by the senior care staff. A total of seven elderly residential homes were recruited to achieve the estimated sample size. Sites were visited prior to data collection to facilitate the logistics and a pilot study was performed to train and standardize the methods of data collection.

4.2 Data collection

Written informed consents were obtained from all participants. Face-to-face interviews with participants were conducted prior to clinical assessments using a standardized data collection form. Details of how long participants had the denture *(<1 year, 1-2years, 3-4years or 5 years or more)*; their typical denture cleaning

practice (*by themselves or with assistance of the caregivers*); the frequency of

denture cleaning (*everyday, almost every day, at least once a week, less often than*

once a week or never); and method of denture cleaning with a range of possible

means (*mechanical and chemical*) were reported. A brief medical history of physical,

cognitive, and medical problems was recorded. Details of their age, gender and how

long they had lived in residential care were also recorded. The standardised

questionnaire used in the interview is presented in *Appendix 2*.

Following the interview, participants' palatal mucosa were examined and

assessed for evidence of denture stomatitis according to *Newton's classification*

based on localized or generalized erythematous lesions and evidence of hyperplasia,

Table 4.1 (Tyldesley et al., 2003). Clinical photographs were taken of a random

sample of 10% of the participants to determine examiner reliability.

Table 4.1 Newton's Classification of Denture Stomatitis

	Newton's Classification of Denture Stomatitis (1962)
Type I	A localized simple inflammation or pinpoint hyperemia
Type II	An erythematous or generalized simple type seen as more diffuse erythema involving a part or the entire denture covered mucosa
Type III	A granular type (inflammatory papillary hyperplasia) commonly involving the central part of the hard palate and the alveolar ridges.
None	Absence of signs associated with Type I–III

The denture was then placed in a bowl with an assigned participant number and a diluted (2:1) plaque disclosing agent (GUM® Red-Cote ® Liquid – a non-toxic vegetable dye) was applied to the denture fitting surface. The disclosing agent was applied with a syringe in order to minimize the disruption of plaque. The denture was rated for denture cleanliness according to the criteria of the *Denture Cleanliness Index*, *Table 4.2*. A lack of any visible plaque or stains was rated as *'very clean'* (code 0); evidence of plaque covering <25% of the denture with little staining was rated as '*visibly clean*' (code 1); evidence of plaque covering 25-50% of the denture with moderate staining was rated as '*poor denture cleaning*' (code 2); evidence of plaque covering more than 50% of the denture with severe staining was rated as '*very poor denture cleaning*' (code 3); and evidence of visible calculus on the denture was rated as 'denture with calculus' (code 4). Photographic images were taken of a random 10% of dentures to determine examiner reliability.

Table 4.2 The Denture Cleanliness Index ratings

0	Clean denture. No plaque is visibly seen, no staining, no plaque detectable.
1	Denture is visibly clean. Little staining. (<25% fit surface stained)
2	Denture has visible plaque and/or debris. Moderate staining of fit surface. (25-50% fit surface stained)
3	Denture has visible plaque and/or debris. Severe staining of fit surface. (>50% fit surface stained)
4	Denture has visible calculus deposit, on any surface.

The denture in its bowl was then transferred to obtain images for planimetric assessments by photographing in a standardized manner blind of clinical assessment ratings. Images of each maxillary denture were captured by digital camera (Canon Powershot G16) and ring light flash (MACRO RING LITE MR-14EX). The distance between the camera and the denture bowl containing the denture was standardized, *Figure 4.1*.

Figure 4.1 Set up for image taking of denture fitting surface

4.3 Denture hygiene intervention

Individualized denture hygiene instruction was conducted on a one-to-one basis and participants were instructed to mechanically clean denture daily with a soft toothbrush provided (Oral B CrossAction® 35 small soft). In addition, they were instructed to place their denture in a container adding warm but not very hot water to cover the denture and then add one Polident® tablet into the water and soak overnight, then rinse the denture afterwards under running water and discard the solution. Written instructions and leaflets were provided. A power-point presentation on the importance of denture hygiene was provided to caregivers at the residential homes.

Figure 4.2 Denture hygiene intervention: OHI and denture cleanser

A) Customized OHI   *B) Polident ® Denture Cleanser*

4.4 Follow- up assessments

Follow-up arrangements for reviewing participants were made for 6 weeks later. Again, participants' palatal mucosa were examined and assessed for evidence of denture stomatitis according to *Newton's classification*. Secondly, the denture was placed in a bowl with an assigned participant number and diluted (2:1) plaque disclosing agent (GUM® Red-Cote® Liquid) was applied to denture fitting surface with a syringe in order to minimize the disruption of plaque. The denture's cleanliness was rated by the *Denture Cleanliness Index* ratings. Images of each maxillary denture were captured following the standardized methods as described above by digital camera (Canon Powershot G16) with ring light flash (MACRO RING LITE MR-14EX), *Figure 4.1*. Compliance to the denture hygiene intervention programme was ascertained by asking participants how often they performed the denture hygiene practice.

4.5 Data analyses

Firstly, the images obtained were processed in Adobe Photoshop (CC2014: adobe systems inc.) according to the methods described by Coulthwaite and Verran (2009). The denture area was selected using the 'quick selection tool' (size 20),

copied, pasted and saved. The pixels of the selected denture area were derived from a histogram, *Figure 4.3*. The contrast of the denture image was adjusted to '-50'. Plaque areas were selected using the 'magic wand' tool (tolerance level 8). Image of the plaque area was copied and saved. The pixels of the selected plaque area were derived from a histogram, *Figure 4.3.*The percentage of plaque coverage on the denture was calculated from the 'Total plaque surface pixels' / 'Total denture surface pixels'*.* A random sample of 24 images were reanalyzed to determine inter- and intra-assessor reliability.

