Gingival Recession Associated With Predisposing Factors in Young Vietnamese: A Pilot Study

Tung Nguyen-Hieu[1], Bao-Dan Ha-Thi[2], Hang Do-Thu[2], Hoa Tran-Giao[3]

[1]PhD, DDS. † [2]MSc, DDS.* [3]DDS.**
Department of Periodontology, Faculty of Odonto-Stomatology, University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam.
†Unité de Recherche sur les Maladies Infectieuses et Tropicales Emergentes, UM 63, CNRS 7278, IRD 198, INSERM 1095, Aix-Marseille Université, Marseille, France.

Abstract
Aims: Several studies have shown a large diversity in the prevalence, extent and severity of gingival recession as well as controversial conclusions of its associated factors. Therefore, the aim of this pilot study was to evaluate gingival recession with predisposing factors in young Vietnamese.
Methods: A cross-sectional study using clinical examination was performed in 120 dental students. Oral hygiene status, tooth malposition and fraenal attachment were recorded. The width of keratinised gingiva was measured after mucosa staining with Lugol's iodine solution. Measurements of gingival recession were performed on labial tooth surfaces. Chi-square test, t-test and Pearson's correlation were used for data analysis.
Results: The prevalence of gingival recession was 72.5% of the studied population. The extent of affected teeth was 11.1% of the examined teeth. The proportion of root-surface exposure was statistically higher (P<0.05) in the maxilla (12.5%) than in the mandible (9.6%). Premolars and right canines were the teeth most frequently and most seriously associated with gingival recession, respectively. There was a strong negative correlation between narrow width of keratinised gingiva and gingival recession (P<0.001). The recession was statistically associated with tooth malposition (P<0.001) but it was not related to high fraenal attachment and gender.
Conclusions: A high prevalence of gingival recession was found in Vietnamese dental students. Gingival recession was associated with narrow width of keratinised gingiva, tooth malposition and maxillary teeth. Further studies performed in larger populations with more extended age groups are needed to confirm these findings.

Key Words: Gingival Recession, Prevalence, Severity, Extent, Tooth Malposition, Fraenal Attachment, Keratinised Gingiva

Introduction

Gingival recession has been defined as a displacement of gingival margin apically from the cemento-enamel junction (CEJ), leading to root-surface exposure, which may cause poor aesthetics, dentine hypersensitivity, plaque retention, gingival bleeding, susceptibility for root caries and fear of tooth loss [1-3]. A denuded root surface frequently results from a combination of predisposing and triggering/aggravating factors. Predisposing factors included bone dehiscence, insufficiency of width and/or thickness of keratinised gingiva, tooth malposition and high fraenal attachment. The triggering/aggravating factors may include: traumatic tooth-brushing, non-carious cervical lesions (abrasion, abfraction, erosion, resorption), inflammation (dental plaque, calculus, gingivitis, periodontitis), iatrogenic factors (inappropriate fixed prostheses, poorly designed partial dentures, operative procedures, orthodontic treatment, traumatic occlusion) and diverse factors (age, gender, piercing, chewing stick trauma) [3,4]. A high prevalence of gingival recession has been reported in America (63%-89%) [5-7], Europe (25%-84%) [8-13] and Australia (71%) [14] but a lower prevalence has been found in Africa (28%) [15,16] and Asia (15%) [17]. However, the extent of root-surface exposure was higher in Africa (18%-51%) [15,16] and America

Corresponding author: Tung Nguyen-Hieu, Unité de Recherche sur les Maladies Infectieuses et Tropicales Emergentes, Faculté de Médecine, Aix-Marseille Université, 27 boulevard Jean Moulin, 13005 Marseille, France; e-mail : nguyen.hieu.tung@gmail.com

(38%-44%) [5-7] than in Europe (5%-17%) [8-13], Australia (4.6%) [14] and Asia (2%) [17]. There are limited published data concerning the prevalence, extent, and severity, as well as associated factors of gingival recession in Asia [16,18]. Furthermore, conclusions of the association between gingival recession and predisposing factors including width of keratinised gingiva [12], fraenum attachment [13,18] and tooth malposition [15,18,19] are still controversial [20]. Although the aetiology of root-surface exposure is multifactorial, determining the influence of predisposing factors has an important role in management of gingival recession such as increasing keratinised tissue, fraenectomy or orthodontic treatment.

Aim

The aim of this pilot study was to measure gingival recession in a population of 19-25 year-old dental students for preliminary assessment of the prevalence, extent, severity of gingival recession and its predisposing factors including width of keratinised gingiva, tooth malposition and fraenal attachment in Vietnamese young adults.

