REVIEW ARTICLE

Menopause and oral health

Vanita Suri, Varun Suri[1]

Department of Obstetrics and Gynecology, Post Graduate Institute of Medical Education and Research, Chandigarh, [1]Department of Public Health Dentistry, Swami Devi Dyal Hospital and Dental College, Barwala, Panchkula, Haryana, India

ABSTRACT

Different phases of a woman's life: Puberty, menses, pregnancy, and menopause have varied influence on her oral health. During the menopause, women go through biological and endocrine changes, particularly in their sex steroid hormone production, affecting their health. Because the oral mucosa contains estrogen receptors, variations in hormone levels directly affect the oral cavity. A few oral conditions and or diseases are seen more frequently during post menopausal years. Role of hormones affecting the health of oro-dental tissues, as well as treatment by HRT in ameliorating these conditions is not clear. There is paucity of randomized controlled trials in this field and more data is needed, before the recommendations for oral health care in post menopausal women can be made. A gynecologist sitting in menopausal clinic should be aware of oral changes happening during this period, and dental needs of these women and should refer them to the dental specialists accordingly. On the other hand, a dentist should also be sensitized about the menopausal status of the woman, her HRT status and special preventive and treatment needs.

Key Words: Burning mouth syndrome, hormone replacement therapy, menopause, oral health, periodontitis, xerostomia

INTRODUCTION

Menopause is a normal developmental stage in a woman's life, marking the permanent cessation of menstruation. It is the result of irreversible changes in the hormonal and reproductive functions of the ovaries. Hormonal fluctuations affect more than a woman's reproductive system. Hormones have potent effects on the development and integrity of the skeleton and oral cavity. They have a strong influence on the oral cavity. Different phases of a woman's life: Puberty, menses, pregnancy, and menopause have varied influence on her oral health. During the menopause women go through biological and endocrine changes, particularly in their sex steroid hormone production, affecting their health.[1,2] Because the oral mucosa contains estrogen receptors, variations in hormone levels directly affect the oral cavity. Oral health in postmenopausal women thus gets affected and needs attention along with other important issues. Keeping this in mind, we thought to review the literature for different aspects of oral health in the postmenopausal women. Internet-based search engines such as PubMed, Science Direct, EBSCO, and Cochrane Database were searched from 1976 to 2013 and the relevant articles on oral health in menopausal women were also included for the review.

Address for Correspondence: Dr. Vanita Suri, Department of Obstetrics and Gynecology, Post Graduate Institute of Medical Education and Research, Chandigarh, India. E-mail: surivanita@yahoo.co.in

ORAL MUCOSA AND FEMALE SEX HORMONES

Menopause affects the oral tissues in the same way as it alters the other systems. Alterations in the oral cavity are due to aging as well as hypoestrogenism.[3] Oral mucosa resembles vaginal mucosa in its histology as well as its response to estrogens. Sex hormone receptors have been detected in the oral mucosa and salivary glands.[4-7]

Estrogen can affect oral mucosa directly or through neural mechanism thus altering the periodontal health in menopausal women.[8] The oral problems may include a paucity of saliva leading to xerostomia, burning mouth syndrome, increase in incidence of dental caries, dysesthesia, taste alterations, atrophic gingivitis, periodontitis, and osteoporotic jaws.[9]

Access this article online

Quick Response Code:

