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ORIGINAL ARTICLE

Dental cross-bite and gingival marginal recession. A cross-sectional study

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KEYWORDS

Gingival index;
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Abstract *Background:* Crossbite (CB) has been reported to be associated with Gingival Marginal Recession (GMR) especially in the anterior region. The current study aims to evaluate the association between GMR and CB both in anterior and posterior regions.

Materials and methods: This was a cross-sectional study in a private dental clinic in Najran, Kingdom of Saudi Arabia involving 120 medically healthy patients with CB, good to fair oral hygiene, non-severe gingival inflammation and without prosthesis. Socio-demographic data was obtained from the clinic records and diagnosis of cross-bite and GMR was made. The diagnosis of GMR was made with periodontal probe. Oral hygiene index (OHI) and Gingival index (GI) was also evaluated.

Results: All the 120 cases of CB had at least 1 tooth with GMR. There were 55 (45.8%) males and 65 (54.2%) females with a M:F of 0.8:1. Age ranged from 11 to 50 years with Mean ± SD (21.78 ± 7.63). Age group < 30 years constitute the majority of the patients. The value of Odd's ratio (OR) is much higher than 1.0 in all the lower anteriors (41, 41, 43, 31, 32 and 33), and statistically significant as compared with much lesser OR values for some of the upper anteriors (21, 22 and 23). Similar findings was also observed in the posterior dentition. Females tend to have better OHI and GI than males with statistical significance in the GI only ($p = 0.048$).

Conclusion: Association between CB and GMR especially in the lower anterior and posterior dentition was observed.

1. Introduction

Gingival Marginal Recession (GMR), also known as gingival recession or receding gums, is the exposure in the roots of the teeth caused by a loss of gum tissue and/or retraction of the gingival margin from the crown of the teeth (ADA, 2007). The etiology of GMR is said to be multifactorial and

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can be associated with single or combined factors such as inflammation, traumatic, iatrogenic, chemical and morphologic (Andreeva and Dilkova, 2016; Chrysanthakopoulos, 2014; Marini et al., 2004; Sather, 2014). Additionally, several studies have reported certain types of malocclusions such as tooth/teeth crowding, protrusion, deep bite, open bite, and anterior crossbite (CB) in the labial area as risk factors for the development of GMR (Andreeva and Dilkova, 2016; Kundapur et al., 2009; Ngom et al., 2006; Seehra et al., 2009). Pugaca et al. (Pugaca et al., 2007) have reported specifically that there is an association between cross bite and GMR in the lower incisors and canine region. Some other studies have corroborated this finding that lower anterior CB is associated with GMR (Mythri et al., 2015; Richman, 2011). Thin vestibular bone in the apical part of the alveolar ridge in the lower anterior region have been identified as a risk factor for the development of GMR in the lower incisor region (Han and Jung, 2011).

Studies describing this clinical condition in the posterior region is rare. The null hypothesis for the current study is that "there is no association between CB and GMR in both the anterior and posterior regions of the dental arch", while the alternate hypothesis is "there is association between CB and GMR in both the anterior and posterior regions of the dental arch". This study therefore aims to evaluate the association between CB and GMR both in the anterior and posterior regions.

2. Materials and methods

This was a cross-sectional study in a private dental clinic in the city of Najran, kingdom of Saudi Arabia involving convenient sample of 120 medically healthy patients classified as ASA I. Other inclusion criteria involves patients with CB and gingival recession, Oral Hygiene Index (OHI) score of 1and II, Gingival Index (GI) score of 0 to 2 and without any form of prosthesis intraorally. Excluded are patients classified as ASA II to IV, GMR not attributed to CB, OHI greater than II, GI of 3 and patients with prosthesis. Socio-demographic data was obtained from the clinic records and diagnosis of cross-bite and GMR was made. The study conformed to the STROBE guidelines.

Gingival Index (GI) by loe and Silness (Löe, 1967) and Oral hygiene index (OHI) by Greene and Vermillion (Greene and Vermillion, 1964) of the selected patients was carried out.

