A scoping review of the use of fluoride varnish in elderly people living in long term care facilities

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ABSTRACT

Elderly people living in long term care facilities are at an increased risk of developing coronal and root caries due to limited mobility, side effects of medications, denture wearing and other factors. Fluoride varnish may be effective in preventing and arresting coronal and root caries in this population. **Objective:** The purpose of this paper is to examine the literature on the use of fluoride varnish in elderly people living in long term care facilities. **Methods:** Six key electronic databases were searched (Medline, EMBASE, CINAHL, Cochrane, BioMed Central and health-evidence.ca), and the titles and abstracts were screened. Those that met inclusion criteria were retrieved and key findings were extracted. **Results:** Seven hundred and ninety-nine citations were identified, and 10 papers, six clinical trials, and four systematic reviews met the inclusion criteria for the review. Data regarding effectiveness of fluoride varnish applications were extracted into tables. The application of fluoride varnish in elderly people living in long term care facilities who receive regular professional prophylaxis has demonstrated effectiveness in controlling coronal and root caries; however, it is less efficient in those with poor oral hygiene. **Conclusion:** Further research needs to be focused on ways of improving the oral hygiene of elderly in long term care facilities so that fluoride varnish can be effective in the reduction of coronal and root caries. Collaboration between long term care facilities and oral health professionals is necessary to achieve maximum benefit from fluoride varnish and for improved oral health of residents.

RÉSUMÉ

Les personnes âgées demeurant dans les établissements de soins prolongés risquent davantage de développer des caries de la couronne ou de la racine à cause d'une mobilité réduite, des effets secondaires des médicaments, du port d'un dentier et d'autres facteurs. Le vernis fluoré peut être efficace pour prévenir et arrêter les caries de la couronne ou de la racine chez cette population. **Objet :** Examen de la littérature sur l'utilisation du vernis fluoré chez les personnes âgées dans les établissements de soins prolongés. **Méthodes :** Recherche dans six bases de données clés (*Medline, EMBASE, CINAHAL, Cochrane, BioMed Central et health-evidence.ca*), vérification des titres et résumés, retenue des bases de données qui répondaient aux critères d'inclusion et extrait des données clés. **Résultats :** Sept cent quatre-vingt-dix-neuf citations ont été relevées et 10 articles, six essais cliniques et quatre examens systématiques répondaient aux critères d'inclusion pour l'étude. Les données portant sur l'efficacité du vernis fluoré ont été extraites sous forme de tableaux. L'application du vernis fluoré chez les personnes âgées des établissements de soins prolongés, qui recevaient une prophylaxie professionnelle régulière, s'est avérée efficace pour maîtriser les caries de la couronne et de la racine; toutefois, elle était moins efficace chez les personnes qui avaient une pauvre hygiène buccale. **Conclusion :** D'autres recherches seront nécessaires pour cibler les façons d'améliorer l'hygiène buccale des personnes âgées des établissements de soins prolongés et/w réduire les caries de la couronne et de la racine. La collaboration entre les établissements de soins prolongés et les autres professionnels des soins buccaux s'avère nécessaire pour obtenir le meilleur résultat possible du vernis fluoré et améliorer la santé buccale des résidents.

Key words: long term care, aged, fluoride varnishes, dental caries prevention and control

BACKGROUND

The elderly population is increasing worldwide, and it is estimated that by 2036, the number of people aged 65 and over is expected to double to reach 10.4 million.[1] Caries is a dental disease that affects all individuals, but studies show that elderly people living in long term care (LTC) facilities have a higher incidence of caries compared to elderly living at home.[2] Fluoride varnish has demonstrated positive results in caries reduction with other age groups and further research on the use of fluoride varnish on elderly people living in LTC facilities is needed, given the complexity of the problem, the high incidence of caries in this population, and the limited research currently available.

