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ORIGINAL ARTICLE

Prevalence and risk indicators of gingival recessions in an Italian school of dentistry and dental hygiene: a cross-sectional study

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Abstract

Objectives The aim of this cross-sectional study is to (i) determine the prevalence, extent, severity, and distribution of gingival recessions and patient perception in a young population and (ii) to identify potential risk indicators.

Material and methods Two hundred fifty-one students with a mean age of 22.9 ± 4.7, attending the School of Dentistry and Dental Hygiene of Vita-Salute San Raffaele University (Milan, Italy) were included. The subjects had undergone a clinical evaluation, by two calibrated examiner, and a questionnaire. Demographic and clinical data were collected to evaluate association of these factors with gingival recessions.

Results The prevalence of gingival recessions at patient and tooth level was 39% and 5.2%, respectively. The only factor associated with the presence of GR was age. On the other hand, age and smoking were associated with the extent, whereas BOP, NCCLs and KT were associated with the severity. Out of 98 subjects presenting at least one GR, 63 (64%) were conscious of the presence of the GR. NCCLs were also strongly associated with the perception of the recession by the patient.

Conclusions There is a low prevalence of buccal gingival recessions in this sample of Italian students. More than 50% of the sample was aware of the problem. Almost all patients presenting symptomatology or aesthetic concern requested appropriate therapy.

Clinical relevance The findings highlight the low relevance of gingival recessions in daily practice and the importance of controlling potential risk indicators in young populations.

Keywords Gingival recessions · Prevalence · Risk indicators · Epidemiology

Introduction

Gingival recession (GR) is defined as an apical displacement of the soft tissue margin with consequent attachment loss and root surface exposure to the oral cavity [1]. GR may be localized at the buccal aspect of the tooth in the presence of normal sulcus and non-diseased inter-dental attachment levels, or it may occur as part of the pathogenesis of periodontal disease, affecting also the interproximal aspects of the tooth in the presence of a periodontal pocket.

Prevalence, extent, severity and distribution of these defects have been widely investigated in the literature, demonstrating heterogeneous results.

According to data from epidemiological studies, the prevalence of patients presenting at least one recession, varied from 15% in a sample of young army recruits in Switzerland [2] to 58% in a large survey including 9689 > 30 years old subjects in the USA [3], to 84.6% of an adult population in France [4], and to basically the whole sample (99.7%) of adult patients included in a rural area of Brasil [5]. Prevalence of GR was also investigated in smaller cross-sectional studies evaluating young dental students or dentists in Italy and Spain. Checchi et al. [6], in a student population attending

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the first and fifth year of the school of dentistry, reported the presence of GR in 64% of the sample. Similarly, Matas et al. [7] examined 40 dental students in their final, reporting a prevalence of 85% that did not vary at the 5-year later examination. Serino et al. [8], analysing 225 regular dental care attendants at 12 community dental clinics in Sweden, found that 25% of the sample presented at least one GR. The longitudinal analysis after 5 and 12 years, demonstrated that the proportion of subjects presenting recessions increased with age.

The extent of ≥ 1 mm recession averaged 22.3% of the teeth in the Albandar study [3], with varying percentages from 8.6% in the youngest age cohort (30 to 39 years) to 56.3% in the oldest cohort (aged 80 to 90 years). Similar results (24.6%) were reported in the study by Sarfati et al. [4], whereas a much higher percentage of teeth (67.6%) with GR ≥ 1 mm was observed in the study by Rios et al. [5] indicating that not only age, but also plaque control may influence in part the extent of GR.

Severity is another important aspect that has been reported in the studies at both recession's level and patient's level. Severity varied between 40% of the GR that were 1 mm in depth, to only 1% that measured 10 mm in the study by Nieri et al. [9]

Similarly, Albandar et al. [3] reported that at the patient level, severity varied between 58% of subjects presenting a recession of at least 1 mm and 5% of the sample presenting GR of at least 5 mm.

When investigating the distribution, maxillary first molars and mandibular central incisors presented the highest frequencies of GR in the survey of Albandar et al. [3] and Rios et al. [5], whereas Nieri et al. [9] reported that premolars were the most frequent (45%), followed by molars (24%), incisors (19%) and canines (12%). Similarly, Checchi et al. [6] reported a higher frequency in maxillary and mandibular bicuspids whereas Matas et al. [7] observed in the cuspids the highest prevalence of GR at the first examination and in the molars at the second examination.

Due to the exposure of the root surface, it has been always claimed that this clinical condition may lead to compromised aesthetics and functional impairment because of root hypersensitivity. Nevertheless, only one study evaluated the impact of GR on patients. Data by Nieri et al. [9] revealed that of 783 GR in 96 patients, only 28% were perceived and only few were symptomatic.