The mouth was divided into 6 segments (3 upper and 3 lower): Lower Anterior (33 to 43), Lower Right (44 to 47), Lower Left (34 to 37), Upper Anterior (13 to 23), Upper Right (14–17), Upper Left (24 to 27). Each tooth was then examined individually for presence of GMR. GMR was then measured with a periodontal probe CP15 (University of North Carolina 15). This probe is unique because it has a long, thin and blunted tip with markings inscribed onto the head of the instrument for accuracy and readability.

Data was stored and analyzed using IBM SPSS software version 25 for IOS (Armonk, NY: IBM Corp). Descriptive statistics were generated as part of the data analysis. Association between crossbite (primary variable) and gingival recession (outcome variable) for both anterior and posterior teeth excluding third molars were examined with Odds ratio (OR) and corresponding 95% Confidence Intervals (CI) together with Chi-square and 2x2 cross-tabulation tables. The OR's were interpreted as: When OR equals 1 (There is no association between crossbite and GMR presence), when OR is < 1 (Crossbite is associated with lower odds of GMR) and when OR is greater than 1 (Crossbite is associated with higher odds of GMR). OR values were considered statistically significant at P value ≤ 0.05.

3. Results

All the 120 cases of CB had at least 1 tooth with GMR. There were 55 (45.8%) males and 65 (54.2%) females with a M:F of 0.8:1. Age ranged from 11 to 50 years with Mean $\pm$ SD (21. 78 $\pm$ 7.63). Age group $<$ 30 years constitute the majority of the patients. When age group was compared with gender, there

Table 1 Distribution of Age-group, Oral hygiene index and gingival index according to gender of patients.

	Gender			
	Male (%)	Female (%)	Total (%)	Statistics
Age group				χ^2 = 15.490, df = 7, p value = 0.03*
11–15	8 (6.7)	18 (15.0)	26 (21.7)	
16–20	20 (16.7)	11 (9.2)	31 (25.9)	
21–25	16 (13.3)	16 (13.3)	32 (26.6)	
26–30	6 (5.0)	11 (9.2)	17 (14.2)	
31–35	5 (4.2)	2 (1.6)	7 (5.8)	
36–40	0 (0.0)	3 (2.5)	3 (2.5)	
41–45	0 (0.0)	3 (2.5)	3 (2.5)	
46–50	0 (0.0)	1 (1.8)	1 (1.8)	
Total	55 (45.8)	65 (54.2)	120 (100.0)	
Oral Hygiene Index				χ^2 = 2.507, df = 1, p value = 0.113
Good	20 (16.7)35	33 (27.5)32	53 (44.2)67	
Fair	(29.1)55	(26.7)65	(55.8)120	
Total	(45.8)	(54.2)	(100.0)	
Gingival Index				χ^2 = 6.080, df = 2, p value = 0.048*
Normal	4 (3.3)25	15 (12.5)28	19 (15.8)53	
Mild inflammation	(20.8)26	(23.3)22	(44.2)48	
Moderate inflammation	(21.7)55	(18.3)65	(40.0)120	
Total	(45.8)	(54.2)	(100.0)	

was statistical significant difference as there were more females (χ^2 = 15.490, df = 7, p value = 0.03) Table 1.

Regarding oral hygiene and gingival health when analyzed according to gender, females tend to have better oral hygiene and gingival health than males with statistical significance in the GI only (p = 0.048)) (Table 1).

Six hundred and fifty-seven teeth had GMR with lower jaw having the highest number (356 (54.2%)). Other distribution of the GMR is as shown in Table 2. It was observed that the Mean ± SD of the posterior teeth with GMR was higher than those of the teeth in the anterior region with GMR except the lower anterior region (Table 2).

Tables 3a-3d showed the frequency statistics, odds ratio, 95% confidence intervals for the odds ratio and the p-values of upper anteriors, lower anteriors, upper posteriors and lower posterior teeth respectively. The value of OR is higher than 1 for some of the upper anteriors (21, 22 and 23), however not statistically significant as compared with much greater OR values for all the lower anteriors (41, 41, 43, 31, 32 and 33). This observation was also similar to the upper posterior teeth, as the OR for the upper posterior teeth is not as high as that of the lower posterior teeth.

