ORIGINAL ARTICLE
COMPARISON BETWEEN TWO TYPES OF MATRIX SYSTEMS FOR CONTACT TIGHTNESS IN CLASS-II COMPOSITE RESTORATIONS

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Background: The reconstruction of proximal defects with tight contacts has always been a challenge for dental clinicians, especially with composite material. Recent literature shows that the most frequently used matrix systems for the restoration of proximal cavities are circumferential or sectional matrix band systems. The objective of this study was to compare the contact tightness that is achieved with these two matrix band systems when using composite material. **Methods:** A total of 30 patients, i.e., 60 cavities were selected in this quasi-experimental study. Patients with two cavities in the posterior teeth were selected. Both the cavities were restored with the circumferential system, i.e., Tofflemire and sectional matrix band system, i.e., Palodent plus on the same appointment. Hence both systems were used in every patient and then contact tightness assess was ed based on an evaluation criterion, i.e., Fédération Dentaire Internationale clinical criteria for evaluation of contact in direct and indirect restorations. To make a comparison between the two systems Chi square test was used and $p<0.05$. **Results:** The mean age of the patients in the study was 31 years (SD, 7.59 years) with a range from 18 to 45 years. Most of the contact tightness in the Palodent matrix system was score 1 (n=33, 55%) and score 2 (n=17, 28.3%) while in Tofflemire was score 4 (n=28, 46.7%) and score 5 (n=19, 31.7%). Statistical analysis showed significance ($p=.037$) between Palodent matrix system contact tightness and Tofflemire. **Conclusion:** The sectional matrix band system was statistically superior to the circumferential matrix band system in achieving a tighter contact for class II composite restorations

Keywords: Matrix system; Restorations; Composite

INTRODUCTION

Modern restorative dentistry relies on restorative care that includes progressive approaches such as optimization of tooth form and function and conservation of tooth structure while utilizing minimal intervention.[1] Proximal contact or contact surface is the surface area where the proximal surface of neighbouring teeth comes in contact. The restored dentition requires that the contacting teeth be in close approximation. For well-functioning dentition adequate proximal contact is necessary while on the other hand, inadequate proximal contact may lead to food impaction, tooth migration, carious lesions, and periodontal disease.[2–5]

Reconstruction of proximal surface anatomy in dentistry traditionally is achieved by using a matrix system. Circumferential/universal matrix band system (CMB) e.g. Tofflemire and Sectional matrix band system (SMB) e.g. Palodent are two matrix systems. The objective of the matrix system is the re-establishment of natural tooth shape and interproximal contact position.[6]

Previous studies show the sectional matrix system creates a more natural and tighter contact between the restoration and adjacent tooth. As Gomes *et al* observed that contact tightness established with a sectional matrix (TDV, Curitiba) like the Palodent system was produced more frequently (90%) than the circumferential matrix (40%).[7] But recent local literature points out that dental clinicians still prefer using the CMB like tofflemire over the SMB as pointed out in the survey conducted in Multan, Pakistan.[8] They pointed out that the reason for this was not actually a lack of knowledge of the SMB superiority in the topic but the technique sensitivity and ease of placing a CMB system over a SMB. Hence pointing out that this clinically significant fact is not emphasized enough in dental societies.

After a thorough literature review, it was found that this study is one of few of this kind based on its methodology. This study is sure to provide us with data to fill the gap in local literature on this topic so that clinicians may have significant literature to review for evidence-based practices. The aim of this study was to compare how good natural tooth contact

can be re-established by using two different matrix systems, i.e., SMB and CMB by assessing the contact tightness in class II restorations with composite material.

MATERIAL AND METHODS

The ethical committee approval from the dental hospital (Rehmat Memorial Dental Teaching Hospital (RMDTH) Abbottabad was taken (Ref#WMC/RMDTH/EC/2083). Data was collected for this quasi-experimental study from June 2021 to June 2022. A sample size of 30 participants with two restorations each, i.e., (60) was calculated with the WHO software with the following assumptions. Significance level=5% Statistical power=80% Anticipation proportion 1=40%. Anticipation proportion 2=90%.[7]With non-probability consecutive sampling technique. Inclusion criteria were patients with fully erupted teeth, aged 18–45 years of both genders and had two posterior Class II cavities to restore. Exclusion criteria were cavities with subgingival margins, patients with periodontal disease and the presence of fixed partial dentures proximal to the cavities. Written consents were taken from all the participants and a detail of the procedure and probable outcomes was explained.