Among the risk indicators, age, gender, plaque index, bleeding index and tobacco consumption have been mostly correlated with GR [4]. Same indicators, with the adjunction of high level of education, regular dental visits and tooth brushing using a horizontal movement were reported by Rios et al. [5] These were risk indicators also in the study by Checchi et al. [6], with the level of education being the most important contributor to buccal gingival recession.

Hence, the objective of this study was to investigate the prevalence, extent, severity, distribution and perception of GR in a young population (of students of dentistry and dental hygiene). In addition, the study aimed to identify risk indicators related with presence, extent, severity and perception of gingival recessions.

Material and methods

Study design

This study is a monocentric cross-sectional observational study performed at the School of Dentistry and Dental Hygiene of "Vita-Salute San Raffaele University" in Milan. It was conducted in accordance with Hospital San Raffaele Ethic Committee. All procedures were submitted and approved with Protocol number REC 1 - V2 of May 18, 2017.

Patient sample

The patient sample consisted of 264 students attending dentistry and dental hygiene school. Each patient was informed about all pertinent aspects of the study by the investigators and an informed consent was obtained prior to the start of the study.

Clinical evaluation

The clinical examination was performed using a manual periodontal probe, Hu-Friedy PCP-15. Percentages of Full Mouth Plaque Score (FMPS) and Full Mouth Bleeding Score (FMBS) were firstly evaluated.

Afterwards, teeth presenting recessions were identified and the following parameters were assessed at the tooth level:

- presence/absence of a non-carious cervical lesion (NCCL);
- gingival recession depth (REC), assessed at the buccal tooth surfaces as the distance in mm from the free gingival margin to the cemento-enamel junction (CEJ), or to the ideal cemento-enamel junction (iCEJ) when a NCCL was present [10] and
- keratinized tissue width (KT), measured in mm from the gingival margin to the muco-gingival junction.

Moreover, teeth presenting recessions were divided into three buccal sites (mesial, middle-buccal, distal) and three lingual/palatal sites (mesial, middle-lingual/palatal, distal). The following parameters were registered at each site:

- probing pocket depth (PPD) as the distance in mm from the gingival margin to the bottom of the sulcus/pocket;

- clinical attachment level (CAL) as the distance in mm from the CEJ to the bottom of the sulcus/pocket and
- plaque index (PI) and bleeding on probing (BOP).

Two trained and experienced investigators performed all measurements (MC and MDM). Before the initiation of the study, a calibration session was conducted on five patients. Measurement of recession depth was assessed and repeated twice at a distance of 1 week. The double measurements were used for the inter-examiner and intra-examiner agreement comparison. The resulting inter-examiner intra-class correlation coefficient was 0.902 (95% confidence intervals, 0.797–0.960). The intra-examiner intra-class correlation coefficients were 0.884 (95% confidence intervals, 0.683–0.958) for MDM and 0.877 (95% confidence intervals, 0.664–0.955) for MC.

Questionnarie

The students were interviewed using a specifically designed questionnaire investigating on demographic data, oral hygiene habits, dental history and the perception of the recession. In detail, a set of key-questions collected information on the students' oral hygiene habits: daily brush frequency, professional maintenance frequency, daily brush frequency, toothbrush type (powered or manual), toothbrushing duration and hand used for toothbrushing. Another set investigated the history of orthodontic treatment and faulty habits such as smoking and presence of intraoral piercing. The last set of questions collected information on the impact of recessions on their quality of life: patients were asked to answer on the perception, symptomatology, aesthetic and request of treatment.

Statistical analysis

Descriptive statistics are presented as frequencies, means and standard deviations. Prevalence of gingival recessions was calculated at patient and tooth level. Extent of gingival recessions was assessed as the proportion of affected tooth in patients with the condition. Severity was expressed as the proportion of recessions presenting with varying mm of depth.

Univariate logistic regression analysis was conducted to determine risk indicators of presence of recessions and patient's perception. Factors with $p < 0.05$ were selected for the multivariate regression model. Similarly, a linear regression analysis was performed to define associated factors with extent and severity of recessions. The statistical analyses were performed by using a software package (SPSS, Statistical Package for the Social Sciences; SPSS Inc., Chicago, IL, USA).

Results

The patients' sample characteristics are reported in Table 1.

Overall, a total of 251 students participated in the examination. Ten students of the dental school and three students of school of dental hygiene refused to participate in the study. The majority (70%, $n = 175$) of our sample was attending the dental school whereas 30% ($n = 76$) attended the school of dental hygiene. The mean age of the sample of patients (62% females) was 22.9 ± 4.7 (range, 19–50; median, 22). The mean % of FMPS and FMBS was 31.1 ± 19.1 and 21.8 ± 19.6, respectively.