Figure 4.3 Image of selected denture area and plaque areas
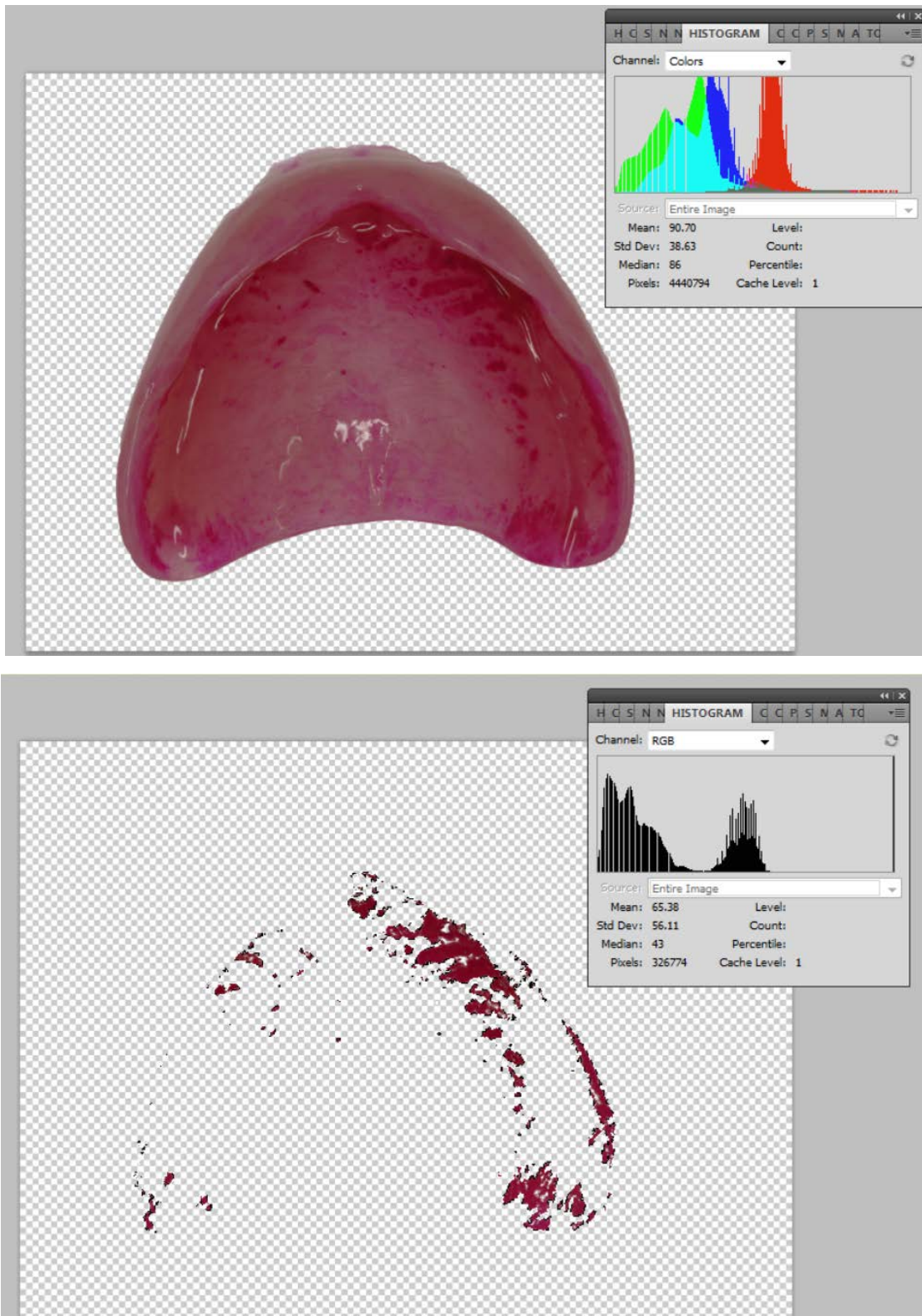
All the data were entered into the Statistical Package SPSS, version 22.0. Firstly, frequency tables were produced to check for missing data and if it was observed the original data collection forms were retrieved and correct values assigned. Frequency tables were produced for responses to face-to-face interviews to determine (i) Socio- demographic profile of participants: age group, gender and time in residential care; (ii) Brief medical history: reported medical problems, currently use of medication and smoking habit; (iii) Denture hygiene practices: self-care of dentures, frequency of denture cleaning, and methods of denture cleaning.

Frequency tables were produced to determine prevalence of denture stomatitis according to *Newton's classification* and denture cleanliness based on the *Denture Cleanliness Index* ratings. Dentures were classified as 'very poorly cleaned' if they were judged to have 'visible plaque/debris covering >50% of the fitting surfaces of the denture' and/or 'presence of calculus'. Mean (SD), median (IQR) and range of percentage of plaque coverage were produced. Based on the frequency distribution of plaque coverage, dentures were categorized as having less than a third of their surfaces covered by plaque or not.

Reliability of denture stomatitis and *Denture Cleanliness Index* ratings was determined using *Kappa statistics*. Reliability of percentage of plaque coverage was determined using Spearman's correlation.

Bivariate analyses were conducted to determine variations in the prevalence of denture stomatitis and *Denture Cleanliness Index* ratings in relation to socio-demographic factors, medical histories and denture hygiene practices using *Chi-square statistics* to determine *p-values*. The *Chi-square test* is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories. Variations in percentage of plaque coverage with respect to socio-demographic factors, medical histories and denture hygiene practices were determined using the *Mann-Whitney U test* as the data of percentage of plaque coverage was not '*normally'* distributed. The *Mann-Whitney U test* is the non-parametric equivalent of the *t-test for independent samples* (used if the data is '*normally'* distributed). Bivariate analyses of percentage of plaque coverage categorized as greater than one third of denture surfaces or smaller than or equal to one third of the denture surfaces in relation to (i) socio-demographic factors, (ii) denture hygiene practices and (iii) medical histories were determined using *Chi-square statistics*.

Response rate to the project was determined from participation at follow-up compared to participation as baseline. The (i) prevalence of denture stomatitis, (ii) *Denture Cleanliness Index* ratings and (iii) percentage of plaque coverage categorized as greater than one third of denture surfaces, or smaller than or equal to one third of the denture surfaces; between baseline and follow-up was determined by *McNemar's tests* – which compares frequencies of related samples over two time points. A comparison of baseline and follow-up percentage of plaque coverage was determined by the *Wilcoxon signed-rank test,* a non- parametric equivalence of the *paired t-test for continuous related data* over t*wo time points.* Frequency tables were produced of compliance to the intervention.

5.0 RESULTS

5.1 Profile of elderly residents: demographics and medical history

Among the seven elderly residential centres visited, we have recruited 56 participants. The socio-demographic profile of participants is presented in *Table 5.1*; most were older than 80 years of age (80.4%, 45) and female (75%, 42). Approximately two-thirds (66.1%, 37) had been living in residential care for less than five years.

Table 5.1 Profile of the group– social demographics

		Percentage (number)
Age group		
	50-64 years	5.4% (3)
	65-80 years	14.3% (8)
	>80 years	80.4% (45)
Gender		
	Male	25% (14)
	Female	75% (42)
Length of time of residence		
	<5 years	66.1% (37)
	5-10 years	14.3% (8)
	>10 years	16.1% (9)
	Not sure	3.6% (2)

Approximately three in four (73.2%, 41) reported to have an underlying medical condition or physical/ cognitive deficit, *Table 5.2*. The most common medical problems reported were related to their cardiovascular system (53.6%, 30) and endocrine system (21.4%, 12). More than a third claimed to be taking medication at present (39.3%, 22) but none reported taking antibiotics or steroids currently. Approximately one in ten reported to be smokers (10.7%, 6). Among those who reported to smoke, all reported smoking for 5 years or more.

Table 5.2 Profile of the group– brief medical history and smoking habit

		Percentage (number)
Medical problems	*Any*	73.2% (41)
	Endocrine	21.4% (12)
	Respiratory	5.4% (3)
	Cardiovascular	53.6% (30)
	Immunological	5.4% (3)
	Physical	5.4% (3)
	Cognitive	7.1% (4)
	Others	14.3% (8)
Medication	*Yes*	39.3% (22)
	No	60.7% (34)
Smoker	*Yes*	10.7% (6)
	No	89.3% (50)

5.2 Profile of denture related factors among elderly residents

Most (82.1%, 46) reported that they had their denture for more than 5-years; 8.9% (5) for 3 to 4 years; 7.1% (4) for less than 2 years and one participant could not remember how long he/she had the denture for.

