ORIGINAL ARTICLE

Oral health in perimenopausal and early postmenopausal women from baseline to 2 years of follow-up with reference to hormone replacement therapy

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Abstract Female sex hormones also affect the mouth but there are little data on oral health of menopause age women. This 2-year follow-up study investigated oral health of perimenopausal and early postmenopausal women. Because hormone replacement therapy (HRT) users have been reported to be more health conscious than nonusers, we expected differences between women using and women not using HRT. Of 3,173 women, a random sample of 400 (200 using and 200 not using HRT) was examined. Of them, 161 case-control pairs of women using/not using HRT were reexamined 2 years later. Dental and periodontal status was recorded according to the WHO criteria and resting and stimulated saliva flow was measured. Panoramic tomography of the jaws was taken at baseline and at follow-up. The patients also filled in a structured questionnaire on their systemic health, medication, and health habits. The results were analyzed statistically between and within the groups. No difference was observed in any dental parameters or salivary flow rates between the groups. However, during the follow-up, women in HRT group had received more dental

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L. Tarkkila · J. H. Meurman Department of Oral and Maxillofacial Surgery, Helsinki University Central Hospital, Helsinki, Finland restorations (p < 0.05) and they also reported more often recent dental appointments (p < 0.05). Although no difference in oral health status or salivary flow rates between women using or not using HRT was found, the observation on dental restorations may indicate a more health conscious attitude in the HRT group.

Keywords Oral health · Dental health · Perimenopause · Postmenopause · Hormone replacement therapy

Introduction

During menopause, women go through biological changes, particularly in their hormone secretion [6]. Some women at this time live with expectations of worsening health [25]. The number of women using hormone replacement therapy (HRT) to cope with the hormonal changes is increasing. Women do not only take HRT to avoid climacteric symptoms but also to protect themselves from cardiovascular diseases and osteoporosis [15, 35]. The use of HRT has received much publicity, however, when the results from large population studies and controlled trials were published showing that the benefits of using HRT for the prevention of other diseases than menopause-associated symptoms may not be warranted [7, 17, 44]. However, there is no doubt that many women clearly benefit from the use of HRT, which may also have implications in the oral cavity [11]. It also seems that women using HRT tend to have healthier lifestyles than nonusers [16, 26].

There are no studies on the effect of HRT use on the prevalence of dental diseases although there are data on oral health in menopause and postmenopause age women in general. For example, in the USA [32], Sweden [5, 13], Norway [34], and Finland [30], the incidence of caries in

elderly populations has been studied. The prevalence of caries in individuals links with low salivary flow rate [20, 23].

The increase in life span expectation also reflects as an increase in the number of dentate people. Most people retain their own teeth for a lifetime but with subsequent increase in periodontal problems, especially in the elderly [3, 18]. Periodontal disease does not only have local effects in the dentition but it seems to associate with general diseases such as atherosclerosis (for meta-analysis, see [19]). It has been also suggested that gingival inflammation and hyperplasia in women associate with serum concentrations of the female steroid hormones [4, 22].

However, more recently, it has been suggested that the reported detrimental effects in the oral cavity of the changes in female steroid hormone concentrations could simply be compensated by practicing good oral hygiene [21, 12]. Subsequently, the association between female sex hormones and oral health is not clear, not even in pregnant women where controversial oral health data exist [28]. The present study project investigated oral health of menopause age women in general [38]. This paper reports how the current use of HRT associated with dental and periodontal index scores and salivary flow rates of the women and with their health behavior. Our hypothesis was based on the findings that women using HRT are more health conscious in general [16, 26]. Hence, we anticipated that they might also be more interested in their oral health than women not using HRT.