Website: www.jmidlifehealth.org

DOI: 10.4103/0976-7800.141187

ORAL DISCOMFORT-BURNING MOUTH SYNDROME

The burning sensation in normal oral mucosa is known as "burning mouth syndrome" and is a common entity seen in postmenopausal women. The symptoms may vary from discomfort to intense pain. Various conditions like lichen planus, candidiasis and viral infections have similar presentation, but in burning mouth syndrome the mucosa is essentially normal.[10] Wardrop *et al.* assessed the relationship between oral discomfort and menopause in 149 women. The prevalence of oral discomfort was found to be significantly higher in perimenopausal and postmenopausal women (43%) than in premenopausal women (6%). The results also showed an association between oral discomfort and psychological symptoms in menopausal women.[11] Gao *et al.* in a case-control study found that menopausal women with burning mouth syndrome had higher follicle stimulating hormone levels and lower estradiol levels than those without oral symptoms.[12] Ben Aryeh *et al.* correlated oral and systemic symptoms of menopause with oral health and salivary flow rate and composition in his study on 154 women attending menopause clinic prior to hormone replacement therapy (HRT). They reported a high prevalence (45-60%) of oral discomfort in the women attending menopause clinic. A highly significant odds ratio between systemic and oral complaints of menopause was found. The composition of saliva was altered as compared to young controls.[13]

SALIVA AND XEROSTOMIA

Another common symptom exhibited by menopausal women is dryness of mouth or xerostomia. The prevalence and severity of symptoms may not be proportional to the amount of saliva secreted by the glands. Saliva acts as a defense mechanism for prevention of caries and reduced salivary flow can encourage oral microbial colonization thus affecting the dental health.[14] Salivary glands contain sex hormone receptors and these hormones have been estimated in the saliva.[7,15]

Salivary flow rates depend upon estrogen status of the individual. Postmenopausal women have low flow rates of saliva than menstruating women. Minicucci *et al.* studied salivary flow rates in menopause and compared them with those of premenopausal women. Salivary flow was evaluated by a chemical absorption stimulation test. Each subject provided three saliva samples: S1, nonstimulated saliva; S2, saliva initially stimulated with two drops of citric acid 2.5%; and S3, saliva super stimulated with two drops of citric acid 2.5% every 30 s for 2 min. Salivary flow was lower in menopausal group only in S2 and S3. Reduction in salivary flow rate can be responsible for xerostomia.[16]

Yalcin *et al.* evaluated 348 women in a menopausal clinic for their oral complaints. The most common symptom was oral dryness, which was significantly higher in non HRT users.[17] In a study from Turkey, Yalcin *et al.* investigating the saliva of a small group ($n = 14$) of menopausal women and the same number of premenopausal controls observed that salivary flow rate decreased at the menopause and increased with HRT use, while salivary pH, electrolytes and calcium concentrations were unaffected.[18]

Sewón *et al.* also showed similar results.[19] A study from Iran on salivary flow rate and composition of 42 menopausal women with or without xerostomia (21 cases, 21 controls) showed that the mean calcium concentration was significantly higher in cases than in the controls.[20]

Same author and associates reported a case–control study of 38 menopausal women (41-77-year-old) with oral dryness and the same number of asymptomatic controls. Salivary beta-estradiol concentrations were analyzed and it was observed that cases had significantly lower concentrations and hormone output than the controls.[21]

Agha-Hosseini *et al.* studied the relationship between lumbar spine bone mineral density (BMD) and oral dryness in 60 menopausal women. They observed significant negative correlation between BMD and xerostomia.[22]

To summarize, the data on effect of menopause on saliva and its clinical implications is small and there is need for adequately powered and well-designed studies.

MENOPAUSE AND PERIODONTAL HEALTH

The periodontium is composed of the supporting structures of teeth, namely; gingiva, periodontal ligament, cementum, and alveolar bone. Sex steroid hormones are responsible for health of periodontium also. They can lead to changes in inflammatory mediators, vascular permeability and growth and differentiation of fibroblasts. There are estrogen receptors in osteoblasts and fibroblasts of periodontal tissues, which respond to the varying levels of hormones in different stages of reproductive life and thus affect the health of the periodontium.[23,24] Postmenopausal women present with periodontal disease more frequently and in more severe form.[17] Numerous factors play a role in increasing the incidence of disease. Scardina and Messina examined oral microcirculation in 27 postmenopausal women using videocapilloscopy and compared it with controls. Their study showed significant differences between cases and controls for the vascular parameters such as the diameter of loops, tortuosity of vessels in labial mucosa and density of periodontal mucosa. All these factors predisposed to inflammation.[25]