Most claimed to clean the dentures themselves (83.9%, 47). The vast majority claimed they cleaned their dentures in some form or another daily (82.1%, 46), one participant claimed he/she cleaned the denture almost every day; 7.1% (4) reported they cleaned their dentures at least once a week; two participants (3.6%) claimed they never cleaned their dentures and two (3.6%) participants could not recall how often they cleaned their dentures but not daily, *Table 5.3*.

There was a range of reported methods for cleaning the dentures; most commonly by rinsing with water (82.1%, 46) and by brushing their dentures (76.8% 43). Approximately a third (32.1%, 18) reported soaking their dentures in denture cleanser solution or in bleach (e.g. hypochlorite).

Table 5.3 Denture cleaning practices

		Percentage (number)
Self-clean denture	*Yes*	83.9% (47)
	No	16.1% (9)
Frequency of denture cleaning	*Everyday*	82.1% (46)
	Almost everyday	1.8% (1)
	At least once a week	7.1% (4)
	Less than once a week	1.8% (1)
	Never	3.6% (2)
	Not sure	3.6% (2)
Methods of cleaning*	*Bare hand*	5.4% (3)
	Cloth	8.9% (5)
	Water	82.1% (46)
	Toothbrush	76.8% (43)
	Soap/ detergent	5.4% (3)
	Hypochlorite (Clorox)	3.6% (2)
	Denture Cleanser	30.4% (17)
	Toothpaste	50% (28)
	Others	0.0% (0)

Multiple answers possible

5.3 Denture stomatitis and Denture Cleanliness Index ratings

On clinical examination most (82.1%, 46) had evidence of denture stomatitis.

Over forty percent had evidence of *Type I denture stomatitis* (42.9%, 24)- localized

inflamed sites or pinpoint hyperemia with evidence of erythematous areas. A quarter

had evidence (25.0%, 14) of *Type II denture stomatitis* - more diffuse erythematous

areas involving the oral mucosa covered by the denture; and 14.3% (8) had *Type III*

denture stomatitis - evidence of inflammatory papillary hyperplasia involving the hard

palpate and/or alveolar ridges, Table 5.4. The weighted *Kappa* value for agreement

between clinical photos and clinical assessments was 0.873.

T*able 5.4 Baseline denture stomatitis findings– Newton's Classification*

		Percentage (number)
Denture stomatitis	*Type I*	42.9% (24)
	Type II	25.0% (14)
	Type III	14.3% (8)
	No	17.9% (10)

Figure 5.1 Photographic images of denture bearing areas

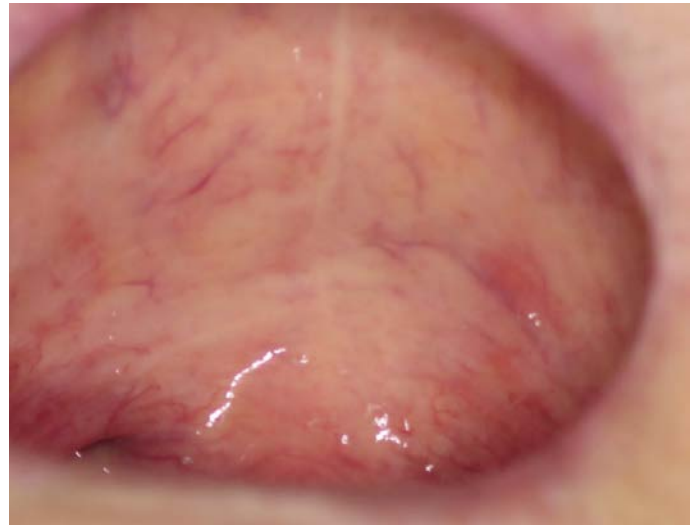**Figure 5.1a Newton's Type I**

Figure 5.1b Newton's Type II

Figure 5.1c Newton's Type III

Based on the *Denture Cleanliness Index* ratings, more than half (62.5%, 35) of the dentures were classified as '*very poorly cleaned*' – having evidence of calculus on the dentures (14.3%, 8) or having visible plaque, debris, and severe staining on more than 50% of the denture fitting surfaces (48.2%, 27), *Table 5.5*, *Figure 5.2*. Approximately a quarter (23.2%, 13) was categorized as '*poorly cleaned*' – having visible plaque, debris, and severe staining on 25%-50% of the denture fitting surfaces. Seven dentures (12.5%) were considered as '*visibly clean*' – with staining or detectable plaque covering less than 25% of the denture fitting surfaces. Only one denture (1.8%) was considered as '*very clean*' – no plaque visibly seen and no staining or plaque detected. The weighted *Kappa* value for agreement between digital images of dentures and DCI ratings was 0.764.

Figure 5.2 Images of dentures with Denture Cleanliness Index ratings
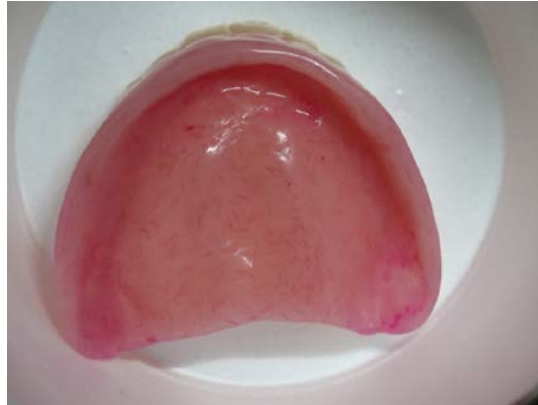
Figure 5.2a DCI Code 1

Figure 5.2b DCI Code 2
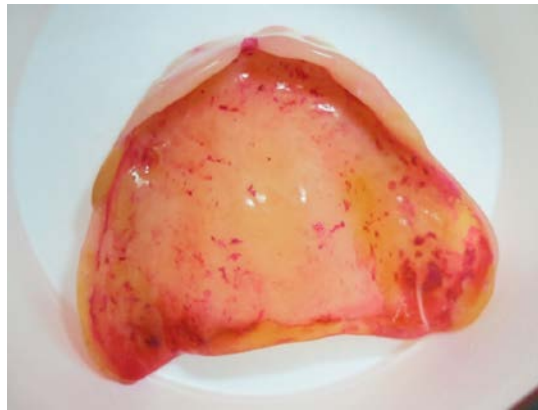
Figure 5.2c DCI Code 3
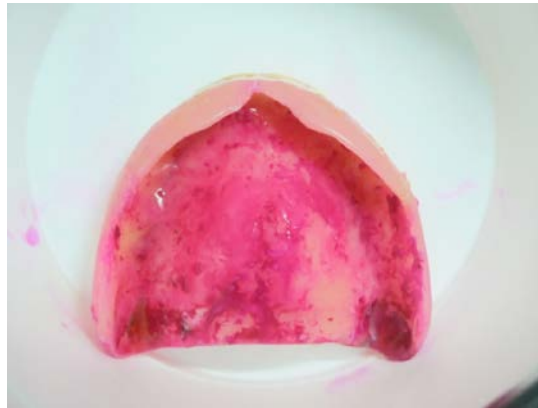
Figure 5.2d DCI Code 4
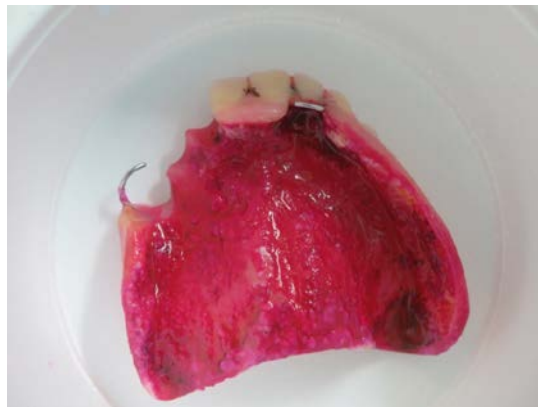
Table 5.5 Denture Cleanliness Index ratings at baseline