Materials and methods

Subjects

The patients were originally included from a sample of 3,173 perimenopausal and early postmenopausal women who had participated in a questionnaire study on oral symptoms. The results of this study have been reported elsewhere [38]. At baseline, the age cohorts of the women were 50, 52, 54, 56, and 58 years. The material of the present study was collected from those responding to the primary questionnaire study. Twenty women were randomized from each of the five age cohorts who reported the use of HRT and 20 women not using HRT, respectively, resulting in 40 women from each age cohort. Thus, 400 women were then altogether invited to attend a clinical examination. One recall letter was sent to those who did not respond to the first invitation. For the baseline study, 249 women attended, with a response rate of 62%. Women who changed their HRT protocol (using/not using HRT) between the baseline and follow-up were excluded from the final analyses (n=32). Eleven women reported regular menstruation and they were therefore excluded from the final analyses. The study profile is given in Fig. 1. All examinations were carried out at the Institute of Dentistry, University of Helsinki, Finland. The study had been approved by the Ethical Committee of the Health Department of the City of Helsinki and an informed consent was obtained from each individual.





Questionnaire, X-ray, and clinical examinations

A structured questionnaire was given to all the subjects prior to the clinical examination. The questionnaire comprised multiple-choice questions on general health, climacteric complaints, and self-assessed general and dental health. Use and duration of prescribed medications as well as illnesses diagnosed by a physician were asked with open questions. Basically, the questionnaire comprised the same questions as in the original inquiry [38]. Self-assessed dental health was considered "satisfactory" when reported as "good" or "fairly good" in the questionnaire and "unsatisfactory" when reported as "moderate", "fairly bad", or "bad". Reported use of medication and current smoking were also included in the model. Use of medication was recorded according to the patient's own report. The drugs were coded in therapy groups as given in the Finnish catalogue of medicines (Pharmaca Fennica 2007). Use of antidepressants, tranquilizers, sedatives, and antipsychotics, however, was coded into the same group. Similarly, diuretics, antihypertensive agents, nitrates, digitalis, and antiarrhythmics were grouped into one as "cardiovascular medication".

Panoramic tomograms were taken of the jaws and the Xrays were available at clinical examination to detect secondary caries, periapical radiolucencies, the number of endodontically treated teeth as well as the number of vertical bone pockets and furcation lesions of multi-rooted teeth. The written report from an oral radiologist was also available to support the clinical decision making.

The same dentist (author L.T.) examined all the patients both at baseline and at follow-up in a normally equipped dental office. Oral examination was made according to the WHO guidelines [43]. Decayed, missing, filled teeth (DMFT) index was calculated. Decayed teeth (DT) and filled teeth (FT) indexes were separately recorded. Teeth were classified as carious whenever one or more surfaces were assessed as needing restoration due to decay. Clinically detected retained roots were included in the decayed teeth score. Teeth with fractures or lost fillings without clinically observable caries were not categorized as carious. Because not all women remembered their history of dental treatment, all the missing teeth despite whether they were extracted or congenitally missing were calculated in the M score of the index. According to the WHO criteria for DMFT index, the third molars were not observed in this index. However, all erupted natural teeth, including third molars, were included in the decayed teeth, filled teeth, and scores of the total number of teeth.

Periodontal health status and treatment needs were recorded using the World Health Organization Community Periodontal Index of Treatment Needs (CPITN) [2]. The periodontal examination involved evaluations of all sur-

faces of the teeth. The highest score per sextant was recorded and used in the analyses. The probing depths were measured to the nearest millimeter (mm) from the gingival margin to the bottom of the pocket at four surfaces of each tooth. A WHO probe was used (tip diameter 0.5 mm). Since the CPITN indicates periodontal treatment needs, no recordings of plaque or gingival recessions were included. The number of ≥ 6 -mm gingival pockets were however recorded separately and "periodontitis" was diagnosed if at least one sextant had a CPITN score 3 or higher. After clinical examinations, the women were informed about the oral health record by giving them a written dental status report and a copy of the X-ray if requested. Saliva samples were taken with the free flowing method for measuring resting salivary flow. Thereafter, a 2-g piece of paraffin wax was given to the subject to chew with an approximate rate of once per second and stimulated saliva was then collected and flow rate measured according to Meurman and Rantonen [27].

