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ORIGINAL ARTICLE

The relationship between recurrent aphthous stomatitis, and periodontal disease and *Helicobacter Pylori* infection

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Abstract
Objective Recurrent aphthous stomatitis (RAS) is a common oral mucosal disease with unknown etiology. This cross-sectional study aimed to test the hypothesis that *Helicobacter pylori* and periodontal disease might play an etiological role in RAS.
Methods Dental plaque samples obtained from 38 patients with RAS and 43 healthy individuals via periodontal examinations were examined for *H. pylori* colonization. *H. pylori* was identified using the rapid urease test (RUT). The periodontal status of the patients and controls was based on the following periodontal parameters: periodontal pocket depth (PPD), the plaque index (PI), the gingival index (GI), and clinical attachment loss (CAL).
Results RUT results were positive in 34 (89.5 %) of the 38 patients and 24 (55.8 %) of the 43 controls ($P = 0.002$). There were not any significant differences in mean PPD, PI, GI, or CAL between the patient and control groups ($P > 0.05$). Mean PPD, PI, GI, and CAL were higher in the RUT-positive RAS patients than in the RUT-negative patients ($P > 0.05$, for all).
Conclusions The present findings show that *H. pylori* might have played an etiological role in RAS and might have caused periodontal disease, but RAS was not associated with any of the periodontal parameters examined in this study.
Clinical relevance The present study indicates that *H. pylori* plays a role in the development of RAS, but periodontal diseases have no effect on it. Eradicating *H. pylori* might be useful to prevent RAS.

Keywords Aphthous stomatitis · *Helicobacter pylori* · periodontal disease · dental plaque

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Introduction

Recurrent aphthous stomatitis (RAS) is among the most common diseases of the oral mucosa. It is characterized by recurrent, round, or ovoid ulcers that are painful, surrounded by inflammatory erythematous haloes, and covered with a yellow-grayish pseudomembrane [1]. Its etiology is not precisely known, but several local, systemic, immunologic, genetic, allergic, nutritional, and microbial factors have been proposed to be causative [2]. As *Helicobacter pylori* is an important risk factor for peptic ulcers, which have similar histologic characteristics as oral ulcers, and both types of ulcers can be treated with wide-spectrum antibiotics such as tetracycline, *H. pylori* is considered to be a potential factor in the development of RAS [3, 4]. It was reported that persistent inflammation and the complex microbiota in periodontal pockets may provide a suitable environment for the colonization of *H. pylori* [5]. Additionally, bacterial colonization and persistent inflammation in periodontal pockets are a significant risk factor for periodontal disease. Moreover, some bacterial species found in periodontal pockets were reported to be involved in the development of systemic diseases as a result of systemic inflammation, with an increase in circulating cytokines and mediators, direct infection, and cross-reactivity/molecular mimicry between bacterial antigens and self-antigens [6]. The

present study aimed to determine the role of oral *H. pylori* colonization and periodontal health in the development of RAS.

Materials and methods

Patients

After the study protocol was approved by the Hacettepe University School of Medicine ethics committee and the participants provided written informed consent, data were collected from 38 RAS patients and 43 controls without lesions ($n=43$). The study was conducted at the outpatient clinics of the Hacettepe University, School of Medicine, Dermatology Department and Periodontology Department, Ankara, Turkey, between June 2013 and August 2013. The diagnosis of RAS was made according to the history of ≥3 attacks of aphthous ulcer annually and clinical examination. Patients who had active ulcers at the time of examination or established ulcers in previous examinations were also included in the study. The age and gender matched controls consisted of individuals who applied for other than RAS to the dermatology outpatient clinic. Patients and controls that were aged <18 years, pregnant, had diabetes mellitus, had Behçet's disease, or had any other dermatological diseases with oral mucosal involvement were excluded from the study. Participants with a history of antibiotic or systemic anti-inflammatory drug use during the 4 weeks prior to the start of the study were also excluded. Complete patient anamnesis and the characteristics of RAS were evaluated.