Due to better dental health care, elderly people are experiencing a greater retention of teeth, which implies an increased number of exposed root surfaces that are susceptible to caries.[3] The cause of coronal and root caries is multifactorial and includes such contributing factors as dietary habits, microbial plaque, long term medications, and xerostomia.[4,5] Studies also indicate that with age, the oral microflora changes can possibly be linked to impaired immune function, increased yeast colonization, and denture wearing.[3] Root caries lesions are often very difficult to restore due to location, problems with moisture control, and proximity to the pulp, and are therefore prone to high recurrence.[5]

There is a high incidence of caries in elderly people living in LTC facilities. Saub and Evans[6] found that 46 per cent

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of elderly residents in a LTC facility required at least one restoration for coronal caries and 30 per cent required at least one restoration for root caries. Hand, Hunt and Beck[2] compared the incidence of caries among school aged children to elderly people, and to that of elderly people living in LTC facilities. Their study found that school aged children had an average annual caries increment of no more than one surface per year, compared to 1.44 surfaces per year found in the elderly population, and compared to 1.90 surfaces per year in institutionalized elderly persons.[2]

Currently there is not much research on the use of fluoride varnish with elderly LTC residents. It has been demonstrated that the use of fluoride varnishes decreases the acidic environment caused by plaque, reverses early decay, and may promote the remineralization of tooth enamel and decrease tooth sensitivity.[7] These studies have been primarily conducted on children and adults, but due to the difference in factors such as lifestyle, medications, immune function, and so on, the findings cannot be directly transferred to elderly patients in general, and especially not to those living in LTC facilities.[3,4,7]

Elderly people living in LTC facilities are retaining their natural teeth, and studies have shown that caries is the major cause of tooth loss in elderly individuals with physical and mental disabilities.[8,9] About six per cent of the population older than 65 years in most Western countries live in LTC facilities.[10] These individuals are more prone to caries compared to elderly individuals who live independently.[9] In one Canadian study, almost three quarters of the elderly participants living in LTC facilities developed one or more carious lesions compared to about two-thirds of those who lived independently.[9]

The reason for the high prevalence of dental caries in this population is usually associated with many factors such as an increase in health problems, disability, and limited dexterity which makes oral hygiene difficult and indirectly influences caries resistance factors.[8,11] When this is coupled with low compliance, excessive consumption of sugar, and side effects of medications such as xerostomia, the levels of cariogenic bacteria increases, and increases their risk for coronal and root caries, as well as periodontal disease.[10–12] Denture wearing has also been shown to increase the number of microorganisms in healthy individuals.[12]

Caries in any age group can impact nutritional habits and overall comfort, but it can be particularly damaging to the systemic health of frail elders.[10] In many cases, elderly people may have dental pulp tissue that is calcified due the deposition of secondary dentin, which can prevent pain signals from being felt when there is an active carious lesion.[9] This may cause the lesion to go unnoticed, allowing it to extend over the entire coronal and/or root surface, causing extensive structural damage.[9] When many teeth are affected, the restoration and replacement of teeth may not always be an option due to limited access to dental services and financial constraints; resulting in chewing difficulties and facial disfigurement.[9,11] In many cases, teeth are extracted due to extensive caries progression which can have a great impact on appearance, speech, and overall well being.[9] It is therefore critical that treatment strategies are based on the prevention and remineralization of incipient caries, and are not dependent on high patient compliance due to limited dexterity and low motivation.[11] Based on studies performed on this population, fluoride varnish may be one of the solutions.[11]

Many studies have shown the benefits of fluoride, "which has a caries inhibiting effect on enamel, dentin and root surfaces, and retards demineralization and promotes remineralization of enamel, dentin and cementum".[11] Fluoride varnish has been shown to be more successful in the prevention of coronal and root caries compared to other topical fluorides.[11]

The need for research on the outcomes of using of fluoride varnish on elderly individuals living in LTC facilities is critical. The growing number of individuals who reside in LTC facilities is increasing and many have retained much of their existing dentition, yet little research has been conducted on how to control the high incidence of dental caries in this population.[2,7]

Review question

Caries is a common dental disease among elderly people living in LTC facilities, and to date, there is a lack of research showing the effects of using fluoride varnish to reduce coronal and root caries in this population. Our review sought to examine what is known about the effectiveness of fluoride varnish in the prevention of coronal and root caries in elderly people living in LTC facilities.

