

## Comparison of saddle contoured metal matrix and pre-contoured self-adhesive matrix in composite resin class II restorations; an in vivo study

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### Abstract

**Objective:** To evaluate composite class II restoration proximal contacts and contours by comparing saddle-contoured metal matrix and pre-contoured self-adhesive matrix system.

**Method:** The randomised controlled trial (NCT05414656) was conducted at the Department of Operative Dentistry, School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University, Pakistan Institute of Medical Sciences, Islamabad, Pakistan, from May to October 2022, and comprised of patients having supra-gingival class II cavities. They were randomised into class II restoration with saddle-contoured matrix band group A, and restoration with pre-contoured self-adhesive matrix group B. The tightness of proximal contacts was evaluated using the Fédération Dentaire Internationale criteria and the quality of proximal contours was assessed using clinical and radiographic examination. Data was analysed using SPSS 16.

**Results:** Of the 60 subjects, 42(70%) were females and 18(30%) were males. The overall mean age was 38.03±15.33 years. There were 30(50%) subjects in each of the 2 groups. The highest restoration was needed in the upper premolar 20(33.3%). The tightness of proximal contact was not significantly different between the groups ( $p=0.94$ ). Clinical examination for production of good contours was higher in group A compared to group B, but the difference was not significant ( $p>0.05$ ).

**Conclusion:** There was no significant difference between saddle-contoured metal matrix and pre-contoured self-adhesive matrix for composite class II restoration proximal contacts and contours.

**Clinical Trial Link:** <https://clinicaltrials.gov> RCT (NCT05414656)

**Key Words:** Dental restoration, Composite resin, Dental caries, Matrix bands.  
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### Introduction

Composite has gained great clinical interest due to its improved mechanical properties and aesthetic outcomes. Professionals are gaining experience in the use of composite resin to replace amalgam.<sup>1</sup> However, it is difficult to build tight proximal contacts and contours due to viscoelastic characteristics and polymerisation shrinkage of the composite.<sup>2,3</sup> When restoring the tooth in class II restoration, accurate anatomical contour restoration and provision of proper proximal contact tightness are critical to promoting periodontal health. Faulty proximal contacts can cause secondary caries and marginal breakdown, and may lead to restoration failure<sup>4</sup>. A strong proximal contact resists the separation under the masticatory forces and prevents food impaction during chewing.<sup>5</sup> As a result, practitioners struggle to reconstruct proximal contacts. Matrix bands have had a great influence on proximal contact, teeth anatomy and the

success of treatment in class II composite restoration.<sup>6</sup> A properly placed matrix band can restore proximal contact points with adjacent teeth and avoid excess filling material at the gingival margins<sup>7</sup>.

Multiple procedures and techniques have been tried in an attempt to produce tighter and more anatomically proximal contacts.<sup>8</sup> Class II composite restorations can be positioned with the aid of a straight as well as a pre-contoured matrix band, which determines the proximal contour. Studies support the use of a contoured matrix to produce a stronger marginal ridge than a straight matrix<sup>9,10</sup>. However, an ideal matrix should be convenient to insert and remove, and cause the least trauma to oral structures, while, at the same time, it should allow the correct establishment of restoration contour<sup>11</sup>.

The pre-contoured self-adhesive transparent matrices are polyester matrices with a standard thickness of 0.075mm that come in a variety of sizes for molars and premolars. Transparent matrices do not affect the composite polymerisation, have less shrinkage, and provide better visual control for composite handling and filling.<sup>12</sup> The saddle-contoured metal matrix is suitable for the wide axial angles' restorations. The system is supplied with the

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spring clip which is inserted into the tube on the margins of the saddle matrix.<sup>13</sup>

The incremental technique utilises the hand instrument held with occlusal pressure on the contact area along with the matrix of the adjacent tooth in polymerisation. This method offers a tighter proximal contact in class II restoration.<sup>14</sup> The required interproximal separation can also be achieved by placing a wooden wedge interdentially before the insertion of the matrix, a technique known as "pre-wedging."<sup>15</sup>

Various studies have shown that proximal contour has a great impact on the quality and durability of the restoration and is influenced by the type and anatomy of the matrix system used.<sup>16</sup>

The current study was planned to evaluate the proximal contacts and contours of class II resin restoration with saddle-contoured metal matrix and pre-contoured adhesive matrix.