There is some correlation between systemic osteoporosis and alveolar bone loss. Decreased BMD of alveolar crest, and subcrestal alveolar bone can lead to attachment loss and tooth loss.[9,26] In a study conducted by Kribbs, it was found that women with advanced osteoporosis were three times more susceptible for teeth loss than their healthy counterparts.[27] The residual ridge resorption after dental extraction in postmenopausal women is also more than in premenopausal women.[9] Ortman *et al.* have not shown any significant effect of menopause on residual ridge resorption in their study on 459 patients.[28]

Imirzalioglu *et al.* could only show the effect of age on the degree of ridge resorption.[29] In a cross-sectional study conducted by Sultan and Rao in 80 postmenopausal women with generalized chronic periodontitis a complete periodontal examination including plaque index, gingival index and clinical attachment loss were measured. Alveolar bone loss was also measured from oral radiographs. Systemic bone loss was estimated from hand-wrist radiograph of the patient through digital X-ray radiogrammetry. Age of the patient, years since menopause and body mass index showed significant correlation with BMD, but clinical attachment loss and alveolar bone loss showed nonsignificant correlation with BMD. They concluded that osteopenia in menopause is a risk indicator for periodontal disease.[30]

HORMONE REPLACEMENT THERAPY

Literature was also reviewed to explore the benefit of hormone (estrogens/progestogens) replacement therapy (HRT) on oral symptoms and signs in postmenopausal women. In a study by Volpe *et al.* conjugated estrogens were administered to one group of postmenopausal women with oral discomfort. They observed that HRT improved subjective and objective symptoms in more than 50% of patients.[31] Forabosco *et al.* evaluated effect of HRT on symptoms of oral discomfort in postmenopausal women and concluded that oral discomfort may be related to steroid hormone withdrawal only in some postmenopausal women and treatment with estrogens may improve the clinical picture in this group of women only. Immunohistochemical identification of estrogen receptors may help to identify patients for whom HRT may be beneficial.[32]

Tarkkila *et al.* used a questionnaire to investigate the prevalence of self-assessed sensations of painful mouth and dry mouth in 3173 menopausal women. They observed that the symptoms of pain and dryness of the mouth were associated with climacteric symptoms in general but the use of HRT did not prevent or improve the symptoms.[33] Menopause leads to decrease in salivary flow rates and alteration in levels of electrolytes in the saliva. Yalcin *et al.* did not observe any difference in salivary pH or electrolyte levels in saliva in postmenopausal women with or without HRT. Though there was no effect of alendronate and calcium supplements on these salivary parameters, hormone replacement along with alendronate and calcium improved saliva flow rate in women with oral symptoms.[19]

Tarkkila *et al.* in a longitudinal study of menopausal women analyzed the difference in their dental health with and without HRT over a 2 year period. Of 3173 women a random sample of 400 (200 using and 200 not using HRT) was examined. Clinical examination, saliva flow rates and panoramic tomography of the jaws were compared at baseline and 2 year follow-up. No difference was observed in any dental parameter or salivary flow rate between the groups. Since women using HRT seem to be more health conscious, it was observed that women in the HRT group had received more dental restorations and reported recent dental appointments more often.[34]

Giuca *et al.* compared estrogens with phytotherapy in treating oral cavity symptoms in 95 menopausal women. It was observed that women on HRT had improvement in oral symptoms when compared with the controls. Estrogens were more effective than phytotherapy regarding the salivary changes, while the gingivitis, bleeding and taste changes was the same for both the therapies.[35] Eliasson *et al.* studied the role of estriol in improving the saliva flow and change in buffer capacity of saliva from minor salivary glands in 18 postmenopausal women (61-76 years). HRT caused a significant increase in the saliva flow and the complaints of dry mouth reduced.[36] Leimola-Virtanen *et al.* investigated the effect of HRT on saliva composition in 19 postmenopausal and 8 perimenopausal women. They found that the proteins, immunoglobulins and salivary peroxidase in both groups are estrogen dependent.[6] In contrast, Ship *et al.* showed that among healthy women salivary gland function is not significantly influenced by menopause or HRT.[37]