Table 2 Descriptive statistics of teeth with Gingival Margin Recession (GMR).

Tooth	Frequency (%)	Minimum (mm)	Maximum (mm)	Mean ± SD (mm)
11	8	1.0	2.0	1.25 ± 0.46
12	13	1.0	2.0	1.23 ± 0.44
13	17	1.0	4.0	1.71 ± 0.77
14	28	1.0	3.0	1.71 ± 0.66
15	29	1.0	3.0	1.48 ± 0.57
16	31	1.0	4.0	1.71 ± 0.82
17	9	2.0	3.0	2.11 ± 0.33
Total	135			
21	10	1.0	2.0	1.10 ± 0.32
22	12	1.0	3.0	1.42 ± 0.67
23	18	1.0	3.0	1.89 ± 0.58
24	31	1.0	3.0	1.54 ± 0.62
25	37	1.0	2.0	1.27 ± 0.45
26	42	1.0	3.0	1.90 ± 0.69
27	16	1.0	3.0	2.06 ± 0.85
Total	166			
41	32	1.0	3.0	2.22 ± 0.71
42	36	1.0	4.0	1.92 ± 0.84
43	38	1.0	4.0	2.34 ± 0.71
44	18	1.0	4.0	1.94 ± 0.94
45	15	1.0	2.0	1.20 ± 0.41
46	19	1.0	3.0	1.68 ± 0.67
47	8	1.0	3.0	1.75 ± 0.71
Total	166			
31	38	1.0	3.0	2.16 ± 0.79
32	36	1.0	3.0	1.97 ± 0.69
33	34	1.0	4.0	2.56 ± 0.75
34	24	1.0	3.0	1.79 ± 0.51
35	21	1.0	3.0	1.57 ± 0.59
36	27	1.0	6.0	1.85 ± 1.03
37	10	1.0	3.0	2.10 ± 0.57
Total	190			
Overall Total	657			

4. Discussion

GMR either localized or generalized sometimes can lead to major functional and esthetic problems in adolescents and young adults. The etiology and pathogenesis of such defects still remains a mystery (Eid, 2014). This condition is quite common in mixed dentition stage but mainly occurs in adults and rarely reported in deciduous dentition stage (Albandar, 2002).

Despite the etiology of GMR remaining a mystery (Eid, 2014), crossbite has been established as a strong etiological factor for the development of GMR. Crossbite is an anterior-posterior malocclusion occurring as a result of a deviation of the eruption axis causing esthetic, functional, and periodontal irregularities (Ustun, Sari et al., 2008).

From the current study, greater OR values for all the lower anteriors (41, 41, 43, 31, 32 and 33) was observed (Fig. 1). This suggests that for the lower anterior teeth, the odds of developing GMR is very high when they are in crossbite. Furthermore, the values are statistically significant ($p < 0.05$). Our result is in tandem with the reports from earlier studies regarding the considerable correlations between GMR and lower jaw anterior crossbite (Han and Jung, 2011; Mythri et al., 2015; Pugaca et al., 2007; Richman, 2011; Staufer and Landmesser, 2004; Ustun et al., 2008).