## Materials and Methods

The randomised controlled trial (RCT) was conducted at the Department of Operative Dentistry, School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University (SZABMU), Pakistan Institute of Medical Sciences (PIMS), Islamabad, Pakistan, from May to October 2022. After approval from the institutional ethics review board, the study protocol was chalked out on the basis of the Consolidated Standards of Reporting Trials (CONSORT) guidelines.<sup>17</sup> The clinical trial was registered at international RCT registry [clinicaltrials.gov](https://clinicaltrials.gov) identifier <https://clinicaltrials.gov> (NCT05414656). The sample was raised using convenience sampling technique from among the patients who presented to the Department of Operative Dentistry with class II occlusal-proximal caries in the upper or lower dental arch.

Those included were patients with permanent completely erupted posterior teeth that had class II supragingival caries or were essential to changing class II restoration. The patients had surrounding teeth available for contact and teeth with buccolingual width not exceeding one-third of inter-cuspal distance.

Patients having partially erupted or primary teeth, and teeth with wires, bands or brackets for orthodontic treatment, mobility greater than grade 1 and presence of diastema in posterior teeth were excluded. Those with 3rd molar or tilted teeth or the teeth with dental caries approaching up to the inner pulp with periapical pathology were also excluded and so were those with periodontally weak teeth.

After taking informed consent from all the subjects, they were subsequently randomised using a computer-generated randomisation method into class II restoration with saddle-contoured matrix band (TOR VM № 1.310 Moscow, Russia) group A, and restoration with pre-contoured self-adhesive matrix (TOR VM № 1.490-1 Moscow, Russia) group B.

The sample size was determined using the World Health Organisation (WHO) calculator<sup>18</sup> with significance level 5% and power of the study 80%. Anticipated population proportion was set at 90% for group A and 40% for group B.<sup>19</sup>

Prior to the initiation of restoration, complete dental and medical history was noted, and clinical examination, including a preoperative radiograph, was done to confirm the extent of caries in dentine. A rubber dam was placed for isolation before class II cavity preparation. For the cavity preparation, a high-speed handpiece (Apple-Dental ME-TU China) with cutting diamond round bur (Mani Inc. Japan) was used. The deep soft caries lesion was removed with the slow-speed handpiece and hand excavator. A fine-grit diamond bur was used to bevel the cavity's contour.

In group A, saddle-contoured metal matrix was used. The saddle clip was stable with the metal matrix around the prepared cavity wall. The anatomical wedge was inserted into the gingival embrasure to preserve the height of the gingival floor and to ensure that the matrix band in the cervical region adapted optimally. A pre-contoured self-adhesive matrix was used in group B along with anatomical wedges. The adhesive end of the band closed around the prepared cavity.

After placing the matrix system, the prepared teeth were restored with resin composite (i-XCITE® LC N USA) through a standard restorative procedure. The prepared cavity was etched with the 37% phosphoric acid for 15 seconds and then resin with water spray. The cavity was dried with a cotton pallet. With an applicator brush, the bonding agent was applied and cured for 20 seconds. The cavity was restored with a composite incremental technique. The composite was used after matching with the composite shade guide (VITA classical A1-D4® Zahnfabrik, Germany). Each increment of resin composite was cured for 30 seconds. Matrix band was removed and restoration was cured from buccal and ling side. Occlusion was adjusted with the help of articulating paper, and restoration was finished with finishing burs. After that, the restoration was assessed clinically or with a periapical radiograph for radiographic assessment.