A manual toothbrush (71%) was mostly used as compared to the electric toothbrush (29%), mostly with the right hand (92%). Seventy-five percent of the subjects had undergone orthodontic treatment. One percent had a labial piercing and 36% were smokers.

Table 1 Descriptive statistics of patients sample

Variable	Patients ($N = 251$)	
	n	*%*
Gender		
Male/female	96/155	38/62
University faculty		
Dentistry/dental hygiene	176/75	70/30
Smoking		
Yes/No	91/160	36/64
Hand of toothbrushing		
Left/right	20/231	8/92
Type of toothbrush		
Electric/manual	73/178	29/71
Past orthodontic treatment		
Yes/no	187/64	74/26
Presence of piercing		
Yes/no	2/249	0.8/99.2
Perception of recessions		
Yes/no	98/153	39/61
Aesthetic concern		
Yes/no	33/251	13/87
Request of treatment		
Yes/no	38/213	15/85
Variable	Mean ± standard deviation	
Age (year)	22.9 ± 4.7	
Number of teeth per patient	29.1 ± 1.6	
Number of recessions	3.8 ± 3.1	
FMPS (%)	31.1 ± 19.1	
FMBS (%)	21.8 ± 19.6	
Maintenance frequency	1.7 ± 1.5	
Tooth brushing frequency	2.4 ± 0.6	
Tooth brushing duration	2.3 ± 1	

FMPS, *f*ull-mouth plaque score; FMBS, *f*ull-mouth bleeding score

Prevalence, extent, severity and periodontal characteristics (PPD, CAL, IP, BOP) of the teeth presenting GR are reported in Table 2.

A total of 375 teeth presented a recession. Of 280 GR with an identifiable CEJ, only the 5% ($n = 15$) were associated with a presence of a NCCL. Whereas, of 85 recessions characterized by the absence of an identifiable CEJ, a larger proportion (75%, $n = 64$) showed a presence of a NCCL. Furthermore, 74% of GR ($n = 279$) was negative to the air sensitivity test.

Prevalence

Three hundred seventy-five recessions (in 7201 analysed teeth) were found in 98 patients, demonstrating a prevalence of 39% and 5.2% at the patient and tooth level, respectively.

Extent and severity

Gingival recessions were found in 98 subjects. The mean number of teeth per patient was 28.9 ± 1.64 and the mean number of teeth presenting a recession was 3.83 ± 3.06 (range, 1–16). Hence, the overall extent of teeth with recessions was 13.2%.

Table 2 Descriptive statistics of teeth presenting gingival recessions

Variable	Recessions ($N = 375$)	
	n	%
Recession depth		
1 mm	200	53
2 mm	119	32
3 mm	52	14
4 mm	4	1
Plaque		
Presence/absence	161/214	43/57
Bleeding on probing		
Presence/absence	56/319	15/85
Identifiable CEJ		
Yes/no	85/290	23/77
NCCLs		
Yes/no	58/317	15/85
Hypersensitivity (air test)		
Yes/no	96/279	26/74
Variable	Mean ± standard deviation	
Recession depth (mm)	1.6 ± 0.8	
Probing depth (mm)	1.2 ± 0.5	
Keratinized tissue (mm)	2.4 ± 1.3	

CEJ cemento-enamel junction; *NCCLs* non-carious cervical lesions

The mean recession depth was 1.6 ± 0.8 mm, although severity varied from 1 mm, (53% of the teeth) to 4 mm (1% of the teeth).

Distribution

As shown in Fig. 1, 60% of GR ($n = 224$) were observed in the maxilla, with the first premolars being the most affected teeth (23%) followed by first molars (20%). Central incisors presented the lowest frequency (0.3%). In the mandible, 40% of GR ($n = 151$) were detected, and the most involved teeth were first (12%) and second (10%) premolars, while no recessions were detected at the second molars.

Patient's perception

Out of the 98 subjects presenting at least one GR, 35 (36%) did not perceive the presence of recessions in their own mouth, whereas 63 (64%) were conscious of the presence of the GR. Of this latter subgroup of patients, 31 (49%) did not present any concern about the GR, 15 (24%) were worried about aesthetics, 10 (16%) reported dental hypersensitivity and 7 patients (11%) reported both concerns. Of these, 24 (38%) patients, all with concerns, requested treatment (Fig. 2).

Tooth- and patient-related factors investigated for the association with the patient's perception were reported in Table 3. At tooth-level, the univariate logistic regression showed that presence of NCCLs (OR = 5.33; 95% CI 2.36–12; $p < 0.001$) and hypersensitivity (OR = 2.33; 95% CI 1.3–4.16; $p = 0.004$) were statistically associated with the perception of recessions by the patient. These factors were confirmed as risk indicators by multivariate regression analysis: presence of NCCLs (OR = 4.84; 95% CI 2.14–10.97; $p < 0.001$) and hypersensitivity (OR = 2; 95% CI 1.1–3.62; $p = 0.022$).