METHODS

This scoping review involved searching six key databases, Medline, EMBASE, CINAHL, Cochrane Database of Systematic Reviews (DSR), BioMed Central, and Health-Evidence.ca. The six databases were searched using MeSH (Medical Subject Headings) and key terms in the following ways:

Search terms

- fluoride varnish AND oral health OR oral hygiene
- oral care, mouth hygiene, oral hygiene care
- carie* AND home aged
- elder* AND nursing home*, long*term care
- fluoride varnish AND dental health OR oral health AND elderly AND nursing homes
- fluoride varnish AND caries

Limiters

- 65+ years
- fluoride varnish NOT child*
- limit "all aged (65 and over)"
- infirm patients, oral hygiene
- fluoride varnish nursing home NOT child*
- fluoride varnish AND institutionaliz* OR long term OR nurs* home OR residential facility AND oral dental AND carie* AND elderly

The MeSH terms and subheadings, truncations, and mapping were adapted as appropriate for the various databases. See Table 1.

The titles of the studies retrieved from this search underwent a preliminary review in order to identify

which articles met inclusion criteria. Papers were selected based on whether the combination of words appeared in the title or anywhere in the paper. Our inclusion criteria related to the effects of fluoride varnish in people living in LTC facilities, articles that did not pertain to this topic were excluded, with the exception of two high quality systematic reviews[13,14] that provided useful information about the effects of fluoride varnish compared to other forms of fluoride.

Titles resulting from the database searches were screened by the first author and this process was reviewed by one of the co authors. Once abstracts were reviewed, articles meeting inclusion criteria were retrieved and read. Data relating to author, date of publication, country of study setting, study population and setting, intervention(s), and results were extracted into two tables according to research method, namely clinical trials and systematic reviews. Data extraction was completed by the first author, and reviewed and verified by the co authors. Since this is a scoping review, quality assessment was not performed.

RESULTS

From the 799 citations originally retrieved, 173 titles remained once duplicates were removed. These titles were screened and sixteen were selected for abstract review.[2,4,6,8–20] Once abstracts were reviewed and compared to inclusion criteria, twelve articles were retrieved and read, with ten articles remaining in the final set—six clinical trials[8,10–12,15,16] and four systematic reviews.[13,14,17,18] See the flow chart in Figure 1. Data were extracted into two tables corresponding to research method, namely clinical trials and systematic reviews. Data extracted are presented below with characteristics of author, date of publication, country of study setting, study population and setting, intervention(s), and results (Tables 2 and 3).

A systematic review by Marinho[13] on children and adolescents evaluating the effect of adding topical fluoride therapy in the form of mouthrinses, gels, or varnishes in conjunction with the use of fluoride toothpaste, found that there was a decrease in caries rate by 10% on average. When comparing which topical fluoride had the greatest caries reduction (mouthrinses, gels, or varnishes), fluoride varnish had a greater effect in caries prevention.[13] Studies by Persson[12] and Potter[15] conducted on institutionalized elders found that neither 0.068% sodium fluoride gel nor 0.4% SnF_2 rinse was effective in neutralizing dental plaque.

Many studies have evaluated the benefits of professional tooth prophylaxis, whether performed with a mechanical handpiece or a toothbrush, and the addition of fluoride varnish. Ekstrand[16] found that there was a decrease in caries incidence in institutionalized elders who received help brushing with toothpaste containing 5000 ppm fluoride twice a day and received Duraphat varnish applications once a month compared to twice a day brushing with a 5000 ppm fluoride toothpaste alone without any fluoride varnish. In a different study, similar results were also found, where caries reduction was also noticed with the application of fluoride varnish (Duraphat) and the use of normal strength toothpaste (1000 ppm to 1450 ppm).[16,18,19] Johnson[11] also found that caries incidence was decreased with professional tooth prophylaxis and the application of fluoride varnish compared to professional prophylaxis alone.