The affected tooth was isolated with a rubber dam or cotton rolls. The affected tooth was prepared without any extension for retention. The SMB Palodent Plus (Thickness: 0.038 mm; Dentsply, Konstanz, Germany) were positioned after the carious lesion was excavated. Using a wooden wedge, the SMB was positioned inter-proximally and fastened. The separation ring was then positioned (Palodent Plus Ring, Dentsply, Konstanz, Germany). The prepared cavity surface was etched with 37% phosphoric acid for 20 seconds after situating the matrix system.

Then the adhesive system was applied on an etched surface according to the manufacturer's guidelines and was cured for 20 seconds. Then the composite resin (3M ESPE, Seefeld, Germany) was inserted into the cavity following incremental technique. After completion of the restoration, the matrix system was removed and the finish and polish of the final restoration was done. During the same visit with the same patient, we applied the Tofflemire bands (no. 101, thickness: 0.04 mm) placed around the tooth in a retainer (Tofflemire Retainer Universal 1140, KerrHawe, Bioggio, Switzerland on another posterior tooth and followed the same restorative steps as mention above. All restoration was placed by a single operator and the contact tightness was evaluated by a final year resident of FCPS Operative Dentistry and Endodontics by dental floss (Oral-B® Essential Floss) using Fédération Dentaire Internationale (FDI) scoring criteria.

The proximal contact tightness was evaluated by checking contact tightness with dental floss while following FDI clinical criteria for evaluation of contact in direct and indirect restoration (Table-1).[9–11]

Table-1: FDI clinical criteria score for evaluation of contacts in restorations[10]

Score	Proximal contact tightness	Functional properties
1	Normal contact point (floss or 25 um metal blades can pass)	Clinically excellent
2	Contact slightly to strong but no disadvantage (floss or 25um metal blade can only pass with pressure)	Clinically Good
3	Somewhat weak contact, no indication of damage to the tooth, gingiva, or periodontal structure, 50 um metal blades can pass	Clinically sufficient/satisfactory
4	Too weak & possible damage due to food impaction 100 um metal blade can pass	Clinically unsatisfactory
5	Too weak and/or clear damage due to food impaction and/or pain/gingivitis	Clinically poor

For statistical relevance, the contact tightness established was considered YES (acceptable) with FDI Clinical Criteria scores 1, 2 and 3 and NO (not acceptable) with scores 4 and 5. Also, participants were categorized into age groups 18–25 years, 26–30 years, 31–35 years, 36–40 years, & 41–45 years.

Data were analyzed by using SPSS version 20.0. Mean and SD was calculated for numerical variables like age. Frequency and percentages were calculated for categorical variables like gender, contact tightness (Yes, no) and diagnosis. The Chi-square test was applied to compare the contact tightness between two types of matrix systems (Palodont and Tofflemire). A comparison of the contact tightness between two types of matrix systems was made for the whole sample and separately for each gender and age group to see effect modifiers. $p<0.05$ was considered significant.

RESULTS

The mean age of the patients in the study was 31 years (SD, 7.59 years) with a range from 18–45 years. Of the total 30 (60 teeth) participants presented for restoration of the posterior with composite material, males were 31 (51.7%) and females were 29 (48.3%). Most of the contact

tightness in Palodent was scored 1 or excellent contact tightness (n=33, 55%) followed by a score 2 or good contact tightness (n=17, 28.3%) and the least was score 3 or satisfactory contact tightness (n=10, 16.7%). With Tofflemire matrix system only 3(5%) cases had a score 2 or good contact tightness. The most common contact pattern in Tofflemire matrix system was score 4 or clinically unsatisfactory contact tightness (n=28, 46.7%). In 31.7% (n=19) of Tofflemire matrix system had score of 5 or clinically poor contact. Score 3 or satisfactory contact tightness of Tofflemire matrix system was present only in 10 (16.7%) participants. The details are shown in Table-2. Most of the contact tightness in Palodent matrix system was score 1 (n=33, 55%) and score 2 (n=17, 28.3%) while in Tofflemire was score 4 (n=28, 46.7%) and score 5 (n=19, 31.7%). The Palodent matrix system had better contact tightness than Tofflemire statistically significantly (*p*=.037). The details are shown in table-3.

When the comparison of contact tightness of Palodent versus Tofflemire matrix system was stratified by gender the results showed that only in males the Palodent contact was better than Tofflemire matrix system statistically significant (*p*=.008). In females, the difference for the comparison of contact tightness of Palodent versus Tofflemire matrix system was not statistically significant (*p*=.287). The detailed percentages and frequencies are in table-4.

