

Assessment of Clinical Efficacy and Patient Comfort Using Three Different Matrix Systems for Restoring Two Surface Lesions in Primary Molars: An in Vivo Study

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Foram Patel

Senior Lecturer, Department of Pediatric and Preventive Dentistry, Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat, India. Email: forampatel281095@gmail.com

Pankti Chokshi

Consulting Pediatric Dentist E-Mail: pankti1096@gmail.com

Megha Patel

Professor and Head, Department of Pediatric and Preventive Dentistry, Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat, India. Email: drmegha1782@gmail.com

Rohan Bhatt

Professor, Department of Pediatric and Preventive Dentistry, Karnavati School of Dentistry, Karnavati University, Gandhinagar, Gujarat, India. Email: drrohanbhatt@gmail.com

Umang Patel

Consulting Dental Surgeon E-mail: umangpatel151092@gmail.com

Corresponding Author: Dr. Foram Patel

Email: forampatel281095@gmail.com

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Abstract

Background: Restorations on posterior teeth can have a number of issues, including incorrect contact points and proximal overhangs. With the recognition of significance of restoring tooth's right contour and contact, and repair of all tooth surfaces, including proximal walls, different matrix systems were introduced.

Aim: Assessing three different matrix systems in terms of their ability to create ideal contacts and contours along with patient comfort.

Material and Methodology: After taking approval from the college ethical committee and parent's consent, a total of 120 patients, aged 4-8 years were treated based on selection criteria after randomly dividing them into 3 groups by computer randomization method. Group 1 used Tofflemire system, Group 2 used Unimatrix R sectional system, and Group 3 used FenderMate system for restoring proximal contacts of two surface lesions in primary molars. Time taken for placement of the system along with proximal contacts, proximal overhangs and patient comfort were assessed at the end of the procedure and a chi-square test was used for statistical analysis.

Results: Maximum optimal contacts were seen with Unimatrix R system and overhangs were absent for Tofflemire system. Also, there were no significant differences regarding the patient comfort among the three groups. The FenderMate system took the least time for application followed by Unimatrix R and Tofflemire system.

Conclusion: Sectional matrices were favoured for optimal contacts, circumferential matrices were determined to be more superior in terms of preference and one piece sectional matrix system showed time efficiency.

1. Introduction:

Dental caries is defined as “a biofilm-mediated, diet modulated, multifactorial, non-communicable,

dynamic disease resulting in net mineral loss of dental hard tissues [Fejerskov 1997]”. Dental caries are still a major worry in this modern era of dentistry. The first stage in treating a carious tooth is complete removal of

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the caries, followed by restoration of the teeth in a manner consistent with their natural structure. Additionally, primary molars progress proximal carious lesions considerably more quickly than permanent teeth. Therefore, after tooth structure has been lost, it is crucial to restore the tooth to its ideal form and function.

According to one definition, a proximal contact or contact surface is the "surface region where the proximal faces of adjacent teeth come into contact." The interacting teeth must be reasonably close together for a restoration to be considered acceptable. A badly aligned dentition and displaced teeth with absent or open contacts as well as proximal contact surfaces with inappropriate dimensions, can cause halitosis, caries development, and periodontal disease.¹

It's still challenging to create ideal contact sites with direct restorations, especially in posterior teeth. Restorations on posterior teeth can have a number of issues, including incorrect contact points and proximal overhangs. This happens as a result of poor restorative material condensation or polymerization shrinkage. Given these issues, treating carious lesions, particularly those in the proximal region, has historically been problematic in pediatric patients for a variety of reasons, including increased salivation, unruly behaviour, difficulties being isolated, post-restorative care, etc.

With the recognition of the significance of restoring tooth's right contour and contact, and repair of all tooth surfaces, including proximal walls, different matrix systems were introduced. These systems aid the in reconstruction of missing walls and keeping the restorative material contained, preventing overhangs. In dentistry, certain kinds of matrices have typically been used to reconstruct proximal surface anatomy.

Dr. Louis Jack was the pioneer of pre-contoured matrix bands in 1871 to fill Class II cavities with dental amalgam.²

Dr. Joseph B.F. Tofflemire invented a modified version of the Ivory No. 8 and 9 systems that can be used to place composite resin and rebuilds appropriate contacts for use with amalgam.³ Instead of solid contact areas, this technique produced straight, non-anatomical proximal walls that resulted in point contacts along with being time-consuming.