However, these studies suggest that in disabled and infirm patients, regular professional prophylaxis, whether performed with a toothbrush or a prophylaxis cup, and the application of fluoride varnish is beneficial. Many institutionalized elders do not receive aid in brushing or regular dental hygiene therapy. Two studies concluded that the application of varnish did not reduce gingivitis in institutionalized elderly people with poor oral hygiene.[8,17] This supports that the main mechanism of action for fluoride varnish is as an anticariogenic agent.

Table 1. Search strategy and results.

Database	# Citations
Medline	8
EMBASE	16
CINAHL	519
Cochrane DSR	256
BioMed Central	0
health-evidence.ca	0
TOTAL	**799**

Figure 1. Search and retrieval process flow chart.

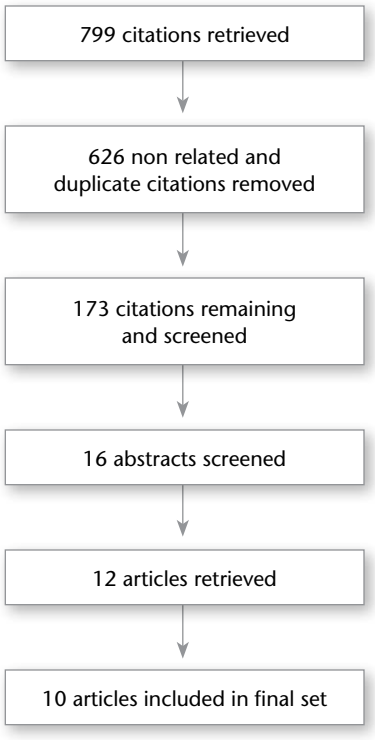

Table 2. Clinical trials.