Denture Cleanliness Index ratings	Percentage (number)
'Very clean' *No plaque is visibly seen, no staining, no plaque detectable.*	1.8% (1)
'Visibly clean' *Denture is visibly clean. Little staining (<25% of fitting surface stained)*	12.5% (7)
'Poor denture cleaning' Denture has visible plaque and/or debris. Moderate staining on fitting surface. (25-50% fitting surface stained)	23.2% (13)
'Very poor denture cleaning' *Denture has visible plaque and/or debris. Severe staining on fitting surface. (> 50% fitting surface stained)*	48.2% (27)
'Calculus present' *Denture has visible calculus deposit, on any surface.*	14.3% (8)

The percentage of plaque coverage on the denture fitting surfaces from images analyzed by Photoshop according to the method described by Coulthwaite and Verran (2009) – planimetric assessments, ranged from 0.55% to 90.85%. The mean and median percentage of plaque coverage on the denture fitting surfaces were 28.11 (SD 19.64) and 21.92 (11.23, 41.04) respectively, *Table 5.6*. An example of image and histogram of plaque coverage is presented in *Figure 5.3*. Twenty-one dentures (37.5%) had plaque covering more than one third of the denture fitting surfaces. The Spearman's correlation value between assessments was 0.800, (P<0.001).

Table 5.6 Percentage of plaque coverage of the denture fitting surfaces

	% of Plaque coverage (*Planimetric assessments*)
Mean (SD)	28.11 (19.64)
Median (IQR)	21.92 (11.23, 41.04)
Range	0.55 - 90.85

Figure 5.3 Image and histogram of plaque coverage

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32
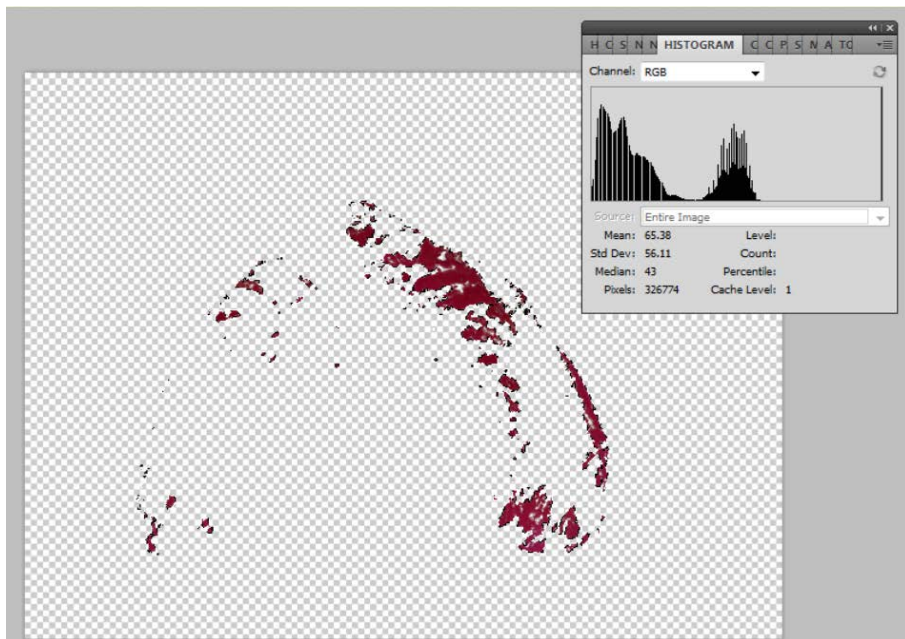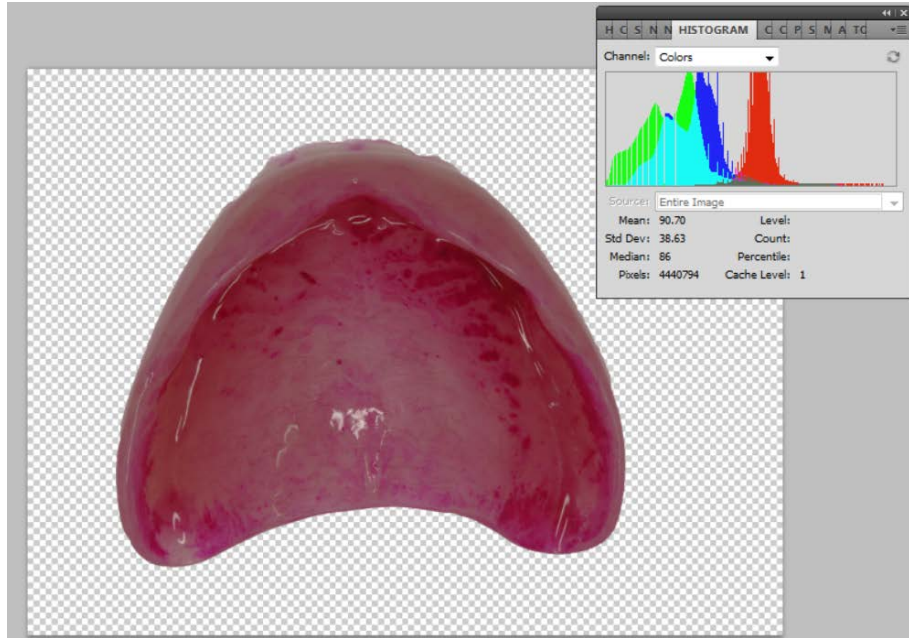
5.4 Associations between denture cleanliness, denture stomatitis and

percentage of plaque coverage.

Denture cleanliness was significantly associated with evidence of denture

stomatitis (p<0.05), *Table 5.7.* Among those who had evidence of denture stomatitis,

56.5% (26) of the denture were categorized as 'very poorly cleaned' (with calculus or

deposits on >50% of the denture fitting surface), while 43.5% (20) of the dentures

were rated as being cleaned better (poorly cleaned/ visibly clean/ very clean), *p<0.05.*

Table 5.7 Association between denture stomatitis and denture
cleanliness

	Denture stomatitis		
	Yes % (number)	No % (number)	*p-value**
Denture cleanliness			0.04
Very poor	56.5 (26)	90.0 (9)	
Not very poor	43.5 (20)	10.0 (1)	

*p-value derived from Chi-square statistics

Denture cleanliness was significantly associated with percentage of plaque coverage on denture fitting surface ($p<0.001$), *Table 5.8*. Among those whose dentures were rated as 'very poorly cleaned', the mean percentage of plaque coverage was 37.96 (SD 18.05) compared with 11.69 (SD 7.32) of those rated as 'not very poorly cleaned'. The percentage of plaque coverage on denture fitting surfaces was not significantly associated with evidence of denture stomatitis ($p>0.05$).