Clinical periodontal parameters

The same periodontist (DK) performed periodontal examination of all the patients and controls. Immediately before the examination, the patients and controls were asked about their oral hygiene practices (usual reason for dental exams, time of last dental exam, and frequency of tooth brushing). Periodontal parameters, including periodontal probing depth (PPD), the plaque index (PI), the gingival index (GI), and the clinical attachment level (CAL), were used to evaluate the participants' periodontal health status [7, 8]. PPD which is the distance from the gingival margin to the base of the gingival sulcus and CAL which is the distance from the cementoenamel junction to the base of the gingival sulcus were measured (mm) using a William's periodontal probe. PPD and CAL scores were recorded for six tooth surfaces (mesiobuccal, mid-buccal, distobuccal, mesiolingual, mid-lingual, and distolingual) for all teeth. The numerical scores were calculated according to the following formulae:

$$\text{Score per tooth(PPD, CAL)} = \frac{\text{sum of individual tooth surface scores}}{6}$$

$$\text{Score per person(PPD, CAL)} = \frac{\text{sum of the scores for each tooth}}{\text{number of teeth}}$$

PI and GI scores were evaluated according to a 4-point scale for four tooth surfaces (mesial, distal, buccal, and lingual) [7, 8]. The scores were calculated for individual teeth and participants separately, according to the following formulae:

$$\text{Score per tooth(PI, GI)} = \frac{\text{sum of individual tooth surface scores}}{4}$$

$$\text{Score per person(PI, GI)} = \frac{\text{sum of the scores for each tooth}}{\text{number of teeth}}$$

Dental plaque collection and detection of *H. pylori*

A commercially available RUT kit (Strong Biotech Corporation, Taiwan) was used to determine the presence of *H. pylori*. Dental plaque samples were removed from two teeth with the deepest periodontal pockets using a sterile periodontal curette. Both supragingival and subgingival plaque were collected from the tooth surfaces, then immediately inoculated onto the RUT kit paper. The test kits were stored at room temperature, and test paper color change was checked 24 h later; yellow was considered negative, whereas pink or magenta was considered as a positive test result.

Statistical analysis

Statistical analysis was performed using SPSS v.21.0 software for Windows (IBM SPSS, IBM Corp., Armonk, New York, USA). Continuous variables are presented as mean ± SD. Categorical variables are presented as frequency and percentage. Continuous variables were checked for parametric test assumptions. The patient and control groups were compared using the independent samples *t* test or Mann–Whitney *U* test, as appropriate. The chi-square test or Fisher's exact test was used to compare categorical variables. Logistic regression analysis was used to determine factors including clinical periodontal parameters and RUT findings affecting RAS. The level of statistical significance was set at $P<0.05$.

Results

Demographic findings

This prospective study included 38 RAS patients (19 male and 19 female) with a mean age of 35.11 ± 10.28 years and 43 controls (21 male and 22 female) with a mean age 34.93 ± 11.03 years. There were not any significant differences in age or gender between the groups. The patients' characteristics are shown in detail in Table 1.

Table 1 Demographics and baseline characteristics of the patients

Number	38
Gender	19 M, 19 F
Mean age, years	38.11 ± 10.28
Family history	
RAS	17
Behçet's disease	3
Comorbidities	
Allergic rhinitis/asthma/urticaria	3/1/ 1
Gastritis/duodenal ulcer	2/2
Hypothyroidism/hypertension	2/2
Arthritis/erythema nodosum	2/1
Nephrolithiasis/hepatosteatosis	1/1

Disease characteristics

Characteristics of RAS, including mean duration of disease, mean ulcer healing time, types of ulcers, ulcer localization, frequency of attacks, number of lesions per attack, and precipitating factors for ulcer development, are summarized in Table 2.

Clinical periodontal parameters

Among the study participants, 13 (34.2 %) RAS patients and 11 (25.6 %) controls had dental exams for control, 21 (55.3 %) patients and 28 (65.1 %) controls had a dental exam within the previous year, and 33 (86.8 %) patients and 32 (74.4 %) controls brushed their teeth daily. Differences in the reason for dental exams, time of last dental exam, and daily tooth brushing between the RAS patients and controls were not significant, as shown in Table 3. PPD, PI, GI, and CAL scores were lower in the RAS patients than in the controls, but the differences were not significant ($P > 0.05$ for all).