Instead, at patient-level, the univariate logistic regression reported age (OR = 1.11; 95% CI 1.04–1.2; $p = 0.003$) and number of recessions per patient (OR = 1.4; 95% CI 1.23–1.6; $p < 0.001$) as risk indicator for patient's perception. In the multivariate analysis, age (OR = 1.07; 95% CI 0.99–1.15; $p = 0.07$) did not reach the statistically significance, while the association was confirmed for the number of recessions per patient (OR = 1.36; 95% CI 1.19–1.56; $p < 0.001$).

Risk indicators

Table 3 shows the crude and adjusted ORs for each patient-related factor associated with presence of recessions. The univariate logistic regression reported that only age (OR = 1.16; 95% CI 1.07–1.26; $p = 0.001$) was significantly associated with recessions.

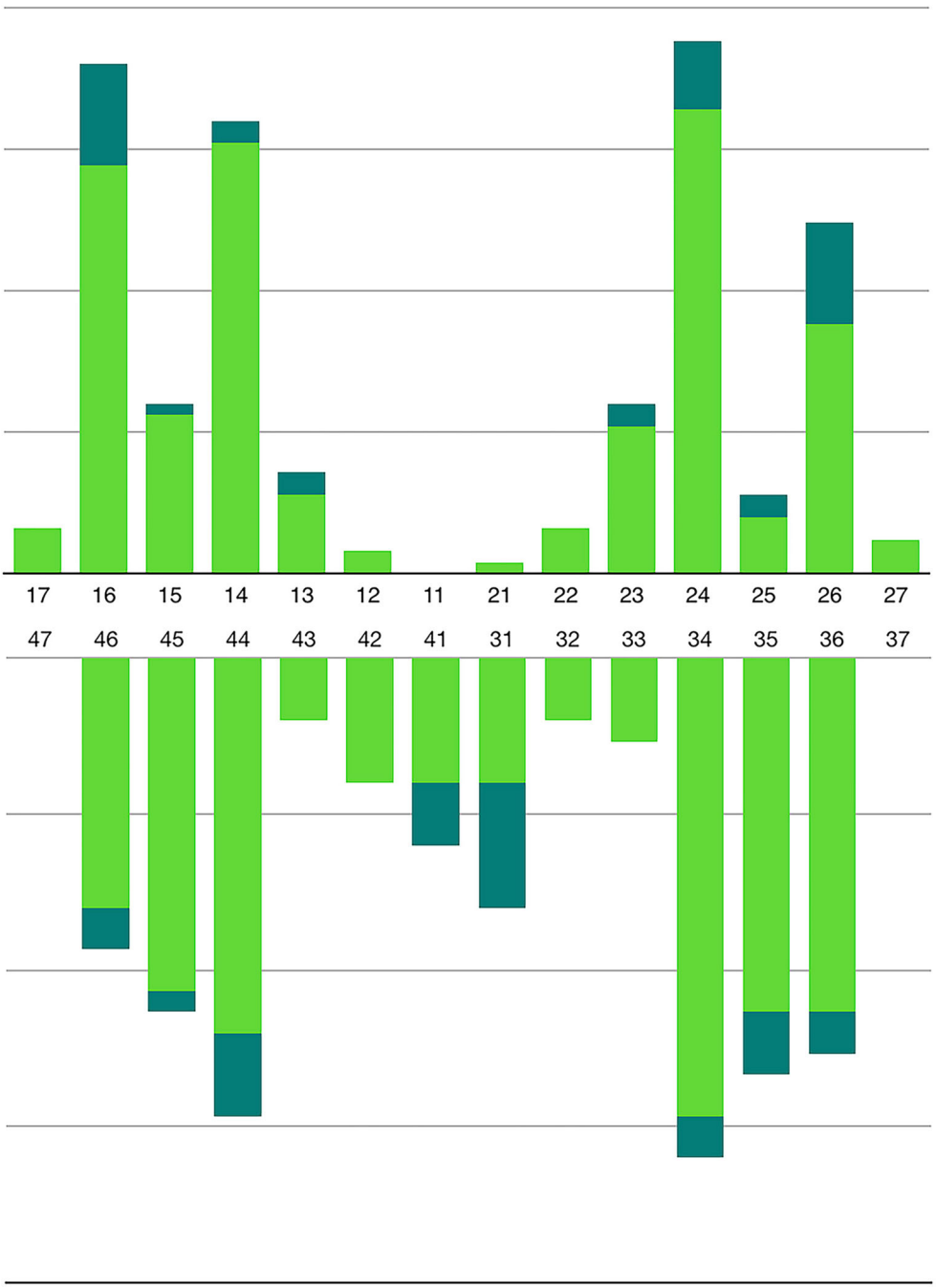

Fig. 1 Distribution of gingival recessions ≤2 mm; > 2 mm

Table 4 shows the results of univariate and multivariate linear regression for each factors associated with the extent and severity of recessions.