Author and country	Study population and setting	Intervention	Results
Clavero et al. (2006)[9] Spain	Age: 65–93 years Experimental n=27 Control n=29 Long term care (LTC) facility	Experimental group: Cervitec varnish (a CHX-thymol varnish) application twice in the first week, a month later, and then every three months for six months. Control group: Placebo fluoride varnish application twice in the first week, a month later, and then every three months for six months.	Chlorhexidine applied in a varnish form in high concentrations has been shown to control effectively *streptococci mutans* and dental caries. In this clinical trial, treatment with Cervitec varnish had significant effect overtime on gingival index scores ($p = 0.029$), but not on plaque index scores ($p = 0.651$). Both groups did not significantly differ in reductions in plaque or gingival index scores between baseline and one, three, or six months.
Ekstrand et al. (2008)[17] Denmark	Age: >= 75 years (mean age 81.6 years) Group 1: n=71 Group 2: n=64 Group 3: n=54 Living at home	Group 1: Tooth brushing performed by a dental hygienist using a 1450 ppm toothpaste and Duraphat varnish application on active root caries for 8 months. Group 2: Brushed with a 5000 ppm fluoridated toothpaste twice a day themselves for eight months. Group 3: Brushed with a 1450 ppm toothpaste twice a day themselves for eight months.	Groups 1 and 2 improved significantly when compared with group 3 ($p < 0.02$). No significant difference was observed between groups 1 and 2 ($p = 0.14$). On average, only three out of 10 participants showed root caries progression in group 1 and 2 compared to five out of 10 in group 3.
Johnson et al. (2003)[12] Sweden	Age: 45–89 years (mean age 69 years) Group 1: n=5 Group 2: n=6 Group 3: n=4 Day care centre in a hospital	Group 1: Professional tooth cleaning and the application of tap water flavored with eucalyptus oil. Group 2: Professional tooth cleaning and application of 1% chlorhexidine/thymol varnish. Group 3: Professional tooth cleaning and application of Cervitec, followed by application of a varnish containing 0.1% fluoride. Professional tooth cleaning included the use of prophylaxis paste containing 0.2% NaF and interproximal cleaning with interdental brush. Treatment was carried out at three-month intervals for 18 months.	No significant differences could be demonstrated among the three treatment groups, sample sizes were too small. However, this study suggests that regular professional dental cleanings with a fluoride containing paste, with or without supplementary fluoride varnish can prevent progression of existing superficial root caries lesions in disabled and infirm patients.
Persson et al. (2007)[13] Sweden	Age: 61–90 years (mean age 76.6 years) Group 1: n=11 Group 2: n=11 Group 3: n=11 (the same subjects were used in each test session) LTC facility	Group 1: Application of fluoride gel (0.068% sodium). Group 2: Placebo. Group 3: Water rinse. Each treatment period lasted for 16 days and the test sessions were separated by a two week wash out period. The fluoride gel, placebo, and water wash were performed four times a day during the test period.	Frequent application of gels did not result in an improved neutralizing effect in the elderly. This may have been due to many factors, such as xerostomia, low solubility, high viscosity, and low release. Instead, an increase in plaque acidogenicity was noted.
Potter et al. (1984)[16] USA	Age: 60–87 years (mean age 78 years) Group 1: n=7 Group 2: n=7 LTC facility	Group 1: Rinsed with a 0.4% SnF_2 mouthwash twice a day for two minutes for a 9 week period. Group 2: Rinsed with a SnF_2 free rinse (placebo) mouthwash twice a day for two minutes for a period of 9 weeks.	There was no change in the total colony forming units (CFU) in the group rinsing with 0.4% SnF_2 from the group rinsing with the placebo. However, SnF_2 was effective in selectively reducing the cariogenic microorganism *S. mutans* by 75 times.
Wyatt et al. (2004)[11] Canada	Age: 54–101 years (mean 83 years) Group 1: n=41 Group 2: n=39 Group 3: n=36 LTC facility	Group 1: Rinsed daily with a 0.12% chlorhexidine (CHX) rinse. Group 2: Rinsed daily with a 0.2% neutral sodium fluoride (NaF) rinse. Group 3: Placebo rinse. Clinical trial was carried out over a two year period.	The prevalence of caries and the dental status of the groups were similar at baseline and after two years. Each group on average lost less than one tooth per person, but the fluoride group compared with the other group had significantly less caries and significantly more reversals from carious to sound tooth surfaces at the end of the trial. A daily oral rinse with 15ml of 0.2% neutral NaF solution by elderly residents in LTC facilities has shown to reduce significantly the number of carious lesions compared to either a 0.12% of CHX solution or a placebo.

Table 3. Systematic reviews.

Author	Study population and settings	Intervention	Results
Innes et al. (2009)[19]	Age: 59–90 years Dental hospitals and long term care (LTC) facilities	Searching of key databases for clinical trials and reviews on the comparison of: a) high concentration (>1450 ppm fluoride) toothpaste compared with standard concentration (1000–1450 ppm fluoride) toothpaste, and b) biannual application of 22,6000 ppm fluoride varnish compared to no application of fluoride varnish	Evidence supports the use of tooth brushing with a 5000 ppm fluoride toothpaste and 22,000 ppm fluoride varnish application twice a year in reducing caries in an elderly population living in resident care homes.
McGrath et al. (2009)[18]	Age: >=60 years Clinic settings, nursing home and community	Searching of four databases using key word for articles relating to the "effectiveness of oral health promotion activities among elderly people". Seventeen articles were identified as effective; 13 randomized controlled tests, three quasi-experimental, and one pre-/post-single group study intervention study. Each study was then scored for quality and data were extracted into tables.	No significant difference in caries increment between elderly using 0.12% chlorhexidine (CHX) rinse and a placebo rinse. A decrease in caries rate when rinsing with a 0.05% NaF solution twice a day and brushing with a 0.32% NaF toothpaste than those brushing with toothpaste alone. A lower prevalence of secondary coronal and root caries experience in individuals who received a comprehensive oral health program compared to those who only received treatment on request. Those who received intraoral prevention experienced less tooth loss. CHX-thymol varnish (Cervitec) did not prove effective in reducing GI and PI scores.
Marinho et al. (2004)[14]	Age: <=16 years Multiple settings	Searching of several databases, as well as hand searching journals, reference lists of articles, and contact with manufacturers.	Topical fluorides (mouthrinses, gels, or varnishes) in addition to fluoride toothpaste achieved a modest reduction in caries compared to toothpaste used alone. The combination of fluoride varnish and fluoride toothpaste had a greater effect in caries reduction than the combination of fluoride toothpaste and mouthrinses or gels.
Marinho et al. (2004)[15]	Age: <=16 years Multiple settings	Searching of several databases, as well as hand searching journals, reference lists of articles, and contact with manufacturers.	Topical fluorides such as mouthrinses and gels do not appear to be more effective at reducing tooth decay in children and adolescents than fluoride toothpaste.