Table 5.8 Association between denture cleanliness and percentage of plaque coverage

	% of Plaque coverage Mean (SD)	*p-value**
Denture cleanliness		<0.001
Very poor	37.96 (18.05)	
Not very poor	11.69 (7.32)	
Denture stomatitis		0.727
Yes	28.00 (20.96)	
No	28.65 (12.63)	

*p-value derived from Mann Whitney U test (non-parametric equivalence of t-test)

5.5 Factors associated with denture stomatitis

Evidence of denture stomatitis was significantly associated with gender ($p<0.05$) but not significantly associated with other socio-demographic factors: age ($p>0.05$) or length of time in residential care ($p>0.05$), *Table 5.9*. Among those who had evidence of denture stomatitis, 80.4% (37) were female and 19.6% (9) were male. Equal proportion (50%, 5) of those without denture stomatitis was male and female.

Denture related factors were associated with evidence of denture stomatitis. Length of time they possessed the denture was significantly associated with evidence of denture stomatitis ($p<0.001$). All who had the dentures for more than 5 years had evidence of denture stomatitis whereas those with dentures for less than 5 years did not have evidence of denture stomatitis. Denture stomatitis was not significantly associated with reported self-cleaning of the denture ($p>0.05$), reported daily cleaning of the denture ($p>0.05$), the practice of soaking the denture in chemical solution ($p>0.05$) or having a defective denture ($p>0.05$). Denture stomatitis was not significantly associated with reported medical problems ($p>0.05$), use of medication ($p>0.05$) or smoking history ($p>0.05$).

Table 5.9 Factors associated with denture stomatitis at baseline

	Denture stomatitis		p-value*
	Yes % (number)	No % (number)	
Age			0.98
>80	80.4 (37)	80.0 (8)	
≤80	19.6 (9)	20.0 (2)	
Gender			
Male	19.6 (9)	50.0 (5)	0.04
Female	80.4 (37)	50.0 (5)	
Length of time of residence			0.31
<5 years	63.0 (29)	80.0 (8)	
≥5 years	37.0 (17)	20.0 (2)	
Length of time with denture			<0.001
<5 years	0 (0)	100.0 (10)	
≥5 years	100.0 (46)	0.0 (0)	
Self-clean denture			0.13
Yes	80.4 (37)	100.0 (10)	
No	19.6 (9)	0.0(0)	
Denture cleaning			0.85
Daily	82.6 (38)	80.0 (8)	
Not daily	17.4 (8)	20.0 (2)	
Soak denture			0.36
Yes	34.8 (16)	20.0 (2)	
No	65.2 (30)	80.0 (8)	
Defective denture			0.79
Yes	13.0 (6)	10.0 (1)	
No	87.0 (40)	90.0 (9)	

Table 5.9 Factors associated with denture stomatitis at baseline (cont'd)

	Denture stomatitis		p-value*
	Yes % (number)	No % (number)	
Medical problems			0.80
Yes	73.9 (34)	70.0 (7)	
No	26.1 (12)	30.0 (3)	
Medication			0.17
Yes	43.5 (20)	20.0 (2)	
No	56.5 (26)	80.0 (8)	
Smoker			0.94
Yes	10.9 (5)	10.0 (1)	
No	89.1 (41)	90.0 (9)	

*p-value derived from Chi-square statistics

5.6 Factors associated with denture cleanliness

Denture cleanliness was not significantly associated with socio-demographic factors: age ($p>0.05$), gender ($p>0.05$) or length of time in residential care ($p>0.05$), *Table 5.10*.

Denture cleanliness was significantly associated with denture related factors: presence of a denture defect ($p<0.05$) and the practice of soaking the denture in chemical solution ($p<0.01$), *Table 5.10*. All the detective dentures were found to be 'very poorly cleaned'. Among the dentures which were classified as 'very poorly cleaned', 82.9% (29) had not been soaked in chemical solution, compared with 17.1% (6) which had been soaked in chemical solution. In addition, a higher proportion of dentures which were classified as 'not very poorly cleaned' had been soaked in chemical solution (57.1%, 12), compared to those not soaking in chemical solution (42.9%, 9). Denture Index ratings was not significantly associated with the length of time they possessed the denture ($p=0.05$), reported practice of self-cleaning ($p>0.05$) or reported daily practice of self-cleaning ($p>0.05$).

Denture cleanliness was not significantly associated with reported medical problems (*p>0.05*), use of medication (*p>0.05*) or smoking history (*p>0.05*), *Table 5.10*.

Table 5.10 Factors associated with denture cleanliness

| | Denture cleanliness | | *p-value** |
	'Very poor' % (number)	'Not very poor' % (number)	
Age			0.93
>80	80.0 (28)	81.0 (17)	
≤80	20.0 (7)	19.0 (4)	
Gender			0.15
Male	31.4 (11)	14.3 (3)	
Female	68.6 (24)	85.7 (18)	
Length of time of residence			0.94
<5 years	65.7 (23)	66.7 (14)	
≥5 years	34.2 (12)	33.3 (7)	
Length of time with denture			0.05
<5 years	74.3 (26)	95.2 (20)	
≥5 years	25.7 (9)	4.8 (1)	
Self-clean			0.64
Yes	85.7 (30)	81.0 (17)	
No	14.3 (5)	19.0(4)	

Table 5.10 Factors associated with denture cleanliness (cont'd)

	Denture cleanliness		p-value*
	'Very poor' % (number)	'Not very poor' % (number)	
Denture cleaning			0.86
Daily	82.9 (29)	81.0 (17)	
Not daily	17.1 (6)	19.0 (4)	
Soak denture			0.002
Yes	17.1 (6)	57.1 (12)	
No	82.9 (29)	42.9 (9)	
Defective denture			0.03
Yes	20.0 (7)	0.0 (0)	
No	80.0 (28)	100.0 (21)	
Medical problems			0.82
Yes	74.3 (26)	71.4 (15)	
No	25.7 (9)	28.6 (6)	
Medication			0.32
Yes	34.3 (12)	47.6 (10)	
No	65.7 (23)	52.4 (11)	
Smoker			0.27
Yes	14.3 (5)	4.8 (1)	
No	85.7 (30)	95.2 (20)	

*p- value derived from Chi- square statistics

5.7 Factors associated with percentage of plaque coverage

Percentage of plaque coverage on denture fitting surface was not significantly associated with socio- demographic factors: age ($p>0.05$), gender ($p>0.05$) or length of time in residential care ($p>0.05$), *Table 5.11*.

Percentage of plaque coverage on denture fitting surface was significantly associated with denture related factors: presence of denture defects ($p<0.05$) and practice of soaking denture in chemical solution ($p<0.05$), *Table 5.11*. Percentage of plaque coverage was not significantly associated with the length of time they possessed the denture ($p>0.05$), reported practice of self-cleaning ($p>0.05$) or reported daily practice of self-cleaning ($p>0.05$).

Percentage of plaque coverage on denture fitting surfaces was not significantly associated with reported medical problems ($P>0.05$), use of medication ($P>0.05$) or smoking history ($P>0.05$), *Table 5.11*.