With the advent in this field, newer systems came into existence like the sectional matrix systems that comprises of separation ring, sectional matrices, custom-fitted plastic wedges, and application forceps. Based on this idea, TDV Inc. created Unimatrix R. Improvements in gingival adaptability, contact surface anatomy, usability, and incorporation of wider (buccolingual) proximal contours have been made possible by this system.¹

There have also been other designs and revisions that combine various kinds of matrices, wedges, and separation techniques. A wedge and a precurved sectional matrix band can be combined into one device without the need for a separation ring, as shown by the FenderMate system (Directa Inc.). They also brought into light, the FenderMate Prime system, that has been designed specifically for primary dentition making proximal restorations much more convenient yet costly.⁴

Different matrix systems provide a variety of benefits, according to their manufacturers, however, there aren't enough facts to support these claims. Hence, this study was conducted with the purpose of assessing three different matrix systems in terms of their ability to create ideal contacts and contours along with patient comfort.

2. Material and Methodology:

After taking approval from the college ethical committee and parent's consent, a total of 120 patients, aged 4-8 years were treated based on selection criteria from out-patient Department of Pediatric and Preventive dentistry of Karnavati School of Dentistry, Gandhinagar.

INCLUSION CRITERIA

- Subjects between 4-8 years of age.
- Fully erupted teeth.
- Fully erupted adjacent tooth.
- Caries involving two surfaces – proximal and occlusal
- Patients showing Frankel's positive and definitely positive behavior.

EXCLUSION CRITERIA

- Mobile teeth.

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- Caries involving less than or more than two surfaces.
- Missing adjacent tooth.
- Spaced dentition.
- Patients showing Frankel's negative and definitely negative behavior.

STUDY DESIGN:

The study was conducted as a simple randomized, parallel-group, double blinded study with sample size of 120 children divided into three groups of 40 each.

- **Group A (n=40):** After securing the Tofflemire matrix band and retainer (NMD Dental), restorations were completed.
- **Group B (n=40):** After installing the pre-contoured sectional matrix (Unimatrix R) and ring retainer, restorations were completed.
- **Group C (n=40):** After placement of the FenderMate Prime matrix (Dentistry Direct), restorations were completed.

METHODOLOGY:

To teach the dentists the correct method for installing all 4 matrix band systems, a workshop was held.

- Comparable lesions were picked for every patient. A single operator prepared the mesio-occlusal or disto-occlusal cavity using a high-speed diamond round bur (no. 010) and water coolant.
- Children who felt pain during the excavation of carious dentin, received local anaesthetic treatment.
- Matrix band systems were placed in accordance with the group allotted; cavo-surface angles were not bevelled; and there were no retentive grooves.

GROUP A:

- Before placing the restoration, a Tofflemire matrix band and retainer were adapted to the tooth, and the inner nut of the retainer was properly tightened to allow the band to conform to the shape of the tooth.

GROUP B:

- An adequate size sectional grid was chosen and positioned interproximally.

- The band was stabilised by a ring retainer (Unimatrix R).

GROUP C:

- Prior to placing the restoration, the FenderMate Prime matrix was inserted interproximally and adapted in accordance with the shape of the tooth.
- The amount of time needed to install the matrix system was noted by a trained observer.
- Cotton rolls and suction tips were employed to regulate dampness.
- The 3M ESPE single bond universal adhesive was used after the tooth had been isolated. An LED light was then used to cure the bonding agent.
- After that, the teeth were restored using a multilayering approach using packable composite resin material (3M ESPE), curing each increment for 20 seconds.
- The matrix band structure was carefully removed after curing.
- Finishing and polishing was done with composite polishing burs.

Checking the Proximal Contact Points:

- An examiner who was blinded about the matrix system in use, passed a waxed dental floss (Colgate Total) interproximally to test the tightness of the proximal contact point (PCP).