Several factors have been considered for the high prevalence of GMR of the lower anterior teeth. One of such factors is the thin buccal plate of bone in the anterior region of the mandible thus making them more susceptible to GMR especially when there occlusal overload because of the presence of crossbite (Fan and Caton, 2018; Han and Jung, 2011; Humagain and Kafle, 2015). Similarly, proclination of lower incisors may predispose to dehiscence and fenestrations leading to GMR (Seehra et al., 2009). When crossbite occurs, there is a change in the direction of occlusal forces leading to the creation of horizontal constituents of these forces during biting (Ustun et al., 2008). Therefore, when the upper anterior teeth is in crossbite, they lead to labial movement of the mandibular incisors 17 (Ustun et al., 2008). Other factors reported to have influenced the periodontium is the type of tooth brush and tooth brushing technique (Yared et al., 2006). These factors usually results in generalized GMR and is related to duration, force, bristle hardness and frequency of changing toothbrush (Rajapakse et al., 2007; Tezel et al., 2001; Kozlowska et al., 2005). On the contrary, other studies have reported that toothbrushing duration and frequency were not related to the development of GMR (Kallestal and Uhlin, 1992; Murtomaa et al., 1987). Currently, the consensus regarding toothbrushing and its correlation with GMR is inconclusive based on the available data (Cortellini and Bissada, 2018; Rajapakse et al., 2007). In the current study, patients claimed use of medium textured toothbrush, however, patients could not specify the technique of toothbrushing. Further studies is needed to unravel this debacle.

For the upper anterior dentition, although the odds of developing GMR is higher than 1 when the teeth are in crossbite, they are not statistically significant ($p > 0.05$). This association of developing GMR is weak and cannot be certified with certainty to crossbite in the upper anterior teeth.

Regarding posterior dentition (Fig. 2), studies describing association between CB and GMR is scarce. This current

Table 3a Association between crossbite and gingival marginal recession in the upper and lower anteriors.

			GMR		Odds ratio at 95% CI			
			Yes (%)	No (%)	OR	Lower bound	Upper bound	P value
11	CB	Yes	-8	-112	–	–	–	–
		No	(6.7)	(93.3)				
12	CB	Yes	-11	-109	–	–	–	–
		No	(9.2)	(90.8)				
13	CB	Yes	-18	-102	–	–	–	–
		No	(15.0)	(85.0)				
21	CB	Yes	0 (0.0)9	1 (100.0)110	1.082	1.023	1.139	0.775
		No	(7.6)	(92.4)				
22	CB	Yes	0 (0.0)11	1 (100.0)108	1.102	1.040	1.167	0.750
		No	(9.2)	(90.8)				
23	CB	Yes	0 (0.0)19	1 (100.0)100	1.190	1.100	1.287	0.663
		No	(16.0)	(84.0)				
41	CB	Yes	32 (84.2)3	6 (15.8)79	140.4	33.09	596.0	0.000*
		No	(3.7)	(96.3)				
42	CB	Yes	36 (87.7)2	6 (14.3)76	228.0	43.8	1185.6	0.000*
		No	(2.6)	(97.4)				
43	CB	Yes	36 (76.6)2	11 (23.4)71	116.2	24.4	552.4	0.000*
		No	(2.7)	(97.3)				
31	CB	Yes	34 (82.9)2	7 (17.1)76	187.0	36.9	947.3	0.000*
		No	(2.5)	(96.2)				
32	CB	Yes	34 (79.1)1	9 (20.9)76	287.1	34.9	2356.8	0.000*
		No	(1.3)	(98.7)				
33	CB	Yes	31 (68.9)3	14 (31.1)72	53.1	14.252	198.2	0.000*
		No	(4.0)	(96.0)				

Key: CB (Crossbite), GMR (Gingival Marginal Recession), OR (Odds Ratio), CI (Confidence Interval).

Table 3b Association between crossbite and gingival marginal recession in the upper and lower posterior.