Methods

Target population

A cross-sectional study using a clinical examination was performed in a population of 120 dental students of University of Medicine and Pharmacy of Ho Chi Minh City in Vietnam. These subjects were randomly selected from about 600 students of Faculty of Odonto-Stomatology. Briefly, 80-120 dental students from every class were classified into ten groups of 8-12 students, from which two groups were randomly selected. A total of 12 groups including 120 students from six classes agreed to participate in this study after reading the research objectives and signing a consent form. Only 19-25 year-old students, non-smoking and those having more than 24 teeth (excluding third molars) were included. Students with a history of orthodontic or periodontal treatment were excluded. The type of toothbrush (soft, medium or hard) used by the students was recorded.

Clinical examination and measurements

All clinical examinations were performed by two periodontists (B-D H-T and H D-T) who had previously calibrated by recording all clinical measurements to be used in the study on ten dental students. They obtained a kappa index of agreement of more than 0.8. Oral hygiene status was evaluated by Simplified Oral Hygiene Index (OHI-S) [21]. Labial surfaces of upper first molars and lingual surfaces of lower first molars (sometimes second molars because of first molar loss) and the labial surfaces of upper right and lower left central incisors were assessed for debris and calculus accumulations. The OHI-S has two components including the Simplified Debris Index (DI-S) and the Simplified Calculus Index (CI-S), which are based on numerical determinations representing the amount of debris and calculus found on the selected tooth surfaces. Each of these indices has scores from 0-3 corresponding with an absence of soft debris/calculus, their amount covering one-third, two-thirds, and more than two-thirds of the examined tooth surface, respectively.

All excluded sites including absent teeth, tooth roots and tooth-supported fixed prostheses (crowns and bridges) were noted. Tooth malpositions including overeruption, rotation and other malalignment were also recorded. The position of the CEJ was determined by visual observation and the "slight scratch" of a periodontal probe on the cervical tooth area in a cervico-occlusal direction. If there were non-carious cervical (wear) lesions or cervical restorations, the position of the CEJ was considered as corresponding with that of adjacent teeth. Gingival recession was evaluated by using a millimetre-graduated periodontal probe to measure from the free gingival margin to the CEJ at the site of maximum gingival recession on the labial surface of each tooth (excluding third molars). In order to localise the mucogingival junction (MGJ), both the gingiva and buccal mucosa were rinsed with water, dried and then stained with 3% Lugol's iodine solution (3 g of elemental iodine and 6 g potassium iodine in 300 mL sterile water) by using a cotton swab. After two minutes, highly keratinised epithelium did not retain the Lugol's iodine solution while buccal mucosa was stained a red-brown colour. The width of keratinised gingiva of each tooth (excluding third molars and previously excluded sites) was measured by using a millimetre-graduated periodontal probe from MGJ to free gingival margin with 1.0 mm precision. Fraenal attachments were also assessed according to the Placek *et al.* (1974) classification [22] in which four levels of labial fraenal attachments are mucosal, gingival, papillary and papillary penetrating. After clinical examination, participants were given oral hygiene instruction and advice on how to control the progression of gingival recession as well as suggestions for appropriate treatment.

Data analysis

For assessing the oral hygiene status, OHI-S value was calculated and classified from 0-1.2 for good status, 1.3-3.0 for medium status and 3.1-6.0 for poor status. Values of DI-S and CI-S were combined to obtain OHI-S value as follows: DI-S = (total scores of debris)/(total number of tooth surfaces with debris), CI-S = (total scores of calculus)/(total number of tooth surfaces with calculus) and OHI-S = (DI-S + CI-S) [21]. Descriptive statistics and the chi-square test were carried out to characterise the prevalence, extent, severity of gingival recession, and the predisposing factors. In this study, the prevalence of gingival recession was the percentage of patients with at least one gingival recession in the studied population, the extent was the percentage of teeth associated with root-surface exposure in examined teeth, and the severity was the level of apical migration of marginal gingiva from the CEJ. The Student's t-test was used to compare keratinised gingiva widths between teeth with and without root-surface exposure. The correlation between keratinised tissue and gingival recession was assessed by Pearson's correlation coefficient. These statistical analyses were independently performed by a specialist using statistical software (Statistical Package for the Social Sciences, version 15.0; SPSS Inc, Chicago, USA). Differences were considered statistically significant when the P-value was <0.05.