- PCP was categorized as:

- Optimum
- Open
- Tight
- The ideal contact point was defined as one through which dental floss could pass with either little resistance or resistance equal to that of the opposing side's natural teeth.
- Open PCPs were those that did not obstruct the passage of dental floss.
- Dental floss was considered tight if it was unable to be passed at all or shredded.

Assessment of proximal overhangs:

- Bitewing radiographs were used for the assessment of proximal overhangs.
- Overhangs were categorized as:
 - Positive

- Negative
- Absent
- Positive overhang was defined as an excess of filling material that extended past the cavity margin or healthy tooth structure at the proximal step of the restoration.
- At the proximal region of the restoration, if filling material was discovered to be short of the cavity boundary or normal tooth structure, it was classified as negative overhang.
- Overhang was said to be absent if the filling material and tooth surface transitioned smoothly at the proximal step of the restoration.



Figure 1: Pre and Post treatment – Tofflemire and retainer



Figure 2: Pre and Post treatment – Unimatrix R



Figure 3: Pre and Post treatment – FenderMate Prime



Figure 4: Checking proximal contact point tightness with dental floss

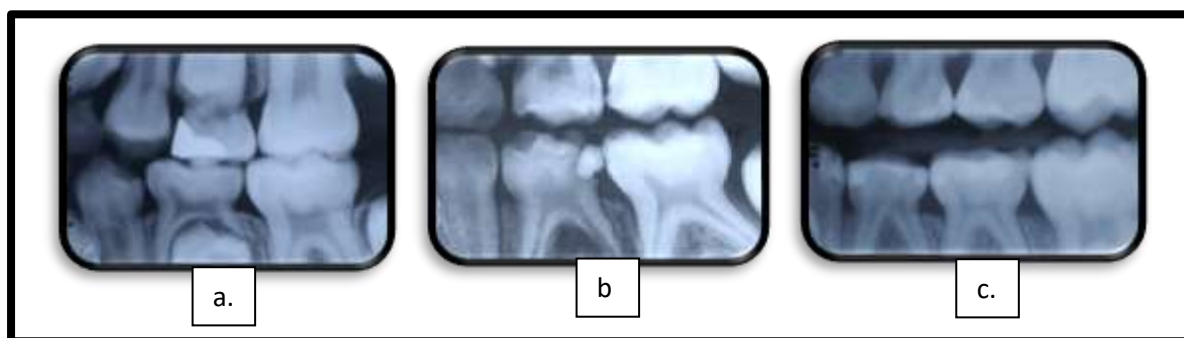


Figure 5: (a) Positive Overhang (b) Negative Overhang (c) Absent Overhang

Assessment of patient comfort: - Patient comfort was noted using the pain rating scale.



- The data was compiled and the operator was asked to fill the questionnaire at the end of the treatment.

3. Results:

In the current investigation, two surface cavities in primary posterior teeth were restored using three different matrix systems and compared. These three systems were assessed for proximal contact point tightness, proximal overhang, patient comfort, and the amount of time needed to place the matrix. (table 1) Table 2 shows that Group B i.e., Sectional Matrix and Ring Retainer created maximum number of optimum PCPs (75%) followed by Group A (50%) and Group C (25%). Tight contacts were seen highest in Group A (35%), followed by Group C (30%) and Group B (10%). A comparative evaluation between all the three groups through Chi square test shows a statistically significant value of 0.004. The overhangs were absent in 75% of restorations done using the Tofflemire matrix

system i.e. Group A followed by Group C (40%) and Group B (35%). Least number of negative overhangs were also found in Group A followed by Group B and Group C. A comparative evaluation between all the three groups through Chi square test shows a statistically significant value of 0.001. (table 2) Patients were most comfortable in Group B (65%), followed by Group A (35%) and Group C (30%). A comparative evaluation between all the three groups through Chi square test showed no statistically significant difference between all the groups. (table 3) Least time was taken in Group C (75%). Highest time was taken in Group A (50%). A comparative evaluation between all the three groups through Chi square test shows a statistically significant value of 0.001. (table 4)

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Table 1: Proximal Contact Point Tightness