The univariate analysis reported that age ($t = 4.74$; 95% CI 0.09–0.23; $p < 0.001$), smoking ($t = 2.82$; 95% CI 0.03–0.19; $p = 0.005$) and FMBS ($t = -2.31$; 95% CI −0.37–(−0.003); $p = 0.022$) were significantly associated with extent of recessions. In the multivariate regression model, only FMBS did not reach statistical significance ($t = -1.63$; 95% CI −0.3–(−0.003); $p = 0.104$). Instead, significant results were confirmed for age ($t = 4.44$, 95% CI 0.08–0.22; $p < 0.001$) and smoking ($t = 2.76$, 95% CI 0.03–0.18; $p = 0.006$).

The association with severity of recessions were investigated for both tooth- and patient-related factors. At tooth level, the univariate analysis reported that bleeding on probing ($t = 2.17$; 95% CI 0.02–0.46; $p = 0.03$), keratinized tissue ($t = -4.19$; 95% CI −0.19–(−0.07); $p < 0.001$), presence of NCCLs ($t = 2.95$; 95% CI 0.09–0.47; $p = 0.003$) and hypersensitivity ($t = 2.11$; 95% CI

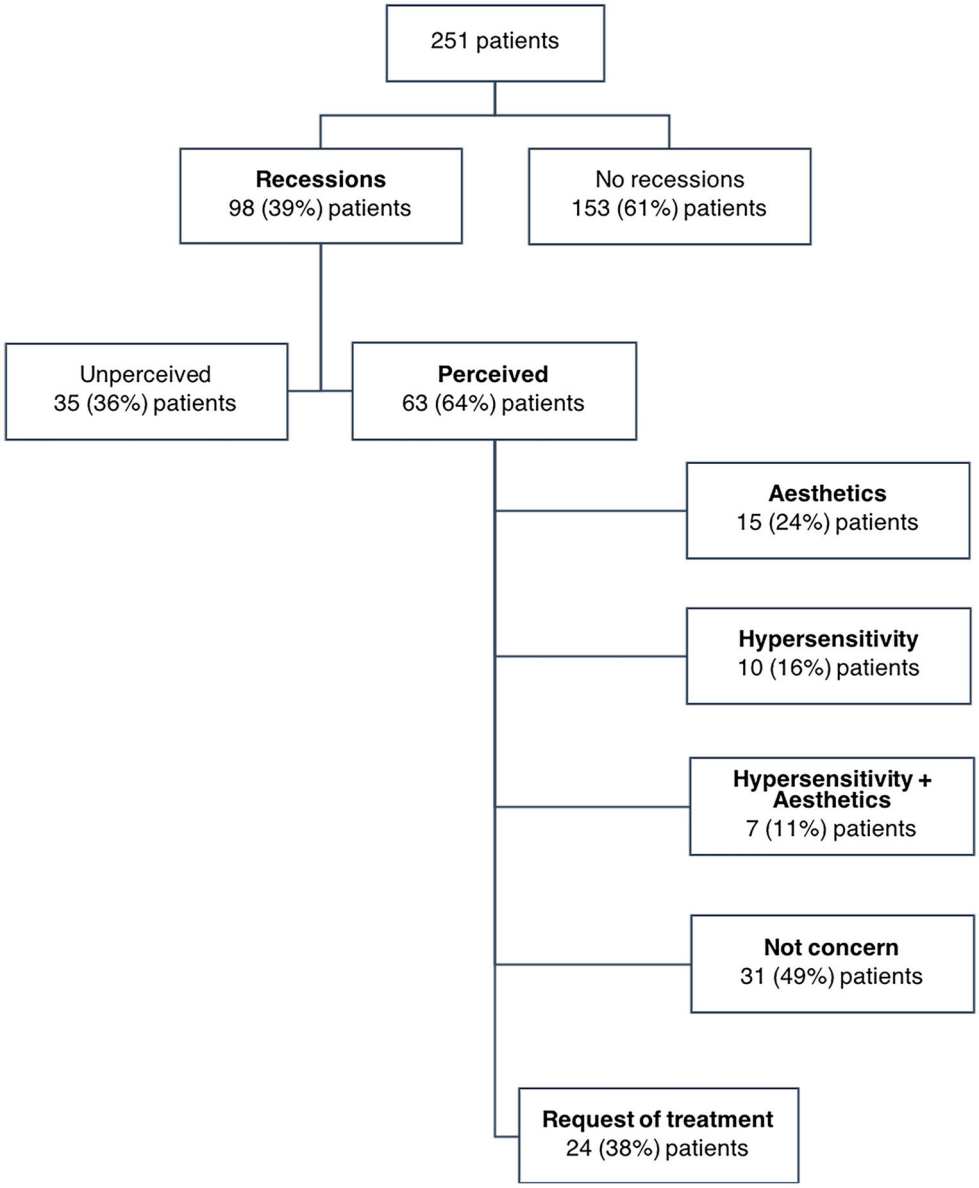

Fig. 2 Patient's perception of gingival recessions

0.01–0.36; $p = 0.035$) were significantly associated with severity. The multivariate analysis confirmed bleeding on probing ($t = 2.25$; 95% CI 0.03–0.45; $p = 0.025$), keratinized tissue ($t = -3.92$; 95% CI 0.18–(−0.06); $p < 0.001$) and presence of NCCLs ($t = 2.52$; 95% CI 0.05–0.42; $p = 0.012$) as significantly associated factors, but not hypersensitivity ($t = 2.1$; 95% CI −0.07–0.28; $p = 0.23$). On the other hand, at patient level, smoking ($t = 1.98$; 95% CI 0.001–0.06; $p = 0.05$), full mouth plaque score ($t = 2.96$; 95% CI 0.003–0.02; $p = 0.004$) and full mouth bleeding score ($t = 2.28$; 95% CI 0.001–0.02; $p = 0.025$) resulted significantly associated with severity of recessions in the univariate regression. Instead, in the multivariate analysis, none of these variables reached the statistical significance.

Discussion

This cross-sectional study investigated the prevalence, extent, severity, distribution and risk indicators of buccal gingival recessions in a sample of students attending a dental university in Italy.

Prevalence

The number of subjects with at least one GR was 98 out of 251 students demonstrating a prevalence of 39% of the sample. This low prevalence is not consistent with the majority of the results observed in the literature. The higher prevalence varying from 58 to 99.7% in