			GMR		Odds ratio at 95% CI			
			Yes (%)	No (%)	OR	Lower bound	Upper bound	P value
14	CB	Yes	0 (0.0)26	1 (100.0)93	1.280	1.164	1.141	0.597
		No	(21.8)	(78.2)				
15	CB	Yes	2(100.0)25	0 (0.0)93	4.720	3.333	6.685	0.008*
		No	(21.1)	(78.8)				
16	CB	Yes	3 (100.0)28	0 (0.0)89	4.179	3.025	5.772	0.003*
		No	(23.9)	(76.1)				
17	CB	Yes	-8	-112	–	–	–	–
		No	(6.7)	(93.3)				
24	CB	Yes	3 (100.0)28	0 (0.0)89	4.179	3.025	5.772	0.003*
		No	(23.9)	(76.1)				
25	CB	Yes	3 (100.0)34	0 (0.0)83	3.441	2.593	4.567	0.009*
		No	(29.1)	(70.9)				
26	CB	Yes	3 (75.0)38	1 (25.0)78	6.158	0.620	61.184	0.080
		No	(32.8)	(67.2)				
27	CB	Yes	1 (100.0)16	0 (0.0)103	7.438	4.715	11.733	0.013*
		No	(13.4)	(86.6)				
44	CB	Yes	14 (42.4)5	19 (57.6)82	12.084	3.878	37.654	0.000*
		No	(5.7)	(94.3)				
45	CB	Yes	13(39.4)1	20 (60.6)86	55.900	6.905	452.55	0.000*
		No	(1.1)	(98.9)				
46	CB	Yes	16 (41.0)2	23 (59.0)79	27.478	5.882	128.377	0.078
		No	(2.5)	(97.5)				
47	CB	Yes	7 (23.3)2	23 ()76.788	13.391	2.065	68.836	0.000*
		No	(2.2)	(97.8)				
34	CB	Yes	17 (41.5)4	24 (58.5)75	13.281	4.072	43.318	0.000*
		No	(5.1)	(94.9)				
35	CB	Yes	16 (39.0)4	25 (61.0)75	12.000	3.667	39.267	0.000*
		No	(5.1)	(94.9)				

(*continued on next page*)

Table 3b (*continued*)

			GMR		Odds ratio at 95% CI			
			Yes (%)	No (%)	OR	Lower bound	Upper bound	P value
36	CB	Yes	21 (42.0)3	29 (58.0)67	16.172	4.471	58.503	0.000*
		No	(4.3)	(95.7)				
37	CB	Yes	9 (24.3)1	28 (75.7)82	26.357	3.195	217.412	0.000*
		No	(1.2)	(98.8)				

Key: CB (Crossbite), GMR (Gingival Marginal Recession), OR (Odds Ratio), CI (Confidence Interval).

study was able to observe association of both lower and upper dentition in crossbite with GMR, however, more stronger association was observed with the lower posterior dentition as compared with upper posterior dentition. Traumatic occlusion associated with crossbite may also be responsible for this observation in the posterior teeth. Further studies is required to justify association of CB and GMR in the posterior dentition.

Another important factor in the development of generalized GMR is the periodontal phenotype of the patients. It is well established that thin gingival phenotype has an increased risk to the development of generalized GMR (ref). However, in the current study the patients were not having generalized GMR but only isolated cases of GMR that were related to individual teeth with CB. Furthermore, a study have reported association between CB and pocket dept and no association between CB and GMR (Haniyah et al., 2018). In the current study patients with associated pocket were excluded. However, future study is underway to study the relationship between pocket dept and GMR.

Limitation of the current study was that Cone Beam CT (CBCT) was not used to evaluate bone morphology. Further studies using CBCT to examine the morphology both in the posterior and anterior regions is required to justify this observation.

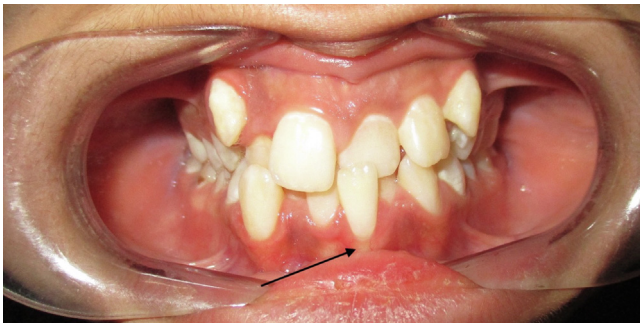

Fig. 1 Lower anterior #31 in crossbite with gingival recession.

Fig. 2 Lower posterior #46 in crossbite with gingival recession.

5. Conclusion

This study was able to highlight the strong association between CB and GMR especially in the lower anterior dentition as previously reported in the literature. Further studies is required to justify association of CB and GMR in the posterior dentition.

Ethical Statement

The authors declared that this study is carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans and animals.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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