López–Marcos *et al.* in a group of 190 women found no significant effect of HRT on periodontal health.[38] On the other hand, a Japanese study in 330 Japanese postmenopausal women showed that estrogen may promote tooth retention by strengthening the periodontal attachment surrounding the teeth, without increasing oral bone height and decreasing oral bone porosity. There was a strong correlation between duration of estrogen use and number of remaining teeth.[39] In a 2 year open follow-up study, Tarkkila *et al.* observed that HRT led to decreasing numbers of positive samples of the periodontal pathogens; *Porphyromonas gingivalis* and *Tannerella forsythia*. Use of HRT did not correlate with Periodontal health status.[40]

Estrogens can influence interleukin levels in women with periodontitis and thus accelerate healing in women on HRT.[41] In the famous Women's health study on 42,171 postmenopausal women from USA, it was found that tooth loss was 24% lower in current HRT users than in nonusers.[42] Meisel *et al.* in Germany compared men with women and found out that number of teeth in HRT users were higher than in men of the same age group.[43]

Tarkkila *et al.* in a random sample of 400 peri- and post-menopausal women of whom 200 were using and 200 not using HRT compared salivary flow rates, and dental status. Of them, 161 case-control pairs of women using/not using HRT were re-examined 2 years later. Panoramic tomography of the jaws was taken at baseline and at follow-up dental and periodontal status was recorded and resting and stimulated saliva flow was measured. The patients also filled in a structured questionnaire on their systemic health, medication, and health habits. Authors did not observe any difference in dental parameters or salivary flow rates between the groups. However, during the follow-up, women in HRT group had received more dental restorations and they also reported more often recent dental appointments indicating a more health conscious attitude in the HRT group.[37]

The unequal responses to HRT shown by different studies may be due to certain host factors. Taguchi *et al.* in a study to explore this differential response found out that the presence of estrogen receptors and vitamin D gene polymorphisms can lead to response variation and rate of tooth loss.[44]

Allen *et al.* have published a systematic review on cost of dental care in postmenopausal women with osteoporosis with or without HRT use. They assessed 20 published studies involving 13,735 postmenopausal women. It was discovered that postmenopausal women with osteoporosis who did not receive HRT had a greater incidence of adverse dental outcomes and incurred higher dental care costs than those who received HRT.[45]

KNOWLEDGE

Oral health specialists and gynecologists should be aware of the problems associated with menopause and need to provide these women complete health package consisting of oral health care as an integral part. Murray and Fried used a questionnaire to assess dental hygienist's general knowledge of menopause and its possible oral manifestations. Fifty-four percent of respondents scored 75% or more in general knowledge about menopause, but only 7% scored well about its oral effects. Education level and dental hygiene college curricula influenced the scores. The authors suggested that dental hygienists need more education about menopause and its effects on oral health.[46]

Patil *et al.* assessed gynecologists' awareness regarding the effect of female sex hormones on oral health in Bagalkot district of the Karnataka state. Majority had knowledge about the effect of hormones on oral health in various phases of a woman's life. The gynecologists working at medical colleges had better awareness than private practitioners. The authors concluded that there is a need to educate the care givers about oral health.[47]

CLINICAL GUIDELINES

There are no guidelines regarding oral health care in postmenopausal women by any society. A few recommendations have been made by Meurman *et al.* in their review on menopause and oral health from their own experience.[48] Frutos *et al.* have also suggested basic dental treatment protocol for menopausal women.[49]

Whenever a woman attends menopausal clinic she should be asked about complaints like dry mouth, discomfort in the mouth, tongue and pain in the teeth etc. Detailed history of systemic diseases and use of drugs should be elicited. A referral to the dentist should be made in case of significant symptoms. A dentist should examine the oral mucosa, dental and periodontal status thoroughly. Dental treatment consists of prevention of caries and treatment of existing conditions. Oral hygiene measures in the form of good brushing technique, use of flossing, chlorhexidine rinses and fluoride containing dentifrices should be advised. Plenty of oral liquids should be advised and local applications of certain drugs may help in burning mouth syndrome. There is a doubtful role of psychotherapy and antidepressants also. HRT may be advised for short term in cases of persistent symptoms. Periodontal disease should be treated depending upon the cause and microflora. The role of bisphoshonates in the management of periodontal disease is suggested by few workers. Alendronate and risedronate have been shown to improve periodontal status.[50-54]