Statistical analyses

Data were entered into a Statistical Package for the Social Sciences data file and differences between the HRT users and nonusers were analyzed separately from baseline and follow-up results. The differences observed during the follow-up period were also analyzed within the groups. Results are expressed as mean values±SD. Percentages were used when applicable. The differences between the mean values were assessed by the Mann–Whitney *U* test. The χ^2 test was used for analyzing proportions. Significance was set at p < 0.05.

Results

Descriptive data at baseline and at 2-year follow-up examination are given in Table 1. As expected, non-HRT users reported more climacteric symptoms than HRT users both at baseline (p=0.000) and also after 2 years in the follow-up examination (p=0.001). However, the percentage of those suffering from climacteric symptoms decreased after 2 years. HRT users and nonusers had no significant differences in their smoking habits or in the use of other medication than HRT.

The descriptive data of dental status are given in Table 2. In HRT group, the FT index score increased significantly during the follow-up indicating that these women had received more dental restorations. At baseline, almost 80% were diagnosed of having periodontitis with no difference between HRT users and nonusers. After 2 years, the respective percentages of diagnosed periodontitis were

	Baseline			2-year follow-up				
	HRT (106)	No HRT (55)	p value	HRT (106)	No HRT (55)	Significance between groups	Significance between baseline and follow-up in HRT group	Significance between baseline and follow-up in no HRT group
Mean age	55.4±2.7	55.9±2.4	ns.	57.4±2.7	57.9±2.4	ns.	<i>p</i> <0.000	<i>p</i> <0.000
Current smoker	23 (22%)	11 (20%)	ns.	19 (18%)	8 (15%)	ns.	ns.	ns.
Current climacteric symptoms	16 (15%)	24 (44%)	0.000	14 (13%)	19 (35%)	<i>p</i> <0.001	ns.	ns.
Satisfactory self-assessed dental health	65 (61%)	28 (51%)	ns.	63 (59%)	31 (56%)	ns.	ns.	ns.
Regular medication								
Use of cardiovascular drugs [#]	29 (27%)	14 (26%)	ns.	39 (37%)	14 (26%)	ns.	ns.	ns.
Use of neurological drugs##	7 (7%)	10 (18%)	0.046	5 (5%)	9 (16%)	<i>p</i> <0.018	ns.	ns.
Use of respiratory drugs###	7 (7%)	4 (7%)	ns.	15 (14%)	4 (7%)	ns.	ns.	ns.
Use of analgesics and antipyretics	7 (7%)	1 (2%)	ns.	5 (5%)	5 (9%)	ns.	ns.	ns.
Allergy medication	4 (4%)	0 (0%)	ns.	0	0	-	ns.	ns.
Oestrogen therapy	49 (47%)			47 (47%)			ns.	
Progestin therapy	2 (2%)			1 (1%)			ns.	
Combination therapy	53 (51%)			53 (53%)			ns.	
Diagnosed illnesses								
Cardiovascular disease	19 (18%)	10 (18%)	ns.	25 (24%)	11 (20%)	ns.	ns.	ns.
Psychiatric disease	1 (1%)	2 (4%)	ns.	1 (1%)	3 (6%)	ns.	ns.	ns.
Asthma	8 (8%)	3 (6%)	ns.	12 (11%)	3 (6%)	ns.	ns.	ns.
Rheumatic disease	8 (8%)	2 (4%)	ns.	6 (6%)	3 (6%)	ns.	ns.	ns.

Table 1 Descriptive data of the study subjects divided in groups according to the use of hormone replacement therapy (HRT)

ns. Statistical difference nonsignificant.

[#]Includes diuretics, antihypertensive agents, nitrates, digitalis, and antiarrhythmic agents;

Includes antidepressant drugs, tranquilizers, sedatives, and antipsychotic agents;

Mainly medication for asthma.

lower but the differences between the groups were not significant.

Salivary flow rate values are also given in Table 2. No difference was observed during the 2-year follow-up within or in between the groups.