Table 5.11 Factors associated with the percentage of plaque on denture fitting surface

	% of Plaque coverage Mean (SD)	*p-value**
Age		1.00
>80 (n=45)	28.21 (20.72)	
≤80 (n=11)	27.70 (15.24)	
Gender		0.36
Male (n=14)	35.87 (23.39)	
Female (n=42)	25.53 (17.79)	
Length of time of residence		1.00
<5 years (n=37)	29.17 (20.27)	
≥5 years (n=19)	26.04 (18.70)	
Length of time with denture		0.73
<5 years(n=10)	28.65 (12.63)	
≥5 years (n=46)	28.00 (20.96)	
Self-clean denture		1.00
Yes (n=47)	29.20 (20.31)	
No (n=9)	22.44 (15.37)	
Clean everyday		0.73
Yes (n=46)	27.16 (18.50)	
No (n=10)	32.48 (24.91)	
Soak denture		0.04
Yes (n=18)	18.88 (15.91)	
No (n=38)	32.50 (19.90)	

Table 5.11 Factors associated with the percentage of plaque on denture fitting surface (cont'd)

	% of Plaque coverage Mean (SD)	p-value*
Denture defect		0.02
Yes (n=7)	44.88 (14.96)	
No (n=49)	25.72 (19.16)	
Medical condition		0.55
Yes (n=41)	27.32 (20.24)	
No (n=15)	30.28 (18.39)	
Medication		0.41
Yes (n=22)	21.53 (13.61)	
No (n=34)	32.37 (21.85)	
Smoker		0.66
Yes (n=6)	36.54 (30.40)	
No (n=50)	27.10 (18.14)	

p-value derived from Mann-Whitney U tests (non-parametric equivalence to t-test)

5.8 Response rate and adherence to the intervention

More than 90% completed the study (91.1%, 51). Among those who completed the study, there was a high level of compliance with cleaning instructions given – cleaning the denture with the soft tooth brush provided and soaking the denture in Polident®, 78.8% (41/52). Most (88.5%, 46/52) reported cleaning their denture every day or almost every day.

5.9 Changes in prevalence of denture stomatitis

There were significant changes in the prevalence of denture stomatitis following the intervention. At baseline, 86.3% (44) had evidence of denture stomatitis whereas at follow up 56.9%(29) had evidence of denture stomatitis, (*p<0.01*), *Table 5.12*. Variations in type of denture stomatitis was also evident (*p<0.05*); with reductions in each type of denture stomatitis. For example, prevalence of *Type III* denture stomatitis reduced from a prevalence of 15.7% to 11.8%, Type II denture stomatitis reduced from 25.5% to 13.7% and Type I denture stomatitis reduced from 45.1% to 31.4%.

Table 5.12 Comparison of prevalence of denture stomatitis before and after intervention

	Baseline % (number)	Follow-up % (number)	p-value*
Denture stomatitis			0.003
No	13.7 (7)	43.1 (22)	
Yes	86.3 (44)	56.9 (29)	
Type of denture stomatitis			0.045
No	13.7 (7)	43.1 (22)	
Type I	45.1 (23)	31.4 (16)	
Type II	25.5 (13)	13.7 (7)	
Type III	15.7 (8)	11.8 (6)	

*p-value derived from McNemar test (related samples over time)

5.10 Changes in prevalence of denture cleanliness

There were significant changes in the denture cleanliness following the intervention programme; at baseline, 64.7% (33) were classified as 'very poorly cleaned' (plaque covering >50% of the denture fitting surfaces or evidence of calculus) whereas at follow-up, 41.2% (21) were classified as 'very poorly cleaned', (*p<0.05*), *Table 5.13*. Variations in specific Denture Cleanliness Index ratings on denture cleanliness were also evident (*p<0.05*); with a reduction in 'presence of calculus' from 13.7% (7) at baseline to 2% (1) at follow-up. There was also a reduction in prevalence of dentures rated as having more than 50% of plaque coverage: 51.7% (26) at baseline compared to follow up: 39.2% (20). There was an increase in the prevalence of dentures classified as clean (<25% plaque coverage) from 7.8% (4) at baseline to 31.4% (16) at follow-up.

Table 5.13 Comparison of denture cleanliness before and after intervention

	Baseline %(number)	Follow-up % (number)	*p-value**
Denture cleanliness			0.017
Very Poor	64.7 (33)	41.2 (21)	
Not Very Poor	35.3 (18)	58.8 (30)	
Denture Cleanliness Index ratings (Plaque coverage)			0.043
'Very clean'	2.0 (1)	2.0 (1)	
'Visibly clean' (< 25%)	7.8 (4)	31.4 (16)	
'Poor denture cleaning' (25-50%)	25.5 (13)	25.5 (13)	
'Very poor denture cleaning' (> 50%)	51.7 (26)	39.2 (20)	
Calculus	13.7 (7)	2.0 (1)	

*p-value derived from McNemar test (related samples over time)

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5.11 Changes in percentage of plaque coverage on dentures fitting surfaces

There were no significant differences in the percentages of plaque coverage following the intervention; at baseline, the mean value was 28.61 (SD 19.32) and at follow-up it was 23.30 (SD 17.71); median values were also similar, 22.44 (IQR 13.48, 40.90) at baseline compared to 22.46 (IQR 10.67, 32.97) at follow-up, (*p>0.05*), *Table 5.14*. Among those who completed the study, at baseline 37.3% (19) had plaque coverage on more than one third of the denture fitting surfaces whereas at follow-up, 23.5% (12) had plaque coverage on more than one third of the denture fitting surfaces, (*p>0.05*).

Table 5.14 Percentage of plaque coverage before and after intervention

	Baseline	Follow-up	*p-value**
Denture cleanliness			0.063
Mean (SD)	28.61 (19.32)	23.30 (17.71)	
Median (IQR)	22.44 (13.48, 40.90)	22.46 (10.67, 32.97)	

*p-value derived from Wilcon Signed Rank test (non-parametric equivalence of paired t-test)

6.0 DISCUSSION

Hong Kong's population, like many developed countries, is ageing rapidly and it is estimated that about 10% of the population over the age of 65 live in non-domestic households – mainly in homes for the aged (Census and Statistics Department, 2011). The participants for our community health project were typically above 80 years of age, female and had been living in care homes for less than 5 years. This corresponds to reports that with advancing age, there is an increasing proportion of those living in residential care.

Not surprisingly, most participants (approximately three-quarters) reported a physical, medical or cognitive impairment. The most common medical problem reported was cardiovascular disease (54%). This corresponds to findings of the thematic household survey of 2009 which reported that 58% of institutionalized elders had hypertension (Census and Statistics Department, 2009). Approximately one in five of our participants reported having endocrinal problems such as diabetes – a similar prevalence to what was observed in the thematic survey (Census and Statistics Department, 2009). However given that the care homes selected participants on the basis of being 'well enough' to participate in the project it is likely that our participants underrepresented those with cognitive deficits.

In terms of denture cleaning practices, the vast majority (~90%) claimed to take care of their denture themselves and reported to do so daily (~80%). This corresponds to findings in Australia, where 85% of residents in aged care facilities in New South Wales reported that they did not need assistance with denture hygiene (Webb et al., 2015). Methods for cleaning their dentures varied widely, highlighting a lack of guidelines for denture hygiene practice within elderly residential care homes, and potentially the lack of customized instructions on how to care for their denture, which has also been reported in other settings (Peracini et al., 2010). The practice of 'brushing' the denture clean was commonly reported (by ~ three quarters) and approximately a third reported to 'soak' their dentures in some form of chemical solution – most frequently with the use of denture cleanser tablets.