Results

Prevalence, extent and severity of gingival recession

The study group comprised 60 males and 60 females with mean age of 22.3±2.0 years. Ninety-six (80%) subjects had a good status of oral hygiene according to the OHI-S value and 116 (97%) subjects used soft/medium toothbrushes. The prevalence of gingival recession (at least one tooth with denuded root surface ≥1.0 mm) was 87/120 (72.5%). This prevalence was slightly higher in females (45/60, 75%) than in males (42/60, 70%) but this difference was not statistically significant.

Among a total of 3269 examined teeth (1634 teeth in the maxilla and 1635 teeth in the mandible), there were 362 teeth (11.1%) with gingival recession. The proportion of root denudation was statistically higher (chi-square test, P<0.05) in the maxilla (205/1634, 12.5%) than in the mandible (157/1635, 9.6%). Furthermore, teeth most frequently associated with gingival recession were the left first molar (35/116, 30.2%) and the right first premolar (31/114, 27.2%) in the maxilla and the right second premolar (24/113, 21.2%) and left first premolar (25/119, 21%) in the mandible (*Figure 1*). In the maxilla, a decreasing degree of root-surface exposure was observed as follows: premolars (84/205, 41%) > molars (74/205, 36.1%) > canines (34/205, 16.6%) > incisors (13/205, 6.3%). In the mandible, this was found as follow: premolars (90/157, 57.3%) > molars (37/157, 23.6%) > incisors (18/157, 11.5%) > canines (12/157, 7.6%).

Students with gingival recession had mean measurements of denuded root surface from 1.0-1.9 mm in both maxilla and mandible. The most serious gingival recession was detected at upper right canines (1.9±1.2 mm) and lower right canines (1.9±1.3 mm) (*Figure 2*).

Predisposing factors associated with gingival recession

Overall, the width of keratinised gingiva was more important in the regions of incisors and molars and less important in the regions of canines and premolars. Teeth with gingival recession had a greater reduced width of keratinised gingiva than non-affected teeth. In particular, these differences were statistically significant in all premolars (t-test, P<0.05) and right canines (*t*-test, P<0.01) of both the maxilla and the mandible (*Figure 3*). A negative correlation was also found between the frequency of root-surface exposure and width of keratinised gingiva (Pearson's correlation, r=-0.33, P<0.001). A narrow width of keratinised gingiva (≤2 mm according to classification of Maynard and Wilson, 1980) [23] was observed in 388 (11.9%) of the teeth. Teeth with a narrow width of keratinised gingiva had a higher prevalence of gingival recession (111/388, 28.6%) than teeth with a broad width of attached gingiva (251/2881, 8.7%) and this difference was statistically significant (chi-square test, P<0.001) (*Table 1*). Gingival/papillary attachments of fraenal (types II, III and IV according to classification of Placek *et al.* (1974) [22]) were only detected at 64 (1.9%) teeth. Teeth with these high fraenal attachments had a lower frequency of denuded root surface (3/64, 4.7%) than teeth without this feature (359/3205, 11.2%) but this dif-