RUT findings

RUT results were positive in 34 (89.5 %) patients and in 24 (55.8 %) controls; the RUT positivity rate in the patient group was significantly higher than in the control group ($P = 0.002$).

The relationship between RUT, and disease characteristics and clinical periodontal parameters

The relationship between RUT positivity, and disease characteristics and clinical periodontal parameters are presented in Table 4. The differences in the frequency of attacks and number of lesions per attack between the RUT-positive and RUT-negative patients were not significant ($P > 0.05$, for both). In addition, there were not any significant differences in the reason for dental exams, time of last dental exam, or frequency of tooth brushing between the RUT-positive and RUT-negative patients. PPD, PI, GI, and CAL scores were higher in RUT-positive patients than in the RUT-negative patients, although the differences were not significant ($P = 0.05$, for all).

Table 2 RAS characteristics

Characteristics	
Mean disease duration, years	10.53 ± 7.56 (range: 1–37)
Mean ulcer healing time, days	9.21 ± 5.00 (range: 2–25)
Type	N
Minor	21 (55.2 %)
Major	2 (5.3 %)
Minor and major	14 (36.8 %)
Minor and herpetiform	1 (2.6 %%)
Localization	
Mucosa of the upper and lower lip	36 (94.7 %)
Buccal mucosa	33 (86.8 %)
Tongue	27 (71.1 %)
Mucogingival junction	16 (42.1 %)
Frequency of attacks	
3–6 attacks per year	8 (21.1 %)
>6 attacks per year	30 (78.9 %)
Lesions per attack	
1	14 (36.8 %)
>1	24 (63.2 %)
Precipitating factors	
Stress	30 (78.9 %)
Trauma	14 (36.8 %)
Infections	14 (36.8 %)
Menstruation	7 (18.4 %)
Foods	3 (7.9 %)
Drugs	1 (2.6 %)

The results of the logistic regression analysis of the factors associated with RAS are summarized in Table 5. RUT positivity was observed to be a significant risk factor for the development of RAS ($P < 0.001$).

Discussion

Periodontal diseases are inflammatory diseases of the gums and tooth-supporting tissues that are caused by microbial shifts in the oral cavity [9–12]. As such diseases are chronic, inflammatory, and infectious in nature, they have been proposed to play an etiological or modulating role in several chronic systemic conditions, including cardiovascular and cerebrovascular disease, diabetes, respiratory disease, chronic kidney disease, adverse pregnancy outcome, and *H. pylori* infection [13–18]. It was recently reported that there is a positive correlation between periodontal disease and oral ulcers in

Table 3 Clinical periodontal parameters and RUT findings in the patient and control groups

	RAS Patients ($n=38$)	Controls ($n=43$)	P
Usual reason for dental exams			0.545
Control, *n* (%)	13 (34.2 %)	11 (25.6 %)	
Emergency, *n* (%)	25 (65.8 %)	32 (74.4 %)	
Last dental exam			0.498
within 1 year, *n* (%)	21 (55.3 %)	28 (65.1 %)	
>1 year ago, *n* (%)	17 (44.7 %)	15 (34.9 %)	
Tooth brushing			0.262
Daily, *n* (%)	33 (86.8 %)	32 (74.4 %)	
Not daily, *n* (%)	5 (13.2 %)	11 (25.6 %)	
PPD (mm)	2.22 ± 0.88	2.72 ± 1.47	0.405
PI	1.22 ± 0.58	1.31 ± 0.57	0.451
GI	1.39 ± 0.50	1.50 ± 0.41	0.358
CAL (mm)	2.42 ± 1.12	3.01 ± 1.80	0.248
RUT			0.002
Positive, *n* (%)	34 (89.5 %)	24 (55.8 %)	
Negative, *n* (%)	4 (10.5 %)	19 (44.2 %)	

Table 4 The relationship between RUT status, and oral hygiene practices and periodontal parameters in the RAS patients