Table-5 shows the comparison of contact tightness of the Palodent versus Tofflemire matrix system stratified by age groups. For age groups; 18–25 years (*p*=.617), 26–30 years (*p*=.655), 31–35 years (*p*=.098), and 36–40 years (*p*= .723) the differences for contact tightness of Palodent versus Tofflemire matrix system was not statically significant. Only in age group 41–45 the palodent matrix system was better than Tofflemire system statistically significantly (*p*=0.047). The details are given in table-5.

Table-2: Frequency of gender, diagnosis, age group, score of Palodont contact and score of tofflemire contact tightness

		Frequency	Percent
Gender	Male	31	51.7
	Female	29	48.3
	Total	60	100
Age group (years)	18–25	16	26.7
	26–30	11	18.3
	31–35	14	23.3
	36–40	12	20
	41–45	7	11.7
	Total	60	100
Palodent Contact tightness	score 1	33	55
	Score 2	17	28.3
	Score 3	10	16.7
	Total	60	100
Tofflemire Contact tightness	Score 2	3	5
	Score 3	10	16.7
	Score 4	28	46.7
	Score 5	19	31.7
	Total	60	100

Table-3: Comparison of contact tightness of Palodent versus Tofflemire matrix system

			Tofflemire Contact tightness				Total	*p*-value
			Score 2	Score 3	Score 4	Score 5		
Palodent Contact tightness	Score 1	N	3	2	18	10	33	.037
		%	100.00	20.00	64.30	52.60	55.00	
	Score 2	N	0	3	8	6	17	
		%	0.00	30.00	28.60	31.60	28.30	
	Score 3	N	0	5	2	3	10	
		%	0.00	50.00	7.10	15.80	16.70	
Total		N	3	10	28	19	60	
		%	100.00%	100.00	100.00	100.00	100.00	

*Chi-Square Test

Table-4: Comparison of contact tightness of Palodent versus Tofflemire matrix system stratified by gender

Gender				Score 2	Score 3	Score 4	Score 5	Total	p-value
				Tofflemire Contact tightness					
Male	Palodent Contact tightness	Score 1	N	0	1	12	3	16	.008
			%	0.00	20.00	75.00	30.00	51.60	
		Score 2	N	0	1	4	5	10	
			%	0.00	20.00	25.00	50.00	32.30	
		Score 3	N	0	3	0	2	5	
			%	0.00	60.00	0.00	20.00	16.10	
Female	Palodent Contact tightness	Score 1	N	3	1	6	7	17	.287
			%	100.00	20.00	50.00	77.80	58.60	
		Score 2	N	0	2	4	1	7	
			%	0.00	40.00	33.30	11.10	24.10	
		Score 3	N	0	2	2	1	5	
			%	0.00	40.00	16.70	11.10	17.20	

*Chi-Square Test

Table-5: Comparison of contact tightness of Palodent versus Tofflemire matrix system stratified by age groups

Age group (years)				Score 2	Score 3	Score 4	Score 5	p-value*
				Tofflemire Contact tightness				
18–25	Palodent Contact tightness	Score 1	n	2	1	4	5	.617
			%	100.00	50.00	66.70	83.30	
		Score 2	n	0	0	1	1	
			%	0.00	0.00	16.70	16.70	
		Score 3	n	0	1	1	0	
			%	0.00	50.00	16.70	0.00	
26–30	Palodent Contact tightness	Score 1	n	0	1	2	3	.655
			%	0.00	50.00	66.70	50.00	
		Score 2	n	0	0	1	2	
			%	0.00	0.00	33.30	33.30	
		Score 3	n	0	1	0	1	
			%	0.00	50.00	0.00	16.70	
31–35	Palodent Contact tightness	Score 1	n	1	0	5	0	.098
			%	100.00	0.00	71.40	0.00	
		Score 2	n	0	2	2	1	
			%	0.00	66.70	28.60	33.30	
		Score 3	n	0	1	0	2	
			%	0.00	33.30	0.00	66.70	
36–40	Palodent Contact tightness	Score 1	n	0	0	4	2	.723
			%	0.00	0.00	50.00	66.70	
		Score 2	n	0	1	3	1	
			%	0.00	100.00	37.50	33.30	
		Score 3	n	0	0	1	0	
			%	0.00	0.00	12.50	0.00	
41–45	Palodent Contact tightness	Score 1	n	0	0	3	0	.047
			%	0.00	0.00	75.00	0.00	
		Score 2	n	0	0	1	1	
			%	0.00	0.00	25.00	100.00	
		Score 3	n	0	2	0	0	
			%	0.00	100.00	0.00	0.00	