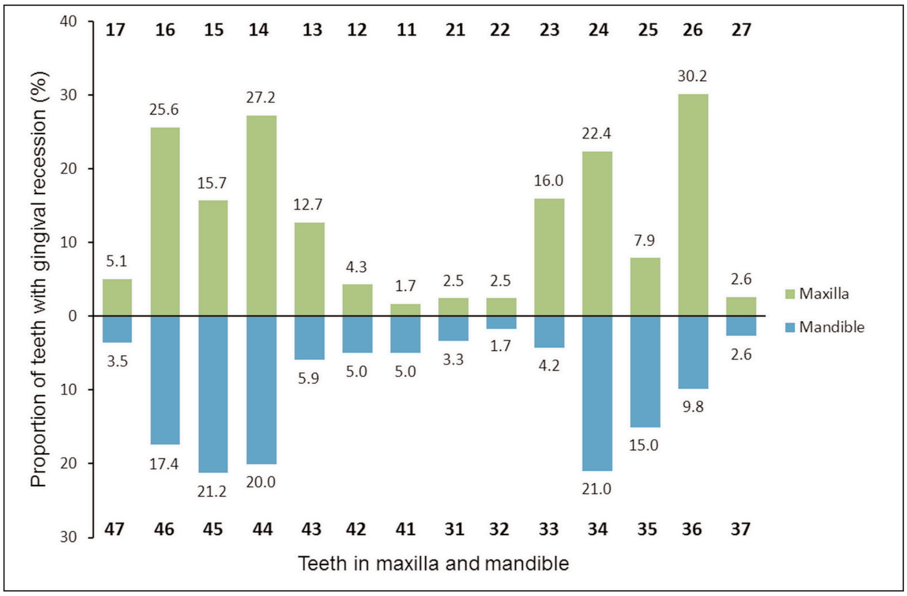

Figure 1. *Extent of gingival recessions in the maxilla and the mandible.*

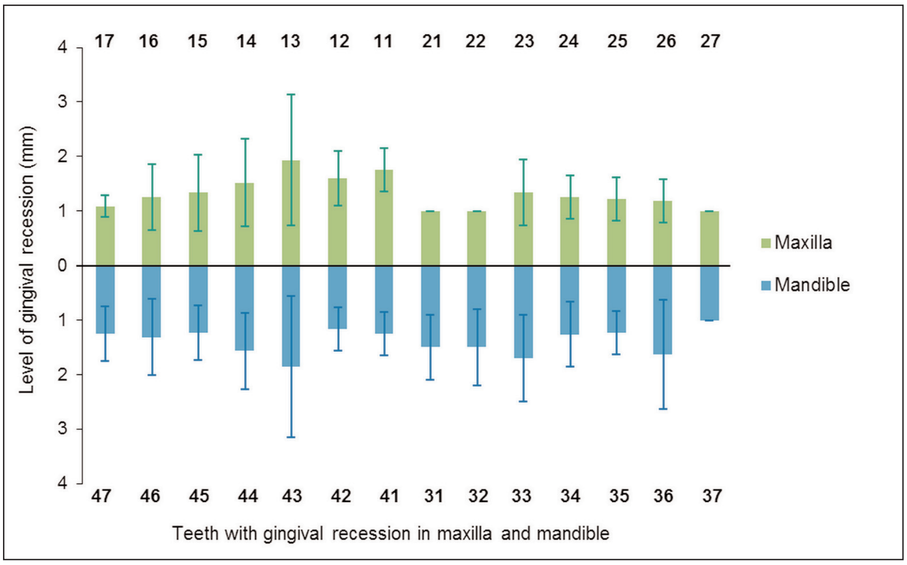

Figure 2. *Severity of gingival recession in the maxilla and the mandible*

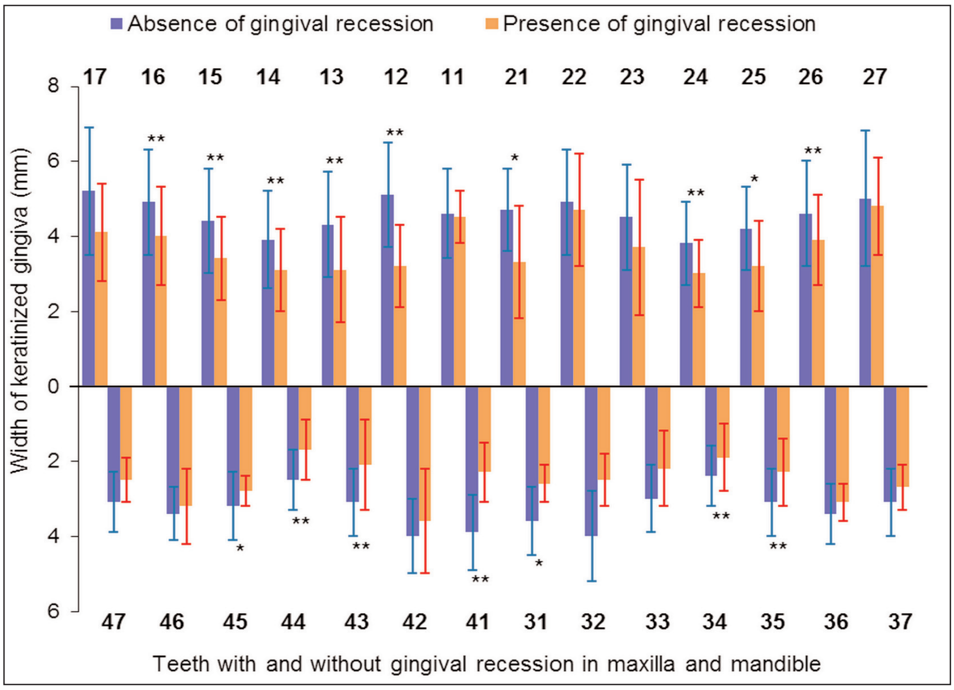

Figure 3. *Width of keratinised gingiva between teeth with and without gingival recession.(t-test: **:P<0.01; *:P<0.05)*