CONCLUSION

Menopause affects a woman's oral and dental health for the same reasons as for other body systems. How much is the role of sex hormones in maintaining oral mucosal, dental and periodontal health is not clear. There is a need for randomized trials to assess the effect of sex hormones on oral mucosa, saliva and periodontal health. Only small numbered studies regarding effects of menopause on oral symptoms are available. Large, adequately powered cross sectional studies are required to answer this query.

Effect of HRT in alleviating symptoms and improving oral health is again controversial. Large randomized controlled studies are needed to document significant effect of HRT and other interventions in menopausal women with oral symptoms. There should be definite guidelines for menopausal women regarding good oral health and life style practices.

REFERENCES

1. Matthews KA. Myths and realities of the menopause. Psychosom Med 1992;54:1-9.
2. Brace M, McCauley E. Oestrogens and psychological well-being. Ann Med 1997;29:283-90.
3. Lopez BC, Perez MG, Soriano YJ. Dental considerations in pregnancy and menopause. J Clin Exp Dent 2011;3:e135-44.
4. Thompson IO, van der Bijl P, van Wyk CW, van Eyk AD. A comparative light-microscopic, electron-microscopic and chemical study of human vaginal and buccal epithelium. Arch Oral Biol 2001;46:1091-8.
5. Leimola-Virtanen R, Pennanen R, Syrjänen K, Syrjänen S. Estrogen response in buccal mucosa — A cytological and immunohistological assay. Maturitas 1997;27:41-5.
6. Leimola-Virtanen R, Salo T, Toikkanen S, Pulkkinen J, Syrjänen S. Expression of estrogen receptor (ER) in oral mucosa and salivary glands. Maturitas 2000;36:131-7.
7. Välimaa H, Savolainen S, Soukka T, Silvoniemi P, Mäkelä S, Kujari H, *et al*. Estrogen receptor-beta is the predominant estrogen receptor subtype in human oral epithelium and salivary glands. J Endocrinol 2004;180:55-62.
8. Cao M, Shu L, Li J, Su J, Zhang W, Wang Q, *et al*. The expression of estrogen receptors and the effects of estrogen on human periodontal ligament cells. Methods Find Exp Clin Pharmacol 2007;29:329-35.
9. Friedlander AH. The physiology, medical management and oral implications of menopause. J Am Dent Assoc 2002;133:73-81.
10. Merskey H, Bogduk N. Classification of Chronic Pain. Seattle, WA: IASP Press; 1994. p. 59-71.
11. Wardrop RW, Hailes J, Burger H, Reade PC. Oral discomfort at menopause. Oral Surg Oral Med Oral Pathol 1989;67:535-40.
12. Gao J, Chen L, Zhou J, Peng J. A case-control study on etiological factors involved in patients with burning mouth syndrome. J Oral Pathol Med 2009;38:24-8.
13. Ben Aryeh H, Gottlieb I, Ish-Shalom S, David A, Szargel H, Laufer D. Oral complaints related to menopause. Maturitas 1996;24:185-9.
14. Guggenheimer J, Moore PA. Xerostomia: Etiology, recognition and treatment. J Am Dent Assoc 2003;134:61-9.
15. Tivis LJ, Richardson MD, Peddi E, Arjmandi B. Saliva versus serum estradiol: Implications for research studies using postmenopausal women. Prog Neuropsychopharmacol Biol Psychiatry 2005;29:727-32.
16. Minicucci EM, Pires RB, Vieira RA, Miot HA, Sposto MR. Assessing the impact of menopause on salivary flow and xerostomia. Aust Dent J 2013;58:230-4.
17. Yalcin F, Gurgan S, Gul G. Oral health in postmenopausal Turkish women. Oral Health Prev Dent 2006;4:227-33.
18. Yalçin F, Gurgan S, Gurgan T. The effect of menopause, hormone replacement therapy (HRT), alendronate (ALN), and calcium supplements on saliva. J Contemp Dent Pract 2005;6:10-7.
19. Sewón L, Laine M, Karjalainen S, Leimola-Virtanen R, Hiidenkari T, Helenius H. The effect of hormone replacement therapy on salivary calcium concentrations in menopausal women. Arch Oral Biol 2000;45:201-6.