	RUT positive ($n=34$)	RUT negative ($n=4$)	P
Frequency of attacks			0.189
3-6 attacks per year	6 (18 %)	2 (50 %)	
>6 attacks per year	28 (82 %)	2 (50 %)	
Lesions per attack			0.616
1	12 (35 %)	2 (50 %)	
>1	22 (65 %)	2 (50 %)	
Usual reason for dental exams			1.00
Control, *n* (%)	12 (35 %)	1 (25 %)	
Emergency, *n* (%)	22 (65 %)	3 (75 %)	
Last dental exam			1.00
within 1 year, *n* (%)	19 (56 %)	2 (50 %)	
>1 year ago, *n* (%)	15 (44 %)	2 (50 %)	
Tooth Brushing			1.00
daily, *n* (%)	29 (85 %)	4 (100 %)	
not daily, *n* (%)	5 (15 %)	0 (0 %)	
PPD (mm)	2.28 ± 0.91	1.67 ± 0.35	0.235
PI	1.24 ± 0.60	1.08 ± 0.51	0.766
GI	1.40 ± 0.52	1.25 ± 0.24	0.199
CAL (mm)	2.51 ± 1.14	1.67 ± 0.35	0.199

patients with Behcet's disease; periodontal parameter scores in patients with Behcet's disease were higher than in controls [15–18]. The similarity of the characteristics of RAS and Behcet's disease ulcers led us to consider that there might be a similar correlation between periodontal disease and RAS.

The present findings show that PPD, PI, GI, and CAL scores were lower in patients with RAS than in the controls, but that the differences were not significant ($P>0.05$ for all), which is inconsistent with the findings reported in studies on Behçet's disease [15–18]. Whereas, RAS is limited to the oral mucosa and tissue-specific autoimmunity is a probable mechanism in its pathogenesis, Behcet's disease is a systemic inflammatory disease with different pathogenetic mechanisms and may be not involved in RAS [19].

In the present study, there was not a significant difference in the frequency of tooth brushing between the RAS and control groups. The frequency of tooth brushing was high enough in the patient group, despite the pain associated with the ulcers and the effect of the trauma of tooth brushing on the development of RAS. Logically, it would be expected that RAS patients would avoid tooth brushing due to the pain and trauma, but the present findings indicate otherwise. RAS is a painful disease that can negatively affect quality of life [20]; therefore, we think that the present study's RAS patients might have been vigilant about their oral hygiene and might have visited their dentists regularly in an effort to mediate such negative effects.

Recent findings concerning the role of *H. pylori* in RAS are inconsistent [21]. Based on the similarity of the histologic features of gastric and oral ulcers, and the fact that both types of ulcers can be treated with wide-spectrum antibiotics such as tetracycline, *H. pylori* is suspected to play a role in the in pathogenesis of RAS [3, 4]. Birek et al. [22] suggested that adherence of *H. pylori* to the oral mucosa and subsequent production of autoantibodies to epitopes shared by oral epithelium cells and *H. pylori* might result in the tissue destruction associated with RAS. They postulated that *H. pylori* might be a cofactor in the pathogenesis of RAS, especially in individuals sensitized via gastric colonization and mucosal attachment [22]. In addition, some researchers report that oral *H. pylori* colonization might arise from gastric colonization via gastroesophageal reflux [23]. In the present study, the observed high prevalence of *H. pylori* colonization in the RAS patients further indicates that *H. pylori* plays a role in the pathogenesis of RAS; however, while investigating the role of *H. pylori* colonization, it was not determined if the source of *H. pylori* was a permanent reservoir in the oral mucosa or gastric colonization. In addition, such symptoms as dyspepsia

Table 5 Logistic regression analysis of the factors associated with RAS

	OR (95 % CI)	P
PPD	0.5 (0.08–2.96)	0.442
PI	1.1 (0.29–4.07)	0.892
GI	1.0 (0.18–5.65)	0.981
CAL	0.9 (0.21–3.94)	0.907
RUT	16.5 (4.3–64.2)	<0.001

and loss of appetite, which can be associated with oral or gastric *H. pylori* colonization were not investigated; both omissions are limitations of the present study.