***Table 1.** Correlations between gingival recessions and predisposing factors*

Predisposing factors	Number of teeth (%)		P*
	Without recession	With recession	
Normal width of keratinised gingiva (> 2 mm)	2630 (91.3%)	251 (8.7%)	<0.001
Narrow width of keratinised gingiva (≤ 2 mm)	277 (71.4%)	111 (28.6%)	
No fraenum/normal fraenal attachments	2846 (88.8%)	359 (11.2%)	>0.05
Gingival/papillary fraenal attachments	61 (95.3%)	3 (4.7%)	
Normal position teeth	2658 (89.9%)	298 (10.1%)	<0.001
Tooth malposition	249 (79.6%)	64 (20.4%)	

* Chi-square test

ference was not statistically significant (chi-square test, *P*>0.05). The proportion of malpositioned teeth was 313/3269 (9.6%), of which dental rotation (117/3269, 3.6%) and labial declination (67/3269, 2%) were most frequently found. Malaligned teeth had a higher prevalence of gingival recession (64/313, 20.4%) than normally positioned teeth (298/2956, 10.1%) and this difference was statistically significant (chi-square test, *P*<0.001) (*Table 1*). Of the 362 teeth associated with root-surface exposure, 111 (30.7%) teeth had a narrow width of keratinised gingiva, 64 (17.7%) teeth were related to dental malpositions, only 3 (0.8%) teeth were associated with high fraenal attachments, and 219 (60.5%) teeth were still non-identified aetiology.

Discussion

In this study, 19-25 year-old students were included because their permanent dentition was relatively complete and the occurrence of gingival recession had previously been detected in this age group. Only subjects without triggering/aggravating factors (smoking, orthodontic/periodontitis treatment, periodontal surgery, and fixed prostheses) of gingival recession were selected to assess the influence of predisposing factors. The reasons for these exclusions were that gingival recession might be related to young adults having orthodontic treatment [17,24]. Moreover, periodontitis is a bacterial infection and inflammation, leading to bone destruction along with an apical migration of junctional epithelium. Periodontal surgery-including the opened flap associated with root surface debridement and the apically repositioned flap for eliminating pockets-can also lead to root-surface exposure [3]. Although gingival recession is more frequently observed in smokers than in non-smokers [7,10,13], the risk of gingival recession attributable to smoking is still controversial [17,25]. Because poor crown margins can be a factor in attachment loss and gingival recession [26], sites with fixed prostheses were also excluded. Although several studies have indicated that dental plaque, gingival inflammation and calculus were significantly associated with root-surface exposure [7,10,16,18,19], gingival recession more frequently occurred in patients having good rather than poor oral hygiene [2,27]. The oral hygiene of dental students who took part in the current study was evaluated by using OHI-S, which may be suitable for subsequent studies assessing oral hygiene and gingival recession in wider populations of non-dental students. In this pilot study, the majority of dental students had a good level of oral hygiene and their use of soft/medium toothbrushes suggested that they had high awareness of the need for good oral health. Therefore, the orodental status of these dental students almost certainly differs from that of young adults in the overall Vietnamese population. This is a limitation of the study in that the results cannot safely be generalised to all Vietnamese young people. However, these preliminary results can be used as reference for further studies in a larger population with wider age groups.

A review of the literature from 1982 to 2011 on the prevalence, extent, severity and associated factors of gingival recession is summarised in *Table 2.* Studies targeting 15-32 year-old subjects [8,9,12,14,17,18] or this age group in a large population [6,7,11] showed 29%-76% subjects were associated with at least one root-surface exposure ≥1 mm and an extent of from 2%-18% of teeth. In the current study, gingival recession was detected in 72.5% of Vietnamese dental students with the same age range. Indeed, this high prevalence was similar to that reported in France (76%) [12], Italy (64%) [8], Brazil (64%-77%) [6,7]. The extent of affected teeth in the current study (11.1%) was also in agreement with previous studies in France

Table 2. *Studies of prevalence extent, severity and associated factors of gingival recession (GR) (continued over)*