20. Agha-Hosseini F, Mirzaii-Dizgah I, Moghaddam PP, Akrad ZT. Stimulated whole salivary flow rate and composition in menopausal women with oral dryness feeling. Oral Dis 2007;13:320-3.
21. Agha-Hosseini F, Mirzaii-Dizgah I, Mansourian A, Khayamzadeh M. Relationship of stimulated saliva 17 beta-estradiol and oral dryness feeling in menopause. Maturitas 2009;62:197-9.
22. Agha-Hosseini F, Mirzaii-Dizgah I, Moosavi MS. Relationship of lumbar spine bone mineral density and oral dryness feeling in menopause. Menopause 2011;18:625-8.
23. Mascarenhas P, Gapski R, Al-Shammari K, Wang HL. Influence of sex hormones on the periodontium. J Clin Periodontol 2003;30:671-81.
24. Amar S, Chung KM. Influence of hormonal variation on the periodontium in women. Periodontol 2000 1994;6:79-87.
25. Scardina GA, Messina P. Oral microcirculation in post-menopause: A possible correlation with periodontitis. Gerodontology 2012;29:e1045-51.
26. Portillo GM. Oral manifestations and dental treatment in menopause. Med Oral 2002;7:31-5.
27. Kribbs PJ. Comparison of mandibular bone in normal and osteoporotic women. J Prosthet Dent 1990;63:218-22.
28. Ortman LF, Hausmann E, Dunford RG. Skeletal osteopenia and residual ridge resorption. J Prosthet Dent 1989;61:321-5.
29. Imirzalioglu P, Yuzugullu B, Gulsahi A. Correlation between residual ridge resorption and radiomorphometric indices. Gerodontology 2012;29:e536-42.
30. Sultan N, Rao J. Association between periodontal disease and bone mineral density in postmenopausal women: A cross sectional study. Med Oral Patol Oral Cir Bucal 2011;16:e440-7.
31. Volpe A, Lucenti V, Forabosco A, Boselli F, Latessa AM, Pozzo P, *et al*. Oral discomfort and hormone replacement therapy in the post-menopause. Maturitas 1991;13:1-5.
32. Forabosco A, Criscuolo M, Coukos G, Uccelli E, Weinstein R, Spinato S, *et al*. Efficacy of hormone replacement therapy in postmenopausal women with oral discomfort. Oral Surg Oral Med Oral Pathol 1992;73:570-4.
33. Tarkkila L, Linna M, Tiitinen A, Lindqvist C, Meurman JH. Oral symptoms at menopause — The role of hormone replacement therapy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2001;92:276-80.
34. Tarkkila L, Furuholm J, Tiitinen A, Meurman JH. Oral health in perimenopausal and early postmenopausal women from baseline to 2 years of follow-up with reference to hormone replacement therapy. Clin Oral Investig 2008;12:271-7.
35. Giuca MR, Carli E, Pasini M, Bonfigli D, Cappè MR. Evaluation of efficacy of estrogen and phytotherapy in oral cavity alterations of women in menopause. Minerva Ginecol 2009;61:13-22.
36. Eliasson L, Carlén A, Laine M, Birkhed D. Minor gland and whole saliva in postmenopausal women using a low potency oestrogen (oestriol). Arch Oral Biol 2003;48:511-7.
37. Ship JA, Patton LL, Tylenda CA. An assessment of salivary function in healthy premenopausal and postmenopausal females. J Gerontol 1991;46:M11-5.
38. López-Marcos JF, García-Valle S, García-Iglesias AA. Periodontal aspects in menopausal women undergoing hormone replacement therapy. Med Oral Patol Oral Cir Bucal 2005;10:132-41.
39. Taguchi A, Sanada M, Suei Y, Ohtsuka M, Nakamoto T, Lee K, *et al*. Effect of estrogen use on tooth retention, oral bone height, and oral bone porosity in Japanese postmenopausal women. Menopause 2004;11:556-62.
40. Tarkkila L, Kari K, Furuholm J, Tiitinen A, Meurman JH. Periodontal disease-associated micro-organisms in peri-menopausal and post-menopausal women using or not using hormone replacement therapy. A 2-year follow-up study. BMC Oral Health 2010;10:10.