Table 3 Univariate and multivariate logistic regression with presence of gingival recessions and patient's perception as dependent variables

Outcome variable	Univariate regression			Multivariate regression		
Presence of recessions	OR	95% CI	*p*	OR	95% CI	*p*
Gender	0.84	0.49–1.41	0.5			
Age	1.16	1.07–1.26	0.001*			
Smoking	1.13	0.67–1.91	0.648			
FMPS	0.99	0.99–1.01	0.936			
FMBS	0.99	0.97–1.00	0.086			
Maintenance frequency	0.89	0.7–1.13	0.348			
Tooth brushing frequency	1.04	0.69–1.56	0.829			
Tooth brushing duration	1.21	0.95–1.55	0.116			
Hand of toothbrushing	2.65	0.85–8.24	0.092			
Type of toothbrush	1.49	0.83–2.68	0.179			
Past orthodontic treat	0.84	0.46–1.51	0.555			
Presence of piercing	1.05	0.62–1.78	0.851			
Outcome variable:	Univariate regression			Multivariate regression		
Patient's perception	OR	95% CI	*p*	OR	95% CI	*p*
Tooth-related factors						
Plaque	1.31	0.83–2.08	0.242			
BoP	1.69	0.84–3.42	0.143			
Probing depth	0.96	0.61–1.53	0.88			
Keratinized tissue	0.87	0.73–1.04	0.137			
NCCLs	5.33	2.36–12	< 0.001*	4.84	2.14–10.97	< 0.001*
Hypersensitivity	2.33	1.30–4.16	0.004*	2	1.1–3.62	0.022*
Patient-related factors						
Gender	1.17	0.69–1.97	0.55			
Age	1.11	1.04–1.2	0.003*	1.07	0.99–1.15	0.07
Smoking	1.24	0.73–2.09	0.426			
Number of recessions	1.4	1.23–1.6	< 0.001*	1.36	1.19–1.56	< 0.001*
FMPS	1.002	0.99–1.01	0.752			
FMBS	0.99	0.98–1.006	0.278			

OR, odds ratio; *BoP*, bleeding on probing; *NCCLs*, non-carious cervical lesions; *FMPS*, full-mouth plaque score; *FMBS*, full-mouth bleeding score

* statistically significant

epidemiological studies [3, 5] are most likely due to the vast array of ages and socio-economic conditions of the samples of these large epidemiological studies. Nevertheless, two similar university-based studies [6, 7] reported a prevalence of 64% and 85% of similar groups of dental students in Italy and Spain, respectively. Differences in the results may be related to the larger number of students evaluated in the present investigation and the progressively higher concern on oral health-related problems of patients and dental students in particular.

Our observations are in agreement with data from Serino et al. [8] who reported a prevalence of 25% in a large sample of 252 subjects between 18 and 65. The preventive program based on a regular dental attention adopted by the Swedish public dental service may in part explain this low prevalence, irrespectively of the adult age of the sample.