According to a baseline questionnaire, more HRT users had visited a dentist less than a year ago more often than nonusers (p < 0.05; Table 3). At follow-up, this difference did not exist anymore. Toothbrushing at least twice daily was reported by 76% vs. 75% of HRT users/nonusers at

Table 2 Dental status findings in subjects with (HRT) or without (no HRT) hormone replacement therapy

	HRT (106)		No HRT (55)	Significance	
	Baseline	2-year follow-up	Baseline	2-year follow-up	
Number of teeth	25.0±5.5	24.6±5.6	23.5±7.5	23.3±7.5	Ns.
DMFT	20.1±4.3	20.9±4.3	20.1 ± 4.7	20.2±4.7	Ns.
DT	$0.4{\pm}0.9$	$0.3 {\pm} 0.7$	0.5 ± 1.0	0.6±1.3	Ns.
FT	16.9 ± 5.3	17.6±4.9	15.5±6.3	15.6±6.1	p < 0.05
Subjects with periodontitis	83 (79%)	74 (71%)	43 (80%)	41 (76%)	Ns.
Number of gingival pockets ≥6 mm	0.9 ± 1.7	1.1 ± 2.1	1.0 ± 1.7	1.2 ± 1.9	Ns.
Resting salivary flow rate (ml/min)	$0.6 {\pm} 0.4$	$0.6{\pm}0.4$	$0.6 {\pm} 0.4$	$0.6 {\pm} 0.4$	Ns.
Stimulated salivary flow rate (ml/min)	$2.0 {\pm} 0.9$	$2.0 {\pm} 0.8$	$1.7{\pm}0.8$	$1.8 {\pm} 0.8$	Ns.

The figures are means with standard deviations or frequencies with percentages.

DMFT Number of decayed, missing and filled teeth, DT number of decayed teeth, FT number of filled teeth, Ns. nonsignificant

Table 3 Self-reported oral health parameters (number and percentage of women who filled in the questionnaire)

	Baseline			2-year follow-up					
	HRT (106)	No HRT (55)	Significance between groups at baseline	HRT (106)	No HRT (55)	Significance between groups at follow-up	Significance between baseline and follow-up in HRT group	Significance between baseline and follow-up in no HRT group	
Last visit to dentist less than 1 year ago	86 (81%)	34 (62%)	*	88 (85%)	37 (71%)	ns.	ns.	ns.	
Removable denture, mandible	6 (6%)	9 (17%)	*	7 (7%)	7 (13%)	ns.	ns.	ns.	
Removable denture, maxilla	9 (9%)	7 (13%)	ns.	10 (10%)	6 (11%)	ns.	ns.	ns.	
Toothbrushing at least twice daily	80 (76%)	41 (75%)	ns.	84 (79%)	37 (67%)	ns.	ns.	ns.	
Uses toothpaste every time	98 (93%)	48 (87%)	ns.	98 (93%)	49 (89%)	ns.	ns.	ns.	
No gingival bleeding when brushing	29 (28%)	16 (30%)	ns.	39 (37%)	18 (33%)	ns.	ns.	ns.	
Satisfactory self- assessed oral health	65 (61%)	28 (51%)	ns.	63 (59%)	31 (56%)	ns.	ns.	ns.	

ns. Not significant

*p<0.05

baseline and by 79% vs. 69% at follow-up, respectively. There was no statistical difference between the groups in this respect. At baseline, self-assessed oral health was considered as satisfactory by 61% of the HRT users and by 51% nonusers and at follow-up by 59% and 56%, respectively. However, these differences were not statistically significant as shown in Table 3.

Discussion

We had anticipated that HRT users would have better dental health than nonusers. This was not the case in our material and thus the study hypothesis was refuted. However, HRT users had received more dental restorations than nonusers during the follow-up, a result which may indicate that the women who use HRT might be more health conscious in general. The finding that women in the HRT groups also had had more often dental appointments during the past year further supports this concept.

Mean DMFT index score was relatively high in both study groups. This is understandable because in the youth of our age cohorts (born in 1940–1948) dental treatment in Finland comprised mainly extractions of the teeth or restorative treatment with large amalgam fillings. As far as we know, there are no previously published data of dental status of women of these age groups in general.