*Chi-Square Test

DISCUSSION

This study was conducted to determine proximal contact tightness (dental floss can pass between two adjacent teeth) in class-II composite restoration using two different type of matrix systems, i.e., Palodent (sectional matrix) and tofflemire (circumferential matrix). Our results showed that the proximal contact of Palodent sectional matrix is better than tofflemire circumferential matrix statistically when based on the FDI evaluation criteria for proximal contacts. This finding is coherent with most other studies done on the same topic in the recent past. A study was carried out by Loomans et al.[12] on the comparison of proximal contacts of Class II resin composite restorations in vitro. They claimed that tighter proximal contacts were produced when section matrices and separation rings were used as opposed to circumferential systems ($p<0.001$). Therefore, when posterior resin composite restorations are done, the use of these devices is

advised.[13] Another randomized clinical trial on the Comparison of two different matrix band systems in restoring two surface cavities in posterior teeth done by senior undergraduate students at Qassim University, Saudi Arabia was conducted. According to their findings, 389 (100%) ideal connections were discovered in repairing proximal contacts using the sectional band approach. Using the circumferential matrix band technique, a highly significant correlation between open contact sites and negative overhanging margins was discovered ($p<0.00$).[14] But it must be highlighted that not all of the studies are in vivo.

Palodent's sectional matrix's tighter contact can be attributed to their superior adaptability to tooth anatomy compared to Tofflemire. The thickness of the matrix system should also be considered when using it for 2-surface restoration. When employing a circumferential system, the overall proximal thickness of the matrix is 0.07 or 0.10 mm, whereas the thickness of sectional matrix systems is 0.04 mm. Application of the separation ring is another explanation for the variations in proximal contact tightness between circumferential and sectional matrices. Has been taught by senior clinicians to apply wedges even before beginning the preparation for posterior restorations to achieve tighter contact.[14–18] However, in a clinical trial and in an in-vitro study, the effect of the wedge could not be proven to be ideal for re-establishing a tight and anatomical contact whereas, the groups using separation rings with sectional matrix systems produced the tightest proximal contacts.[14,19,20] This suggests that combining separating rings and circumferential matrix systems is probably advantageous.[21] It must be considered here that only the contact tightness of the restorations is being discussed as the adequate contour of the proximal surfaces is another topic altogether. This has equally important clinical significance. The literature also states that the sectional matrix gives better anatomical contouring of the inter-dental area. The combination of tight contact and near to ideal anatomical contouring with sectional matrix systems will give the benefits of a healthy inter-dental papilla, and prevent periodontal disease and caries development.[22,23]

In the present study with the help of statics, an association of gender with the type of matrix system used for tight contact was assessed. There was statistical significance (p value= 0.08) for males with Palodent matrix system. The reason for this should be attributed to the fact that the size of male teeth is usually bigger, i.e., the effect of sexual dimorphism.[24] This implies that the contact point is usually bigger and more difficult to achieve. The prevalence of gingival recession in males is also greater.[25–27] Which

also has effects on the contact point area and health of the adjacent surrounding all leading to the difficulty of establishing a tighter contact inter-proximally. The association was also established with age. As Palodent system was more significant in creating tight contact in participants above 40 years (p-value=0.047). This is another finding that needs to be further studied. But correlations can be made between age and tooth wear and periodontal disease which have both been identified as to be associated clinical variables in creating proximal contact area and tightness.[27–29]

The drawbacks of this study were mostly related to the study design as we could not rule out multiple variables and associations could not be concluded.

CONCLUSION

The sectional matrix band system Palodent was statistically superior to the circumferential matrix band system the Tofflemire in achieving a tighter proximal contact for class II composite restorations. It is recommended to conduct further studies on the same topic with better study designs to confirm any associations of contact tightness with the age or gender of dental patients.

Conflict of interest: None.

AUTHORS' CONTRIBUTION

MA: Data collection, study design, data analysis, write-up. IK: Design, data analysis, interpretation, proof reading. AQ: Write-up, literature search, design, analysis. MZ: Data interpretation, literature search, write-up. NA: Data collection, write-up, proof reading. MIK: Write-up, proof reading.

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