Extent and severity

Severe recession depth (≥ 4 mm) was only observed in 1% of teeth, while 14% were 3 mm depth and most of the sample was characterized by shallow GRs with approximately 50% of the affected teeth presenting a 1-mm recession. Notwithstanding the young age of the present sample, the findings are consistent with results from epidemiological data from older populations with both low and high levels of oral hygiene [3, 5].

Distribution

The distribution of recessions in the sample was higher on the upper jaw (60%) than on the mandible (40%) with the highest prevalence of GRs observed at maxillary first

Table 4 Univariate and multivariate linear regression with extent and severity of gingival recession as dependent variables

Outcome variable	Univariate regression			Multivariate regression		
Extent	*t*	95% CI	*p*	*t*	95% CI	*p*
Gender	− 0.90	− 0.99-0.37	0.368			
Age	4.74	0.09–0.23	< 0.001*	4.44	0.08–0.22	< 0.001*
Smoking	2.82	0.03–0.19	0.005*	2.76	0.03–0.18	0.006*
FMPS	− 0.22	− 0.02–0.02	0.827			
FMBS	− 2.31	− 0.37–(− 0.003)	0.022*	− 1.63	− 0.03–0.003	0.104
Maintenance frequency	− 0.35	− 0.26–0.18	0.726			
Tooth brushing frequency	0.36	− 0.43–0.62	0.718			
Tooth brushing duration	0.11	− 0.3–0.34	0.91			
Hand of toothbrushing	0.23	− 0.97–1.22	0.821			
Type of toothbrush	1.44	− 0.17–1.07	0.152			
Past orthodontic treat.	0.47	− 0.58–0.94	0.642			
Presence of piercing	1.33	− 1.21–6.26	0.184			
Outcome variable:	Univariate regression			Multivariate regression		
Severity	*t*	95% CI	*p*	*t*	95% CI	*p*
Tooth-related factors						
Plaque	0.65	− 0.10–0.21	0.516			
BoP	2.17	0.02–0.46	0.03*	2.25	0.03–0.45	0.025*
Probing depth	− 0.64	− 0.21–0.11	0.523			
Keratinized tissue	− 4.19	− 0.19–(− 0.07)	< 0.001*	− 3.92	− 0.18–(− 0.06)	< 0.001*
NCCLs	2.95	0.09–0.47	0.003*	2.52	0.05–0.42	0.012*
Hypersensitivity	2.11	0.01–0.36	0.035*	1.2	− 0.07–0.28	0.23
Patient-related factors						
Gender	− 1.82	− 0.55–0.02	0.072			
Age	1.84	− 0.002–0.04	0.069			
Smoking	1.98	0.001–0.06	0.05*	1.7	− 0.001-0.02	0.092
FMPS	2.96	0.003–0.02	0.004*	0.5	− 0.007-0.012	0.624
FMBS	2.28	0.001–0.02	0.025*	1.72	− 0.004-0.05	0.088
Maintenance frequency	− 0.94	− 0.3–0.11	0.349			
Tooth brushing frequency	− 0.42	− 0.27–0.17	0.674			
Tooth brushing duration	1.04	− 0.06–0.19	0.301			
Hand of toothbrushing	0.78	− 0.44–1	0.437			
Type of toothbrush	1.17	− 0.11–0.43	0.244			
Past orthodontic treat.	− 0.35	− 0.39–0.28	0.73			
Presence of piercing	− 0.04	− 1.03–0.99	0.967			

BoP, bleeding on probing; *NCCLs*, non-carious cervical lesions; *FMPS*, full-mouth plaque score; *FMBS*, full-mouth bleeding score

* statistically significant

premolars and molars sites. Our observations are in agreement with what reported by Serino et al. [8], Röthlisberger et al. [2] and Slutzkey and Léevin [11]. In contrast with these latter observations, other studies reported a higher prevalence in the mandible [12], being the cuspid the most affected tooth [7]. When evaluating the incidence of GRs in a longitudinal scale, the most pronounced increase was observed at incisors and cuspids [8] or molars [7]. Differences in age, hygiene habits, anatomy, may in part explain the discrepancies within the results.

Perception

To the best of the authors' knowledge, only one study [9] investigated the perception of GR by the patients. According to the questionnaire, 60% ($n = 63$) of the patients with GRs were aware of the presence of these lesions in their own mouth. A small proportion (24%) of these patients was worried about aesthetics, 16% was positive to the air sensitivity test and 11% both. Nevertheless, out of the 63 patients, only 24 (38%) of these patients required treatment. Nieri et al. [9] reported that fewer, 28%, of patients perceived the recession,

among these 17% were hypersensitive, 6% presented aesthetic complaints and 4% both. Overall, 11% of the patients requested for treatment. The higher % of patients concerned about the GRs and requiring treatment in the present study may be related to the population of interest composed by dental and oral hygiene students educated to these types of lesions. Furthermore, the perception model in the present investigation showed that NCCLs, hypersensitivity to air test and number of recessions were significantly associated with the perception of gingival recession. The highest OR was related to the presence of NCCL (OR = 4.64). This latter finding is in agreement with what reported by Nieri et al. [9] In this latter study, also age, tooth type and recession depth were significant factors.