Approximately four in five of the participants had evidence of denture stomatitis but mostly Type I – localized areas of erythema. A quarter had evidence of generalized erythema involving the denture bearing area and approximately 15% had evidence of hyperplasia of the palate or alveolar ridges. An epidemiological review of denture stomatitis estimated its prevalence to be between 15% to over 70% (Gendreau and Loewy, 2011). However, estimates of the prevalence of denture stomatitis vary among studies and this in part may be related to differences in criteria

of assessments, study population and study settings (Martori et al., 2014; Atashrazm and Sadri, 2013; Mozafari et al., 2012). Denture stomatitis was associated with how long participants have had their denture, with all those who reported to have their dentures for more than 5 years having evidence of denture stomatitis. Others have also reported significant associations between denture stomatitis and length of time elders possess their dentures for (Mandali et al., 2011; Coelho et al., 2000).

More than half (62.5%) of the dentures were classified as 'very poorly cleaned' – with evidence of calculus or plaque/ debris/ staining covering more than 50% of the denture fitting surfaces. Reports of denture cleanliness among older population vary and this again is likely to be attributed to method of assessment of denture cleanliness, study population and study setting. An audit of denture cleanliness at a general practice in England reported a poorer denture cleanliness using *the Denture Cleanliness Index* ratings - 84% had a DCI ratings of greater than 2 (Mylonas et al., 2014). Denture cleanliness was significantly associated with reported practice of soaking the denture in a chemical solution, which suggests the value of this cleaning method as has been proposed in the literature (Jagger and Harrison, 1995). Of note *Denture Cleanliness Index* ratings was also associated with the presence of denture defects suggesting that defects may harbour plaque.

In our project we also considered a quantitative method of denture cleanliness by employing methods and criteria of Coulthwaite and Verran (2009), in an attempt to provide a more objective assessment of denture cleanliness, based on planimetric (area measurement) assessment of percentage of stained plaque coverage on denture fitting surfaces. The mean and median values were relatively low at 29.11 and 21.92 respectively but variation in values were large (as evident by the large standard deviation and associated interquartile range). Although the subjective assessment based on the *Denture Cleanliness Index* ratings was significantly associated with planimetric values, their ratings are different, thus it is suggested to include two or more measures when assessing denture cleanliness. Planimetric values of plaque coverage were also associated with the practice of soaking the denture in a chemical solution and presence of denture defects (similar to the findings of associations with the *Denture Cleanliness Index*).

The response rate to the denture hygiene intervention programme was high with more than 90% attending for follow-up assessments, in addition, compliance was high. This highlights the feasibility of conducting community based knowledge exchange programme among institutionalized elders.

After the 6-week intervention, there was significant difference in the prevalence of denture stomatitis at follow-up compared to baseline supporting its value. In addition, there was a reduction in all types of denture stomatitis. However, evidence of denture stomatitis remained common with more than half of participants still having evidence of some form of denture stomatitis. Almost a quarter still had evidence of generalized erythematous areas and/or hyperplasia relating to the denture bearing areas. Denture stomatitis is a multifactorial disease and it is important to consider other potential contributing factors (Lombardi and Butz-Jorgensen, 1993). We observed that the length of time they possessed the denture was associated with evidence of denture stomatitis. Dentures used for more than five years are likely to have deficiencies in retention and stability, in addition to problems with vertical dimensions and overall occlusion – factors reported to contribute to denture stomatitis (Fenlon et al., 1998). The underlying established bacterial and fungal infections warrant consideration and the effect of denture hygiene intervention programme maybe limited in this regard, particularly the effect on underlying systemic factors (Preshaw et al., 2011). The role of topical application of nystatin or miconazole has been advocated when yeasts have been isolated or when lesions do not resolve to denture hygiene instructions. However, findings from a Cochrane review suggest that

while there is support for antifungals in terms of microbiological outcomes, evidence in terms of clinical outcomes is limited (Emami et al., 2014).

There was also an observed improvement in denture cleanliness following the denture hygiene intervention programme. At baseline, almost two-thirds of the dentures were classified as 'very poorly cleaned', compared to approximately 40% at follow up. There was also a significant change in the profile of the *Denture Cleanliness Index* ratings. In particular a dramatic reduction in prevalence of calculus on the dentures was evident, from approximately 14% at baseline to 2% at follow-up. In contrast, findings of a study of toothbrush/paste and brush/soap failed to identify significant changes in calculus deposit removal (McCabe et al., 1995).

The role and assistance of caregivers in residential settings should not be underestimated. As highlighted by findings from a systematic review and meta-analysis of the effect of oral health education programme for caregivers on oral hygiene, there were notable improvements in visible plaque and denture stomatitis (Wang et al., 2015).

7.0 CONCLUSIONS AND IMPLICATIONS

1. The prevalence of denture stomatitis among participants of our community health project was high affecting four out of five participants. This highlight the importance of monitoring and managing denture related infection among older people in residential care. Denture stomatitis is likely to have implications for comfort, ability to wear dentures and denture function, with ultimate consequences affecting their daily life and quality of life.

    In our project, presence of denture stomatitis was associated with the length of time they possessed the dentures. Given that most of the elders (four in five) possessed their dentures for more than five years, it would be important to consider denture retention, stability, vertical dimensions and overall occlusion as these may contribute to denture stomatitis. It is recommended that all elderly (including those who are edentulous) have an oral examination annually. Timely adjustments and replacement of dentures are important for function and could reduce the likelihood of infections. The proposed government oral health care services through the Elderly Health Care Voucher Scheme are likely to assist in this regard.

2.   Qualitative assessment of denture hygiene by means of the *Denture Cleanliness Index* suggested that almost two thirds of dentures were 'very poorly cleaned'. Quantitative assessments by the planimetric method suggested that dentures were somewhat cleaner with approximately four in ten of the dentures having plaque covering more than one-third of the fitting surfaces. Qualitative and quantitative assessments were significantly associated but qualitative assessment, being subjective in nature, may overestimate the lack of denture cleanliness. In addition, the findings suggest quantitative assessments as a potential tool for caregivers in elderly homes to monitor denture cleanliness, by simply taking digital images of dentures without dentist involvement. Further exploration of this quantitative method of denture cleanliness is warranted.

Denture cleanliness was significantly associated with denture stomatitis highlighting the importance of denture hygiene as a contributing factor to infection. The length of time they possessed the denture and presence of defects were associated with denture cleanliness, thus maintaining and replacing dentures in a timely manner is important. The proposed government oral health care services through the Elderly Health Care Voucher Scheme are likely to assist in this regard.

3. The reported practice of soaking the denture in a chemical solution was associated with denture cleanliness highlighting the potential effectiveness of this relatively simple and inexpensive method which formed the basis of our intervention.

4. There was a statistically significant difference in the prevalence of denture stomatitis following the denture hygiene intervention programme, a reduction from 86.3% to 56.9% over the 6-week period. However, denture stomatitis remained common and approximately a quarter had generalized erythematous areas and/or hyperplasia relating to the denture bearing areas at the 6-week review. The value of a longer term intervention is warranted. It should be borne in mind that denture hygiene intervention alone may have a limited effect as denture stomatitis is a multifactorial disease. Where denture hygiene programmes do not improve denture stomatitis considerably, consideration for denture related factors, systemic health, and the microbiology of infection should be investigated and managed. The role of topical application of nystatin or miconazole, when yeasts have been isolated or when lesions do not resolve to denture hygiene programmes, maybe warranted.