Authors ***Study***	**Year** ***Country***	**Population [males/females]** ***Years of age (mean)***	**Prevalence (% subjects with GR)** ***Examined surfaces***	**Extent (% teeth with GR)** ***Most frequent teeth***	**Severity**	**Associated factors**	**Non-associated factors**
Tenenbaum ***Cross-sectional***	1982 *France*	100 dental students [68/32] *19-26 (21.7)*	76/100 (76%) Male = female *Labial*	320/2725 (11.7%) *First premolars*	-	Attached gingiva (*r* = -0.201, *P*<0.05)	Oral hygiene status, fraenum attachment
Khocht ***et al.*** ***Cross-sectional***	1993 *USA*	182 subjects *18-65*	(63%) Male > female	-	-	Age, tooth brushing frequency	-
Serino ***et al.*** ***Cross-sectional and longitudinal***	1994 *Sweden*	225 subjects *18-65*	(25%) 18-29 years: (44%) *Labial*	1373/5168 (26.6%) 18-29 years: (7%) *Upper first molars and premolars*	-	Age, loss of approximal attachment (multiple regression model, *P*<0.01)	Gingival inflammation
Van Palenstein Helderman ***et al.*** ***Cross-sectional***	1998 *Tanzania*	575 subjects [350/225] *20-64*	*Labial and lingual*	20-34 years: (18%) 35-44 years: (31%) 45-64 years: (51%)	Most serious: lingual surface of lower incisors	Calculus (Pearson correlation, *P*<0.05), age	-
Checchi ***et al.*** ***Cross-sectional***	1999 *Italy*	55 dental students [29/26] *19-26*	(64%) Male < female *Labial*	Left side (55%) > right side (45%) *Premolars*	-	Tooth-brushing (multiple regression model, *P*<0.05)	Age, gender
Arowojolu ***Cross-sectional***	2000 *Nigeria*	491 subjects [259/232] *16-82*	137/491 (27.7%)	-	-	Tooth malalignment, chewing stick trauma, traumatic tooth-brushing, calculus	-
Dodwad ***Cross-sectional***	2001 *India*	1200 GR patients [804/396] *15-24*	*Labial*	*Mandibular anterior teeth*	Classification of Miller: I (86.2%), II (11.8%), III (1.8%), IV (0.6%)	Tooth-brushing method and tooth-brush type, plaque and gingival inflammation, malaligned teeth (chi-square test, *P*<0.001), fraenal pull	-
Marini ***et al.*** ***Cross-sectional***	2004 *Brazil*	380 subjects [146/234] *≥ 20*	338/380 (89%) 20-29 years: (64%) *Labial and lingual*	3526/9379 (38%) 20-29 years: (13.9%) Mandible > Maxilla *Mandibular central incisors*	Classification of Miller: I (59.2%), II (2.8%), III (32.5%), IV (5.6%)	Age	-
Susin ***et al.*** ***Cross-sectional***	2004 *Brazil*	1586 subjects [719/867] *14-103* *(37.9 ± 13.3)*	(83.4%) 20-29 years: (76.5%) Male = female *Labial and lingual*	(43.5%) 20-29 years: 18.1% *Mandibular incisors*	GR ≥ 3 mm (51.6 %), GR ≥ 3 mm (22 %)	Cigarette smoking, supragingival calculus (Wald test, *P*<0.05 and relative risk ratio, *P*<0.05), age (*P*<0.01)	Gender, race, dental visits, socio-economic status
Kozlowska ***et al.*** ***Cross-sectional***	2005 *Poland*	455 medical students *18-32*	134/455 (29.4%) Male < female *Labial*	(5.1%) *Premolars and lower canines and incisors*	-	Age, tooth-brush and tooth-brushing, female gender (multiple regression model, *P*<0.05)	-

Table 2. *Studies of prevalence extent, severity and associated factors of gingival recession (GR) (continued)*

Authors ***Study***	**Year** ***Country***	**Population [males/females]** ***Years of age (mean)***	**Prevalence (% subjects with GR)** ***Examined surfaces***	**Extent (% teeth with GR)** ***Most frequent teeth***	**Severity**	**Associated factors**	**Non-associated factors**
Thomson *et al.* ***Longitudinal***	2006 *New Zealand*	915 subjects [469/446] *32*	628/882 (71.2%) *Labial and lingual*	(4.6%) Lower incisors	-	-	Age
Slutzkey& Levin ***Cross-sectional***	2007 *Israel*	303 subjects [126/177] *18-22*	(14.6%) Male > female *Labial surface*	(1.6%)	GR = 1-2 mm (79.5%), GR ≥ 3 mm (20.5%)	Past orthodontic treatment and oral piercing (Fisher exact test and Pearson chi-square test, $P<0.01$)	Dental plaque, gingivitis, smoking
Toker&Ozdemir ***Cross-sectional***	2008 *Turkey*	831 subjects [294/537] *15-68* *(32.2 ± 11.7)*	(78.2 %) Male > female ($P<0.05$) *Labial and lingual*	(17.4%) Maxilla < Mandible ($P<0.05$) *Mandibular incisors and right canine*	GR = 3-4 mm (0.8 %), GR ≥ 5 mm (0.2%)	Age, high fraenum, traumatic tooth-brushing, smoking duration (multiple regression model, $P<0.05$), male gender, dental plaque and calculus-	-
Sarfati *et al.* ***Cross-sectional***	2010 *France*	2074 subjects [1017/1057] *35-65 (49 ± 9)*	(84.6 %) *Labial*	2-5 teeth with GR (29.2% subjects) 6-9 teeth with GR (20.5% subjects) ≥ 10 teeth with GR (24.6% subjects)	GR = 1-3 mm (76.9 %), GR = 4-5 mm (5.9 %), GR ≥ 6 mm (1.8 %)	Age, male gender, number of missing teeth, plaque index, gingival bleeding index, tobacco consumption (multiple regression model, $P<0.05$)	Diabetes, increase of body mass index, alcohol intake, dental visits
Chrysantha-kopoulos *et al.* ***Cross-sectional***	2011 *Greece*	344 GR patients [165/179] *18-68* *(46 ± 3.8)*	*Labial*	*Maxillary molars*	Classification of Miller: I (79.4%), II (15.3%), III (4%), IV (1.2%)	Tooth-brush type and brushing method, dental plaque and gingival inflammation, malpositioned teeth (chi-square test, $P<0.05$)	-
Nguyen-Hieu *et al.* ***Cross-sectional***	This study *Vietnam*	120 dental students [60/60] *19-25* *(22.3 ± 2.0)*	87/120 (72.5%) Male < female *Labial*	362/3269 (11.1%) Maxilla > Mandible ($P<0.01$) *Premolars*	GR = 1.0-3.2 mm, Most serious: Upper right canines (1.9 ± 1.2 mm) and lower right canines (1.9 ± 1.3 mm)	Keratinised gingiva (Pearson correlation, *t*-test, and chi-square test, $P<0.001$), tooth malposition (chi-square test, $P<0.001$)	High fraenum attachment