Risk indicators

The present study demonstrated a statistically significant correlation between the presence of GR and the patient's age, with an observed OR of 1.62. This result corroborates previous epidemiologic studies reporting that age is a strong risk indicator associated with the presence of gingival recession [3, 4, 13]. Age was also identified together with smoking as a risk indicator for the number of gingival recessions. Similarly, Susin et al. [13] reported that subjects who were moderate or heavy cigarette smokers and those in the ≥ 30 years group who were heavy smokers had a significantly higher prevalence of recession ($p < 0.01$) and had higher percentages of teeth affected ($p < 0.01$) than subjects who did not smoke.

The multivariate logistic regression also revealed that the presence of BOP, NCCL and the amount of keratinized tissue were significantly associated with the severity of the gingival recession. BOP at the site level indicates an inflammation of the periodontal marginal tissues that may justify the association with the severity of the lesion. Sarfati et al. [4] corroborated the present findings, reporting that gingival bleeding was significantly associated with the severity of gingival recessions. The amount of keratinized mucosa was also a risk indicator for the severity of the gingival recession. Unfortunately, the cross-sectional design of the study does not allow to explain this association, whether it is causal or if it only represents a consequence of the apical displacement of the gingival margin.

Interestingly, the presence of NCCLs was associated with deeper gingival recessions. This observation corroborates findings from a similar cross-sectional study in which the authors concluded that the lesions' depth and morphology contributed to the severity of recessions [14].

A high percentage (75%) of the subjects in the present study had undergone orthodontic treatment. Despite this high percentage, no statistically significant correlation was observed between orthodontic treatment and the presence, extent or severity of GR. These data are in disagreement with results from Slutzkey and Levin [11] in which prevalence, severity and extent of recessions correlated with past orthodontic treatment. Furthermore, in a case control-study, the odds ratio for orthodontic young patients, as compared with controls, to have recessions was 4.48 [15]. The reasons for such discrepancies in the present sample are currently unknown.

Tooth brushing have been commonly associated with the initiation and progression of GR. Several mechanical factors have been described, such as traumatic tooth brushing [16], frequency of tooth brushing [17], hardness of tooth brushing's tuff [18, 19] and brushing technique [6]. However, there are still insufficient data to support or refute these associations [20]. From the submitted questionnaire, it is known that 100% of this students brushed their teeth at least twice daily for more than 2 min using either manual (66%), electric (29%) or both alternately (6%). The specific dental and oral hygiene students aware of these dental pathologies may justify the lack of any association observed in the present investigation.

The limits of the present study are inherent to the cross-sectional design and the exploratory multivariate approach. Indeed, the results of multivariate analysis depend on the variables that are included in the model. The present study design does not permit any inference about the causal relationship between the investigated risk indicators and presence/absence, extent or severity of the gingival recessions and hence no clinical recommendations may be extrapolated. Furthermore, no data on the incidence and the progression of these lesions may be anticipated since no longitudinal evaluation has been performed. Knowing the future evolution of gingival recessions in the mouth of our patients would greatly help in the planning of an appropriate clinical treatment approach and this unfortunately still represents a gap in our knowledge.

Another limitation of the current investigation is inherent to the study population. This is a sample of future hygienists and dentists that may limit in part the external validity of the study. Indeed, this specific population has an age that varies between 19 and 50 (median 22) and who presents specific concerns on this type of lesion, as compared to a normal sample of patients. Being the age of patients as one of the most correlated risk indicators for the presence of recession, and considering this specific population of students, the low prevalence of recessions could be anticipated. Nevertheless, although the external validity may be in part weakened, several risk indicators have been highlighted by the analysis, demonstrating that age and tobacco are associated with the extent of GR and that BOP, NCCL and KT at the tooth level are associated with the severity of GR. This is indeed an important observation in terms of clinical relevance and it may signify that, independently the young age of the patients, these are important factors that have an impact on the occurrence and further progression of these periodontal lesions and hence need to be controlled.

In summary, the present cross-sectional study demonstrated a low prevalence of buccal gingival recessions in a sample

of young Italian dental and oral hygiene students. More than half of the students (60%) were aware of the GR; almost half (38%) requested treatment. The only factor associated with the presence of GR was age. On the other hand, age and tobacco consumption were associated with the extent, whereas BOP, NCCLs and KT at the tooth level were associated with the severity. NCCLs were also strongly associated with the perception of the recession by the patient.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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.

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