DISCUSSION

Elderly people living in LTC facilities are at a high risk of developing coronal and root caries. The application of fluoride varnish in this population could be recommended based on their high rate of caries incidence and studies showing the benefits of topical fluoride varnish compared to other topical fluorides, although, further research is needed to fill the gaps in literature.

Coronal and root caries is a common dental disease among elderly people living in LTC facilities, but unfortunately many of them do not have the access nor the economic means to receive treatment. This may lead to numerous caries lesions with large structural damage, resulting in tooth loss. Research has shown that fluoride varnish is very effective in preventing and arresting caries, more so than other topical fluoride treatments such as mouthrinses and gels. Due to the limited dexterity of elderly people, caregivers are important in the daily maintenance of oral hygiene. Greater benefits of fluoride varnish uptake have been shown when elderly individuals receive help with tooth brushing in combination with frequent applications of fluoride varnish. New research needs to be conducted so that appropriate measures can be taken to help control the high caries rate in this population.

Many elderly individuals do not receive help with oral care, nor do they receive regular dental prophylaxis by dental professionals; therefore, many have poor oral health. One possible way to address this issue is by dental professionals and LTC facilities collaborating with one another. This may include the training of caregivers by dental professionals on how to assist the elderly with oral care, and monthly visits by a dental professional for oral health promotion activities and the application of fluoride varnish.

This scoping review is based on randomized clinical trials (RCTs) and systematic reviews (SRs) that were available in key databases. Due to the limited research on the effectiveness of fluoride varnish in elderly people living in LTC facilities, the conclusions from this scoping review may not be complete. Some of the limitations of this scoping review include:

i. limited information that directly deals with fluoride varnish and elderly in LTC facilities,
ii. quality assessment was not performed on included RCTs but had been performed as part of the process of the SRs,
iii. incomplete findings due to a limited number of databases, and

iv. a limited time frame of three months to complete this scoping review.

Additional databases and further searching reference sections may have identified additional citations.

CONCLUSION

Based on the findings of this review, the application of fluoride varnish has demonstrated effectiveness in preventing coronal and root caries in individuals living in LTC facilities; however, these findings are shown in elderly people who receive assistance with oral hygiene. Many of the research studies performed on the efficacy of fluoride varnish have been performed on children and adolescents. Due to the many differences in oral environment, physical abilities, mental status, and motivation to perform oral healthcare, findings from children and adolescents may not be appropriate for elderly people living in these facilities.[10,21] To date, there are limited studies showing the benefits of fluoride varnish in elderly people in LTC facilities. There is a need for greater research evaluating the effectiveness of fluoride varnish application in this population to reduce the high rate of caries incidence in this underserved population. Our scoping review suggests that this holds great promise.

There are gaps in the literature. More research needs to be done specifically on institutionalized elders and chemotherapeutic mechanisms to reduce caries based on residents' abilities and limitations. We suggest that our findings demonstrate the necessity of collaboration between dental professionals and caregivers in residential settings.