(11.7%) [12] and Brazil (13.9%) [6]. Hence, the findings seemed to be similar to those reported in Europe and America but they were very different from those found in Asia (only 14.6% of 18-22 year-old subjects in Israel and 1.6% of teeth associated with at least one root-surface exposure) [17]. Although in the current study the prevalence of gingival recession was slightly higher in females than in males, this difference was not statistically significant. This result was in agreement with the majority of previous studies [7-9,12] excluding a study in Turkey [13], which found that males had more gingival recession than females. Moreover, the proportion of affected teeth in the current study was statistically higher in the maxilla than in the mandible whereas two previous studies [6,13] reported an opposite finding. This contradiction could be explained by the assessment of gingival recession of both labial and lingual tooth surfaces in these two studies. Indeed, the frequent accumulation of calculus on the lingual surface of lower incisors increased the proportion of root-surface exposure in mandible [7,13,16]. Therefore, teeth most frequently associated with gingival recession also varied according to which tooth surfaces were examined. Studies assessing both labial and lingual surfaces have usually found that the most frequently affected teeth were mandibular incisors [6,7,13, 14,16] whereas studies assessing only labial surfaces have suggested premolars or upper first molars as most frequently associated with gingival recession [8,9,11,12,19]. Accordingly, maxillary and mandibular premolars were most frequently associated with gingival recession in the current study. The narrowest width of keratinised gingiva was also found in premolar regions. Moreover, the study of Joshipura *et al.* (1994) suggested that gingival recession might be due to tooth-brushing force in premolars or debris/calculus accumulation in molars [28]. A significant negative correlation has also been found between gingival recession and dental plaque [29]. However, the role of calculus as an aetiological factor or consequence of gingival recession is disputed [6].

Although many studies have confirmed the influence of toothbrush type, tooth-brushing method and tooth-brushing frequency on the incidence of gingival recession [5,8,9,13,18,19], a systematic review by Rajapakse *et al.* (2007) concluded that data to support or refute this relation were inconclusive [30]. The highest level of evidence leading to this conclusion was presented in just one abstract of an industry-sponsored randomised controlled clinical trial and after presentation at a scientific conference, this full trial had not been published [31]. Interestingly, in the current study it was observed that the most serious gingival recession was found in right canines of both the maxilla and the mandible. According to the evaluation of root-surface exposure in left- and right-handed adults, Tezel *et al.* (2001) suggested the relationship between gingival recession and the hand used in tooth-brushing. In right-handed subjects, denuded root surfaces were frequently detected in premolar and canine regions of upper right and lower right arches. A similar result was also observed in left-handed subjects: gingival recession was usually detected in their upper left and lower left arches [32]. The majority of Vietnamese dental students were right-handed, used soft/medium toothbrushes and had a good level of oral hygiene. This suggested a correlation between gingival recession and tooth-brushing. Moreover, because of the transitional site between anterior and posterior teeth, the specific position of canines in dental arch could make them more susceptible to traumatic tooth-brushing. Although subjects with periodontitis, or those who had undergone or had periodontal surgery, orthodontics, fixed prostheses and smoking were excluded from this study, other triggering/ aggravating factors including traumatic tooth-brushing and non-carious cervical lesions (abrasion, erosion) may be risks for bias. Indeed, tooth-brushing and an acidic diet are probably related to both tooth wear and dentine hypersensitivity and may be associated with gingival recession that is termed "healthy recession" [1]. Traumatic tooth-brushing can cause superficial damage of the gingiva usually termed "gingival abrasions". However, the relevance of this phenomenon to gingival recession remains unclear [33]. Nevertheless it is clear that toothbrush abrasion may cause wear at the CEJ, resulting in the destruction of the supporting periodontium and leading to gingival recession [34].