		Group A	Group B	Group C	Total	P value
Open	Number(n)	6	6	18	30	0.004*
	% Within Group	15.0%	15.0%	45.0%	23.8%	
Optimum	Number(n)	20	30	10	60	
	% Within Group	50.0%	75.0%	25.0%	43.8%	
Tight	Number(n)	14	4	12	30	
	% Within Group	35.0%	10.0%	30.0%	32.5%	
Total	Number(n)	40	40	40	120	
	% Within Group	100.0%	100.0%	100.0%	100.0%	

Legends

Group A: Tofflemire matrix and band, Group B: Sectional Matrix and Ring Retainer, Group C: FenderMate Prime

* = P value (<0.05 is significant)]

Table 2: Evaluation of proximal overhangs

		Group A	Group B	Group C	Total	P value
Absent	Number (n)	30	14	16	60	
	% within Group	75.0%	35.0%	40.0%	47.5%	
	Number (n)	6	24	20	50	
	% within Group	15.0%	60.0%	50.0%	36.2%	

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Negative	Number (n)	4	2	4	10	0.001*
	% within Group	10.0%	5.0%	10.0%	16.2%	
Positive	Number (n)	40	40	40	120	
	% within Group	100.0%	100.0%	100.0%	100.0%	
Total	Number (n)	40	40	40	120	
	% within Group	100.0%	100.0%	100.0%	100.0%	

Legends

Group A: Tofflemire matrix and band, Group B: Sectional Matrix and Ring Retainer, Group C: FenderMate Prime

* : P value (<0.05 is significant)

Table 3: Assessment of patient comfort

			Group A	Group B	Group C	Total	P value
Patient Comfort	No Hurt	Number	2	0	0	4	
		% within Group	5.0%	0.0%	0.0%	2.5%	
	Hurts little bit	Number	6	4	0	22	
		% within Group	15.0%	10.0%	0.0%	13.8%	
	Hurts little More	Number	14	26	12	70	
		% within Group	35.0%	65.0%	30.0%	43.8%	
	Hurts even more	Number	16	10	22	56	
		% within Group	40.0%	25.0%	55.0%	35.0%	
		Number	2	0	4	6	

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	Hurts whole lot	% within Group	5.0%	0.0%	10.0%	3.8%	0.083
	Hurts worst	Number	0	0	2	2	
		% within Group	0.0%	0.0%	5.0%	1.2%	
Total	Number		40	40	40	120	
	% within Group		100.0%	100.0%	100.0%	100.0%	

Table 4: Time Taken for Placement of Matrix

		Group A	Group B	Group C	Total	P value
0-2 minutes	Count	12	26	30	68	0.001
	% within Group	30.0%	65.0%	75.0%	48.8%	
2-3 minutes	Count	8	14	10	32	
	% within Group	20.0%	35.0%	25.0%	27.5%	
>3 minutes	Count	20	0	0	20	
	% within Group	50.0%	0.0%	0.0%	23.8%	
Total	Count	40	40	40	120	
	% within Group	100.0%	100.0%	100.0%	100.0%	

4. Discussion:

In primary molars, interproximal lesions predominate over occlusal lesions, particularly when primary molar contacts are formed.⁵ According to a longitudinal study done by Mirja Varpio (2009), the mesial surfaces of the second primary molars and the distal surfaces of the first primary molars were where proximal caries was most frequently seen.⁶ A primary goal for the dentist is to restore proximal surface cavities that result from class II carious lesions to "normal" anatomical parameters.

A well-designed, firm proximal contact may safeguard the gingival tissues and aid in cleaning the surrounding surfaces, preventing cavities from developing. Inadequately constructed proximal connections might cause caries and gingivitis. In order to maintain the integrity of the dental arch and periodontal health, tight proximal contact and shapes with correct marginal adaptation are crucial.⁷ Food impaction may be brought on by loose contact and improperly designed shapes, which leads to the development of dental decay.

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Restorations on posterior teeth can have a number of issues, including incorrect contact points and proximal overhangs. This happens as a result of poor restorative material condensation or polymerization shrinkage. It is essential to employ a matrix band system in order to establish appropriate contact regions and fully recover the tooth as class 2 restorations show microleakage regardless of the type of composite used.⁸ A matrix band's main purpose is to make up for missing walls and keep the filler material contained.⁹ To replace the missing tooth structure, many matrix band systems have been created.