41. Reinhardt RA, Payne JB, Maze C, Babbitt M, Nummikoski PV, Dunning D. Gingival fluid IL-1beta in postmenopausal females on supportive periodontal therapy. A longitudinal 2-year study. J Clin Periodontol 1998;25:1029-35.
42. Grodstein F, Colditz GA, Stampfer MJ. Tooth loss and hormone use in postmenopausal women. Compend Contin Educ Dent Suppl 1998;22:S9-16.
43. Meisel P, Reifenberger J, Haase R, Nauck M, Bandt C, Kocher T. Women are periodontally healthier than men, but why don't they have more teeth than men? Menopause 2008;15:270-5.
44. Taguchi A, Kobayashi J, Suei Y, Ohtsuka M, Nakamoto T, Tanimoto K, *et al*. Association of estrogen and vitamin D receptor gene polymorphisms with tooth loss and oral bone loss in Japanese postmenopausal women. Menopause 2003;10:250-7.
45. Allen IE, Monroe M, Connelly J, Cintron R, Ross SD. Effect of postmenopausal hormone replacement therapy on dental outcomes: Systematic review of the literature and pharmacoeconomic analysis. Manag Care Interface 2000;13:93-9.
46. Murray DL, Fried J. Dental hygienists' knowledge of menopause and its potential oral manifestations. J Dent Hyg 1999;73:22-8.
47. Patil SN, Kalburgi NB, Koregol AC, Warad SB, Patil S, Ugale MS. Female sex hormones and periodontal health-awareness among gynecologists — A questionnaire survey. Saudi Dent J 2012;24:99-104.
48. Meurman JH, Tarkkila L, Tiitinen A. The menopause and oral health. Maturitas 2009;63:56-62.
49. Frutos R, Rodríguez S, Miralles-Jorda L, Machuca G. Oral manifestations and dental treatment in menopause. Med Oral 2002;7:26-30, 31-5.
50. Tenenbaum HC, Shelemay A, Girard B, Zohar R, Fritz PC. Bisphosphonates and periodontics: Potential applications for regulation of bone mass in the periodontium and other therapeutic/diagnostic uses. J Periodontol 2002;73:813-22.
51. Lane N, Armitage GC, Loomer P, Hsieh S, Majumdar S, Wang HY, *et al*. Bisphosphonate therapy improves the outcome of conventional periodontal treatment: Results of a 12-month, randomized, placebo-controlled study. J Periodontol 2005;76:1113-22.
52. Rocha ML, Malacara JM, Sánchez-Marin FJ, Vazquez de la Torre CJ, Fajardo ME. Effect of alendronate on periodontal disease in postmenopausal women: A randomized placebo-controlled trial. J Periodontol 2004;75:1579-85.
53. Palomo L, Bissada NF, Liu J. Periodontal assessment of postmenopausal women receiving risedronate. Menopause 2005;12:685-90.
54. Palomo L, Liu J, Bissada NF. Skeletal bone diseases impact the periodontium: A review of bisphosphonate therapy. Expert Opin Pharmacother 2007;8:309-15.

How to cite this article: Suri V, Suri V. Menopause and oral health. J Mid-life Health 2014;5:115-20.

Source of Support: Nil, **Conflict of Interest:** None declared.