There are several methods for detecting *H. pylori* in gastric mucosa [24]. Studies have reported that RUT has a specificity near 100 % and sensitivity between 70 and 90 % in gastric biopsy samples [25, 26]. In the present study, we found positivity of RUT in 89.5 % of the patients and in 55.8 % of controls. Although urease tests are reasonably specific for detection of the microorganism in gastric biopsy specimens, investigators have doubted its reliability for detecting *H.pylori* in oral specimens because of other urease-producing bacteria, including *Streptococcus vestibularis* and *Actinomyces viscosus* [27, 28]. As such, we think the present findings must be confirmed based on more sensitive techniques such as polymerase chain reaction (PCR). In the present study, *H. pylori* was detected in dental plaque samples obtained during dental examinations. *H. pylori* has also been isolated from saliva and the oral mucosa via swabbing [5]; as such, we think it may be practical to routinely collect samples via swabbing and perform RUT in dermatology outpatient clinics.

In the present study, there was not a relationship between RUT positivity and the severity of RAS, according to the frequency of attacks and number of lesions per attack. In addition, *H. pylori* colonization was associated with RAS, but not the severity of RAS, but we think more research is warranted in order to clarify the relationship between oral *H. pylori* colonization and the severity of RAS.

In addition to investigating the role of *H. pylori* colonization in the development of RAS, the present study evaluated its effect on periodontal parameters in RAS patients. All clinical periodontal parameters were higher in the present study's RUT-positive patients than in the RUT-negative patients, but the differences were not significant. According to the literature, the precise role of *H. pylori* colonization in periodontal disease remains unknown, but numerous studies have reported *H. pylori* colonization in 5.9–79 % of subgingival plaque samples in patients with periodontitis [29–32]. In contrast to reports of the role of *H. pylori* colonization in periodontal disease, Namiot et al. [33] reported that there is not a correlation between dental plaque *H. pylori* antigen and the number of natural teeth, carious teeth, filled teeth, the plaque index, or the periodontal index. Okuda et al.[34] reported that *Streptococcus mutans* and *Prevotella intermedia* inhibited *H. pylori* growth in the oral cavity, which led us to hypothesize that the increase in the populations of these bacteria in cases of periodontal disease might inhibit oral *H. pylori* colonization, but the present findings did not support the hypothesis.

In conclusion, the present findings indicate that there might be an association between *H. pylori* and RAS, but periodontal parameters have no effect on the development of RAS. The small sample size of 38 patients and short inclusion period of 3 months are limitations of the study. Additional studies, with larger sample sizes and longer inclusion periods, are required to more clearly understand the correlations between *H. pylori* and RAS and periodontal disease.

Compliance with ethical standard

Conflict of interest The authors declare that they have no competing interests.

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Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Chattopadhyay A, Shetty KV (2011) Recurrent aphthous stomatitis. Otolaryngol Clin N Am 44:79–88
2. Akintoye SO, Greenberg MS (2005) Recurrent aphthous stomatitis. Dent Clin N Am 49:31–47
3. Fritscher AM, Cherubini K, Chies J et al (2004) Association between Helicobacter pylori and recurrent aphthous stomatitis in children and adolescents. J Oral Pathol Med 33:129–132
4. Hernando-Harder AC, Booken N, Goerdt S et al (2009) Helicobacter pylori infection and dermatologic diseases. Eur J Dermatol 19:431–444
5. Bago I, Bago J, Plečko V et al (2011) The effectiveness of systemic eradication therapy against oral Helicobacter pylori. J Oral Pathol Med 40:428–432
6. Inaba H, Amano A (2010) Roles of oral bacteria in cardiovascular diseases—from molecular mechanisms to clinical cases: Implication of periodontal diseases in development of systemic diseases. J Pharmacol Sci 113:103–109
7. Silness J, Loe H (1964) Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condtion. Acta Odontol Scand 22:121–135
8. Loe H, Silness J (1963) Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontol Scand 21:533–551
9. Huck O, Tenenbaum H, Davideau JL (2011) Relationship between periodontal diseases and preterm birth: recent epidemiological and biological data. J Pregnancy 2011:164654
10. Michalowicz BS, Wolff LF, Klump D et al (1999) Periodontal bacteria in adult twins. J Periodontol 70:263–273
11. Pihlstrom BL, Michalowicz BS, Johnson NW (2005) Periodontal diseases. Lancet 366:1809–1820
12. Socransky SS, Haffajee AD (2005) Periodontal microbial ecology. Periodontol 38:135–187
13. Boylan MR, Khalili H, Huang ES et al (2014) A prospective study of periodontal disease and risk of gastric and duodenal ulcer in male health professionals. Clin Transl Gastroenterol 5:49
14. Detert J, Pischon N, Burmester GR et al (2010) The association between rheumatoid arthritis and periodontal disease. Arthritis Res Ther 12:218