5. There was a statistically significant difference in the prevalence of dentures rated as 'very poorly cleaned' following the denture hygiene intervention programme, a reduction from 64.7% to 41.4% over the 6-week period. However, no significant mean change in planimetric plaque values (quantitative assessment of denture cleanliness) was observed. Nonetheless, at this stage it would seem prudent to consider both qualitative and quantitative assessments of denture hygiene when assessing and monitoring denture cleanliness over time. It would also be useful to consider the impact of repeated denture hygiene instruction within denture hygiene interventions programme. Furthermore, the role of caregivers involvement at improving denture hygiene is warranted. Ultimately, establishing guidelines and best practices for denture hygiene within residential homes would be useful.

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Appendix 1

敬啟者：

<u>推廣假牙護理知識和研究計劃</u>

我們是香港大學牙科學系四年級學生，希望到訪貴院推廣護理假牙的知識，與此同時希望透過此推廣計劃進行大學學術研究。此計劃目的除了可增加護理員及長者對護理假牙的認識外，更可以令長者健康能夠得到多一重的保障。

由於長者和護理員普遍對假牙護理缺乏認識，部分長者亦因行動不便以致難以自理保持假牙衛生，導致口腔衛生欠佳。而有研究報告指出，口腔衛生欠佳會令長者較容易患上吸入性肺炎，因此推廣假牙護理知識實屬刻不容緩。我們希望透過講座和示範教導護理員和長者，使他們對口腔和假牙護理有更深入的認識，而提升長者的健康水平。

貴院多年來都為長者提供無微不至的服務，為關懷長者作出無窮貢獻，所以我們特意挑選了貴院進行此計劃推廣和研究，希望能攜手為長者提供更優質和健康的生活。此外，貴院如能參與大學研究計劃，亦能協助本地學術界跨前一大步。希望貴院接受我們的邀請參加此推廣和研究，為長者和學術盡一點綿力。

如有任何疑問或有興趣參與此計劃，歡迎電郵至 group4.1chp2014@gmail.com 聯絡此計劃的負責人黎智峰（電話: 67068921），或致電 28590295 聯絡此計劃的負責教授 Professor Colman McGrath。

香港大學牙科學生
黎智峰謹啓
二零一四年十二月十日

Dear Sir/Madam,

We are a group of senior dental students studying in the University of Hong Kong. As partial fulfillment for the degree of Bachelor of Dental Surgery, we are required to conduct a dental community health project.

Increasing public health concerns are the denture hygiene of older people, who for multiple reasons have difficulties in maintaining denture hygiene. Poor denture hygiene not only has implications for oral health but may also affect systemic health, leading to, in some cases, aspiration pneumonia which may be life-threatening.

We will provide an oral health promotion to assist caregivers of older people at your institution, and we cordially invite you to participate in our project.   Please feel free to contact us by email: group4.1chp2014@gmail.com to contact our project coordinator Dominic Lai (Tel: 67068921), or call our project supervisor Professor Colman McGrath Tel: 2859029.

Thank you for your kind attention and we are looking forward to your favorable reply.

Yours faithfully,
Dominic Lai
Group 4.1, BDS IV
HKU

Appendix 2

<u>口腔健康研究計劃問卷</u>

<u>假牙衛生：</u>

1. 你已佩戴假牙多久？

<1 年 □　　1 至 2 年 □　　3 至 4 年 □　　5 年或以上 □

2. 你的假牙是否由你自己清潔？

是 □　　否 □（由 _____ 清潔 ）

3. 你清潔假牙的次數？

每天 □　　幾乎每天 □　　至少每週一次 □　　少於每週一次 □　　從不 □

4. 你通常怎樣清潔假牙？（可選擇多項）

雙手 □　布或毛巾 □　　清水 □　　牙刷 □　　肥皂／清潔劑 □　　漂白水 □

假牙清潔片 □

其他 □：_____

<u>個人病歷：</u>

5. 你有否吸煙？

有 □（每天包數：_____ 吸煙年數：_____ ） 沒有 □

6. 你有沒有以下系統性長期疾病？（可選擇多項）

內分泌疾病（例如：糖尿病） □　呼吸系統疾病 □　　心血管疾病 □　　免疫系統疾病 □

運動系統 □

認知性疾病 □　　其他 □：_____

7. 你是否正服食以下藥物？（可選擇多項）

類固醇 □　　長期性抗生素 □　　其他 □：_____

64

個人資料：

8. 年齡

<50 歲 □　　50 至 64 歲 □　　65 至 80 歲 □　　>80 歲 □

9. 性別

女 □　　男 □

10. 你已住在院舍多久？

<5 年 □　　5 至 10 年 □　　>10 年 □

Oral health project questionnaire

Denture hygiene:

1. How long have you been wearing a denture? :

<1 year □   1-2 years □   3-4 years □   5 years or more □

2. Typically do you clean your denture <u>yourself</u>? :

Yes □   No □ (by: _____)

3. How frequent is your denture cleaned? :

Everyday □   Almost everyday □   At least once a week □

Less often than once a week □   Never □

4. Usually how is your denture cleaned? (Multiple responses possible)

Bare hand □   Cloth □   Water □   Toothbrush □   Soap /detergent □

Hypochlorite (Clorox) □   Denture cleaning tablet □   Others □ : _____

Medical history:

5. Do you smoke? :

Yes □ (Pack/day: _____ Years:_____)   No □

6. Do you have any of the following medical problems? : (Multiple responses possible)

Endocrinal (Diabetes mellitus) □   Respiratory □   Cardiovascular □

Immunological □   Physical □   Cognitive □   Others □ : _____

7. Are you currently taking any of the following drugs? : (Multiple responses possible)

Steroid □   Long term antibiotic □   Others □:_____

Background information:

8. What age are you? :

<50 years □   50-64 years □   65-80 years □   >80 years□

9. Gender:

Female □   Male □

10. How long have you lived in residential care? :

5 years □   5-10 years □   >10 years □

Clinical assessment form

1. Denture stomatitis (*Newton's classification*)

     Yes (Type: 1   2   3)□   No□

Ref:

	Newton's Classification of Denture Stomatitis
Type I	A localized simple inflammation or pinpoint hyperemia
Type II	An erythematous or generalized simple type seen as more diffuse erythema involving a part or the entire denture covered mucosa
Type III	A granular type (inflammatory papillary hyperplasia) commonly involving the central part of the hard palate and the alveolar ridges.
None	Absence of signs associated with Type I-III

2. *Denture Cleanliness Index* ratings

       0   1   2   3   4   *

Ref:

0	Clean denture. No plaque is visibly seen, no staining, no plaque detectable.
1	Denture is visibly clean. Little staining. (<25% fit surface stained)
2	Denture has visible plaque and/or debris. Moderate staining of fit surface. (25-50% fit surface stained)
3	Denture has visible plaque and/or debris. Severe staining of fit surface (>50% fit surface stained)
4	Denture has visible calculus deposit, on any surface.