Three distinct matrix methods were employed in the current investigation to repair class II cavities. Tofflemire matrix band and retainer made up Group A. The most popular and conventional matrix system is Tofflemire. It provides a number of benefits, including affordability, accessibility, and stability. It has a number of drawbacks, including a longer processing time, technique sensitivity, and the need for wedge placement to produce a correct contour.³

Group B used the Unimatrix R. (TDV Inc) which shows wider (buccolingual) proximal contours and an improvement in gingival adaptation by advancements in ring, matrix, and wedge design.¹ However, it is not economical.

System FenderMate Prime was utilized in Group C (Directa Inc). This system's main benefit was that it combined a wedge and a precurved sectional matrix band (without the use of a separating ring) into a single device.⁴ Therefore, it took less time. However, this approach was inefficient and did not provide accurate contours.

Dental floss was used in the current investigation to examine the tightness of the proximal contact point. According to Table 1, Group C had the most open contact points (45%), followed by Group A (15%), and Group B (15%). The FenderMate Prime matrix was difficult to bend and conform to the tooth, and this system's wedging effect might have contributed to the largest number of open contacts in Group C. This finding was in contrast to the results of the study done by Dindukurthi et al. which concluded that FenderMate system did not show any open or defective contacts.¹⁰

Group B showed highest optimum contacts as in this group pre-contoured matrix band was used which

helped to create proper proximal contacts. This result of our study is in accordance with results of the study done by Bhatia et al.¹¹ who demonstrated that higher number of ideal/optimum contacts were established with sectional matrix system.

In the present study, proximal overhangs were examined using bitewing radiograph because it is not possible to properly visually evaluate cervical areas for marginal flaws such as overhangs, ditches, and gaps due to the presence of nearby teeth and gingival tissue.¹²

The percentage of groups without proximal overhangs was 75% in group A, 40% in group D, and 40% in group C. Group B had the highest percentage of negative overhangs (underfilled), followed by Group C (50%) Group A (15%). In Group A, there were no proximal overhangs since it was conceivable for the matrix band to extend past the cemento-enamel junction. The band's perfect stability with the retainer contributed to the material's proper condensation as well. Tofflemire system produced the fewest marginal overhangs as a result. This result is in accordance with Owens and Phebus¹³ who suggested that overhang was reduced by employing Tofflemire matrices as opposed to restoration using sectional bands.

Using the Wong-Baker Faces Pain Rating Scale, patient comfort was evaluated. Group B had the patient feeling the most at ease (65%), followed by Group A and Group C. The patient in Group C experienced the most discomfort because the wedge-shaped portion of the FenderMate Prime matrix caused pain when it was inserted into the interdental space. This can be explained by the fact that primary teeth have short cervico-occlusal crown length and it is possible to alter the matrix band and wedge placement depth in accordance with the crown height with other two systems in contrast to FenderMate system that is an inseparable assembly of matrix and wedge. This might lead to impingement on gingival tissues resulting in trauma and subsequent discomfort to the child.¹⁰ As wedging was not necessary in Group B, it resulted in the least degree of discomfort. As a result, patient felt most at ease in Group B. (Unimatrix R).

FenderMate system (Group C) took the least amount of time for placement (75%) whereas maximum time was consumed in the Tofflemire system (Group A). The least amount of time was needed for placement in

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Group C because the matrix and wedge were both present as a whole.¹⁰ In contrast, Group A required more time to put the matrix band into the retainer. This result was in contrast with a study done by Bhatia et al.¹¹ which showed that circumferential systems took less time than the sectional systems.

LIMITATIONS OF THE STUDY:

- Operator comfort in placing and working with these systems along with the problems encountered by them while using these systems could have been assessed.

STRENGTH OF THE STUDY:

- This study has contributed to the lacking literature in terms of use of circumferential, sectional and specialized one-piece sectional matrix systems like the FenderMate system in restoring proximal lesions in primary teeth.

5. Conclusion & Clinical Significance Of The Study:

- This study was carried out to evaluate a superior matrix system for pediatric patients. Sectional matrices were favored for optimal contacts, circumferential matrices were determined to be more superior in terms of preference and one piece sectional matrix system showed time efficiency.

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