15. Mumcu G, Ergun T, Inanc N et al (2004) Oral health is impaired in Behçet's disease and is associated with disease severity. Rheumatology (Oxford) 43:1028–1033
16. Karacayli U, Mumcu G, Simsek I et al (2009) The close association between dental and periodontal treatments and oral ulcer course in behcet's disease: a prospective clinical study. J Oral Pathol Med 38: 410–415
17. Celenligil-Nazliel H, Kansu E, Ebersole JL (1999) Periodontal findings and systemic antibody responses to oral microorganisms in Behçet's disease. J Periodontol 70:1449–1456
18. Akman A, Kacaroglu H, Donmez L et al (2007) Relationship between periodontal findings and Behçet's disease: a controlled study. J Clin Periodontol 34:485–491
19. Nakae K, Agata T, Maeda K, Masuda K, Hash|moto T, Inaba G (1981) Behcet's disease, pathogenic mechanism and clinical future: case control studies on Behcet's disease. University of Tokyo Press, Tokyo, pp 41–49
20. Hapa A, Aksoy B, Polat M et al (2011) Does recurrent aphthous stomatitis affect quality of life? A prospective study with 128 patients evaluating different treatment modalities. J Dermatol Treat 22:215–220
21. Li L, Gu H, Zhang G (2014) Association between recurrent aphthous stomatitis and Helicobacter pylori infection: a meta-analaysis. Clin Oral Investig 18:1553–1560
22. Birek C, Grandhi R, McNeill K et al (1999) Detection of Helicobacter pylori in oral aphthous ulcers. J Oral Pathol Med 28: 197–203
23. Kignel S, de Almeida Pina F, André EA et al (2005) Occurrence of Helicobacter pylori in dental plaque and saliva of dyspeptic patients. Oral Dis 11:17–21
24. Bytzer P, Dahlerup JF, Eriksen JR et al (2011) Diagnosis and treatment of Helicobacter pylori infection. Dan Med Bull 58:C4271
25. McNulty CAM (1992) Detection of Helicobacter pylori by the biopsy urease test. In: Rathbone BJ, Heatley RV (eds) Helicobacter pylori and gastroduodenal Disease. Blackwell Scientific, Oxford, pp 58–59
26. Deltesre M, Burette A, Glupcaynski Y (1988) Rapid identification of Campylobacter pylori in gastric biopsies. In: Menge H, Greyar M, Tytgot GNJ (eds) Campylobacter pylori. Springer Verlag, Berlin, pp 135–144
27. Madinier IM, Fosse TM, Monteil RA (1997) Oral carriage of Helicobacter pylori: a review. J Periodontol 68:2–6
28. Dowsett SA, Kowolik MJ (2003) Oral Helicobacter pylori: can we stomach it? Crit Rev Oral Biol Med 14:226–233
29. Riggio MP, Lennon A (1999) Identification by PCR of Helicobacter pylori in subgingival plaque of adult periodontitis patients. J Med Microbiol 48:317–322
30. Anand PS, Nandakumar K, Shenoy KT (2006) Are dental plaque, poor oral hygiene, and periodontal disease associated with Helicobacter pylori infection? J Periodontol 77:692–698
31. Tinoco EMB, Beldi MI, Campedelli F et al (1998) Clinical and microbiological effects of adjunctive antibiotics in treatment of localized juvenile periodontitis. A controlled clinical trial. J Periodontol 69:1355–1363
32. Engstrand L, Nguyen AM, Graham DY (1992) Reverse transcription and polymerase chain reaction amplification of rRNA for detection of Helicobacter sp. J Clin Microbiol 30:2295–2301
33. Namiot DB, Leszczyńska K, Namiot Z et al (2010) The occurrence of Helicobacter pylori antigens in dental plaque; an association with oral health status and oral hygiene practices. Adv Med Sci 55:167–171
34. Okuda K, Kimizuka R, Katakura A et al (2003) Ecological and immunopathological implications of oral bacteria in Helicobacter pylori-infected disease. J Periodontol 74:123–128