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REFERENCES

1. Human Resources and Skills Development Canada. *Canadians in context – aging population.* [cited 2010 Aug 14]. Available from: http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=33
2. Hand JS, Hunt RJ, Beck JD. Incidence of coronal and root caries in an older adult population. *J Public Health Dent.* 1988;48(1):14–19.
3. Preza D, Olsen I, Aas JA, Willumsen T, Grinde B, Paster BJ. Bacterial profiles of root caries in elderly patients. *J Clin Microbiol.* 2008;46(6):2015–21.
4. Slade GD, Locker D, Leake JL, Price SA, Chao I. Differences in oral health status between institutionalized and non-institutionalized older adults. *Community Dent Oral Epidemiol.* 1990;18(5):272–76.
5. Gupta B, Marya CM, Juneja V, Dahiya V. Root caries: An aging problem. *Journal of Dental Science.* 2007;5(1)
6. Saub R, Evans RW. Dental needs of elderly hostel residents in inner Melbourne. *Aust Dent J.* 2001;46(3):198–202.
7. American Association of Public Health Dentistry. *Draft AAPHD resolution fluoride varnish for caries prevention.* [cited 2011 Aug 09]. Available from: http://www.astdd.org/docs/FluorideVarnishPolicyStatement(ECFebruary12010).pdf
8. Clavero J, Baca P, Paloma González M, Valderrama MJ. Efficacy of chlorhexidine–thymol varnish (Cervitec®) against plaque accumulation and gingival inflammation in a geriatric population. *Gerodontology.* 2006;23(1):43–47.
9. Wyatt CCL, MacEntee MI. Dental caries in chronically disabled elders. *Spec Care Dentist.* 1997;17(6):196–202.
10. Wyatt CCL, MacEntee MI. Caries management for institutionalized elders using fluoride and chlorhexidine mouthrinses. *Community Dent Oral Epidemiol.* 2004;32(5):322–28.
11. Johnson G, Almqvist H. Non-invasive management of superficial root caries lesions in disabled and infirm patients. *Gerodontology.* 2003;20(1):9–14.
12. Persson A, Lingström P, Bergdahl M, Claesson R, Dijken JWV. Buffering effect of a prophylactic gel on dental plaque in institutionalised elderly. *Gerondontology.* 2007;24(2):98–104.
13. Marinho VC, Higgins JP, Sheiham A, Logan S. Combinations of topical fluoride (toothpastes, mouthrinses, gels, varnishes) versus single topical fluoride for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev.* 2004;03(1);1–40.
14. Marinho VC, Higgins JP, Sheiham A, Logan S. One topical fluoride (toothpaste, or mouthrinse, or gels, or varnishes) verses another for preventing dental caries in children and adolescents (Review). *Cochrane Database Syst Rev.* 2004;03(1):1–47.
15. Potter DE, Manwell MA, Dess R, Levine E, Tinanoff N. SnF_2 as an adjunct to toothbrushing in an elderly institutionalized population. *Spec Care Dentist.* 1984;4(5):216–18.
16. Ekstrand K, Martignon S, Holm-Pedersen P. Development and evaluation of two root caries controlling programmes for home-based frail people older than 75 years. *Gerodontology.* 2008;25(2):67–75.
17. McGrath C, Zhang W, Lo EC. A review of the effectiveness of oral health promotion activities among elderly people. *Gerodontology.* 2009;26(2):85–96.
18. Innes N, Evans D. Caries prevention for older people in residential care homes. *Evid Based Dent.* 2009;10(3):83–87.
19. Tan HP, Lo ECM, Dyson JE, Luo Y, Corbet EF. Prevention and arrest of root surface caries in Chinese elders living in residential homes. *J Dent Res.* 2010;89(10):1089–90.
20. Davis RM. The rational of oral products in the elderly. *Clin Oral Investig.* 2004;8(1):2–5.
21. Petersen PE, Yamamoto T. Improving the oral health of older people: The approach of the WHO global oral health programme. *Community Dent Oral Epidemiol.* 2005;33(2):81–92.