Mean salivary flow rate values did not differ between the groups during the follow-up either. Interestingly, Dural and

Cağirankaya recently reported no difference in stimulated salivary flow rate and buffer capacity during the menstrual cycle indicating that these variables were not hormone dependent [9].

Periodontal disease was highly prevalent in all the women with slight albeit not significant decrease during follow-up. Many women were totally unaware of their poor periodontal condition although they had visited dentists regularly.

The study of Reinhard et al. [33] investigating women in early menopause showed that estrogen supplementation was associated with reduced gingival inflammation and a reduced frequency of clinical attachment loss. The lower reference limit for serum estradiol was >40 pg/ml in this regard. In our study, no blood tests were however taken and we thus rely upon the women's own report of HRT use based on cross-sectional assessment. This is an evident source of error in the present investigation which could not be avoided due to practical reasons of the study design. For future studies, it might be interesting to follow prospectively women using or not using HRT with subsequent monitoring of serum values and then to analyze concomitantly the parameters of oral health.

The reliability of CPITN in diagnosing periodontal disease may be criticized but it has been recommended for prevalence studies and assessments of the severity of periodontal disease [8]. In the present study, the number of \geq 6-mm-deep gingival pockets was also recorded but no difference was observed between the groups. We also

included smoking status in the analyses since smoking has been strongly associated with periodontal disease [1, 29, 36, 39, 42]. Again, no differences between the groups were observed in this respect either.

The effect on osteoporosis has been suggested to be one mechanism by which HRT may affect dental health [45]. However, in our recent study, no effect of the osteoporosis drug alendronate alone or in combination with HRT could be seen on oral health parameters except that mean resting salivary flow rate values decreased in the alendronate group [10].

HRT exerts its effects by various mechanisms and through different pathways. It can be anticipated to have beneficial effects by a variety of mechanisms also in the oral cavity. These include inhibition of matrix metalloproteinases, inhibition of prostaglandin production, stimulation of osteoblasts, inhibition of osteoclasts, and other anti-inflammatory mechanisms [24, 37]. In the study of Pilgram et al. [31] on healthy postmenopausal women, no relationship was found between radiographic alveolar bone height and probing attachment level. However, Grodstein et al. [14] had observed in their prospective study on 42,171 postmenopausal women that HRT reduced the risk for tooth loss by 24%. In their study, little effect was found in this regard in women who had stopped taking hormones. Hence, HRT may have an effect on dental health but more investigations are needed before a final conclusion can be drawn on the interaction.

The hypothesis of this study laid on the idea that those women who had chosen to take HRT in the first place were women with better health and health habits in general. According to a Finnish survey, educated women used HRT more often than less educated women did [40]. However, in the capital city area where the present study was conducted, the demographic differences in employment, social class, or level of education did not exist between HRT users and nonusers [41]. We did not however include questions on social status or education into our questionnaire, but it can well be assumed that the large population cohorts originally included (n=3,173) effectively leveled off bias in this regard [38]. Furthermore, despite the request to check the current regular medication before attending the examination, considerably many women still did not remember all their medications when filling in the questionnaire. Therefore, we had to categorize the medication fairly widely especially concerning the use of neurological and psychiatric medications and the cardiovascular medication. Use of medication (nature of drugs) did not associate with oral health variables in this material, however. Until the year 2001, Finns born before 1956 had not been eligible for any nationwide subsidized dental care in adulthood. In Helsinki, for practical reasons due to shortage of oral health care

professionals, subsidized dental care has covered only those born in 1963 and later until the year 2001. The women attending our study were all citizens of Helsinki. Therefore, the majority of the study subjects had used private dentists for their dental appointments instead of community health center clinics. Subsequently, they had mainly paid the treatment fees out of their own pockets, a fact might have affected their choices of treatment.

In conclusion, our study hypothesis was not confirmed. More prospective long-term studies are needed to clarify whether use of hormone replacement therapy correlates with oral health and oral health habits.

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