Localising the MGJ was facilitated by mucosa staining with 3% Lugol's iodine solution. Indeed, Lugol staining has been widely used to detect malignant changes in the cervix uteri and the oesophagus [35], and recently has been used to detect epithelial dysplasia in oral mucosa [36]. This staining produced a red-brown colour based on the reaction of iodine with glycogen granules of oral mucosa whereas content glycogen was inversely related to degree of keratosis, leading to keratinised gingiva unstained with Lugol's iodine solution [35,36]. This iodine solution has also been used to measure the width of keratinised gingiva in previous studies [20,37]. Lang and Löe (1972) found that in areas with less than 2 mm of keratinised gingiva, inflammation persisted in spite of effective oral hygiene and they suggested that at least 2 mm of keratinised gingiva was necessary to maintain gingival health [37]. Only one longitudinal study has demonstrated that in patients maintaining proper plaque control, lack of an adequate zone of attached gingiva did not result in the increased incidence of gingival recession [20] whereas several cross-sectional studies have confirmed a correlation between the decreased width of keratinised/attached gingiva and soft-tissue recession [12,38]. In the current cross-sectional study, statistical tests showed a strong negative correlation between the lack of keratinised gingiva and root-surface exposure in subjects with good oral hygiene. Additionally, teeth with narrow width of keratinised gingiva had a statistically higher prevalence of gingival recession than teeth without. However, it cannot be concluded from these findings that a narrow width of keratinised gingiva was a cause or a consequence of gingival recession. Further longitudinal studies are required to investigate this question.

Malaligned teeth had a statistically higher proportion of root-surface exposure than those in a normal position. This finding was in accordance with previous studies [15,18,19]. It was seen that tooth malposition, including rotation and lingual inclination, was usually associated with soft debris retention and calculus because of difficult access during tooth-brushing. Labially inclined teeth were often susceptible to traumatic tooth-brushing and appeared to be more susceptible to non-carious cervical lesions. Furthermore, if a tooth erupts close to the MGJ, there is probably very little or no keratinised gingiva labially and then gingival recession can occur [3].

In the current study, no correlation was found between high fraenal attachment and root-surface exposure. This finding was similar to that from a study in France which also showed a low proportion (3%) of affected teeth with high fraenal attachments [12]. However, high fraenal attachments have been reported as significantly associated with gingival recession in two previous studies [13,18]. It has been suggested that gingival/papillary fraenal attachments could impede access for plaque removal [13] and that fraenal pull due to lack of attached gingival is also a factor causing gingival recession [18]. Although the fraenal attachment has been reported as influencing plaque accumulation and gingivitis [39], in well-motivated individuals with good oral hygiene (such as the dental students who took part in the current study) this influencing factor for gingival recession can be reduced or eliminated. A key finding in the current study was that 60.5% of teeth related to gingival recession did not appear to be associated with predisposing factors. Therefore, further studies will be needed to investigate the issue further.

Conclusions

This pilot study performed in a small population of dental students with high awareness of dental care may not be representative of the whole population of the Vietnamese young adults. However, some preliminary conclusions may be drawn:

- A high prevalence of gingival recession (72.5%) was found in 19-25 year-old Vietnamese dental students with 11.1% extent of affected teeth.
- The proportion of root-surface exposure was statistically higher in the maxilla (12.5%) than in the mandible (9.6%).
- Premolars were most frequently associated with gingival recession and right canines were the most severely affected teeth.
- There was a strong negative correlation between a narrow width of keratinised gingiva and soft-tissue recessions.
- Root-surface exposure was statistically associated with tooth malposition.
- Gingival recession was not associated with high fraenal attachment and gender.

Further studies performed in a larger population of non-dental students with more extended age groups are required to confirm these findings.

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Author contributions

- T N-H and B-D H-T conceived and designed the study.
- B-D H-T and H D-T performed the clinical examinations.
- T N-H and H T-G wrote the paper.

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