**Table-1:** FDI clinical criteria for the evaluation of direct and indirect restorations.

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

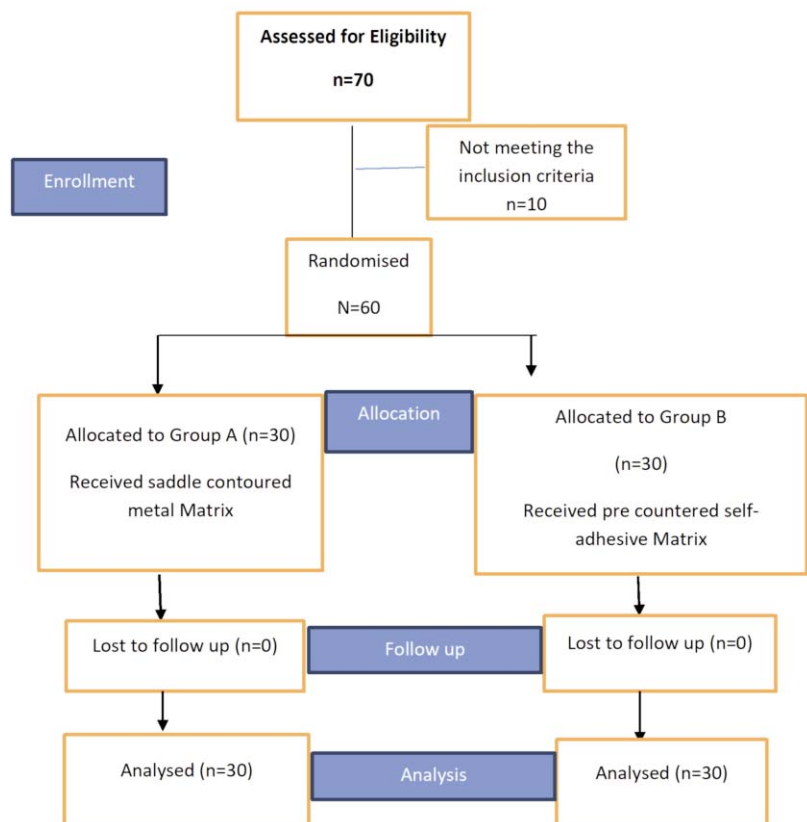
FDI: Fédération Dentaire Internationale.

The restoration was assessed for proximal contacts and proximal contours. The tightness of the proximal contact area resulting in the saddle matrix and self-adhesive matrix band systems was assessed by using 12-inch dental floss (Oral B Essential Floss USA.). Fédération Dentaire Internationale (FDI) criterion was used for direct clinical evaluation (Table 1). The secondary outcomes, including proximal contours and overhangs, were examined with a hand explorer and with a postoperative radiograph. Efforts were made to identify and control for potential confounding factors that could influence the outcomes of the study, like the type of composite used, technique of placement, isolation and operator skills.

Data was analysed using SPSS 16. Descriptive statistics were used to determine frequencies, percentages, mean and standard deviations. Chi-square test was used to determine the relationship between categorical variables, such as proximal contact tightness, proximal contours and overhangs, in the restoration of both groups. Spearman's rank-order correlation coefficient was applied to measure the strength of linear association between ranked variables, and to find the correlation between variables in the final outcome. Positive values indicated a positive correlation, negative values indicated a negative correlation, and values closer to zero suggested a weaker or no correlation.  $P < 0.05$  was considered statistically significant.

## Results

Of the 70 individuals assessed, 60(%) were included, with 30(50%) in each group (Figure 1). There were 42(70%) females and 18(30%) males. The overall mean age was  $38.03 \pm 15.33$  years. The highest restoration was needed in

**Figure-1:** Consolidated Standards of Reporting Trials (CONSORT) flow chart.

the upper premolar 20(33.3%) (Figure 2). The clinical proximal contact in the groups was not significantly different ( $p=0.925$ ) (Table 2). On radiographic evaluation, there was no significant inter-group difference ( $p=0.62$ ) in terms of proximal contacts.

The tightness of proximal contact was not significantly different between the groups ( $p=0.94$ ) (Table 3). No correlation was found between proximal contact tightness and composite restoration contours ( $p > 0.05$ ).

The coefficient test ruled out any significant relation between group B clinical and proximal contacts (Table 4).

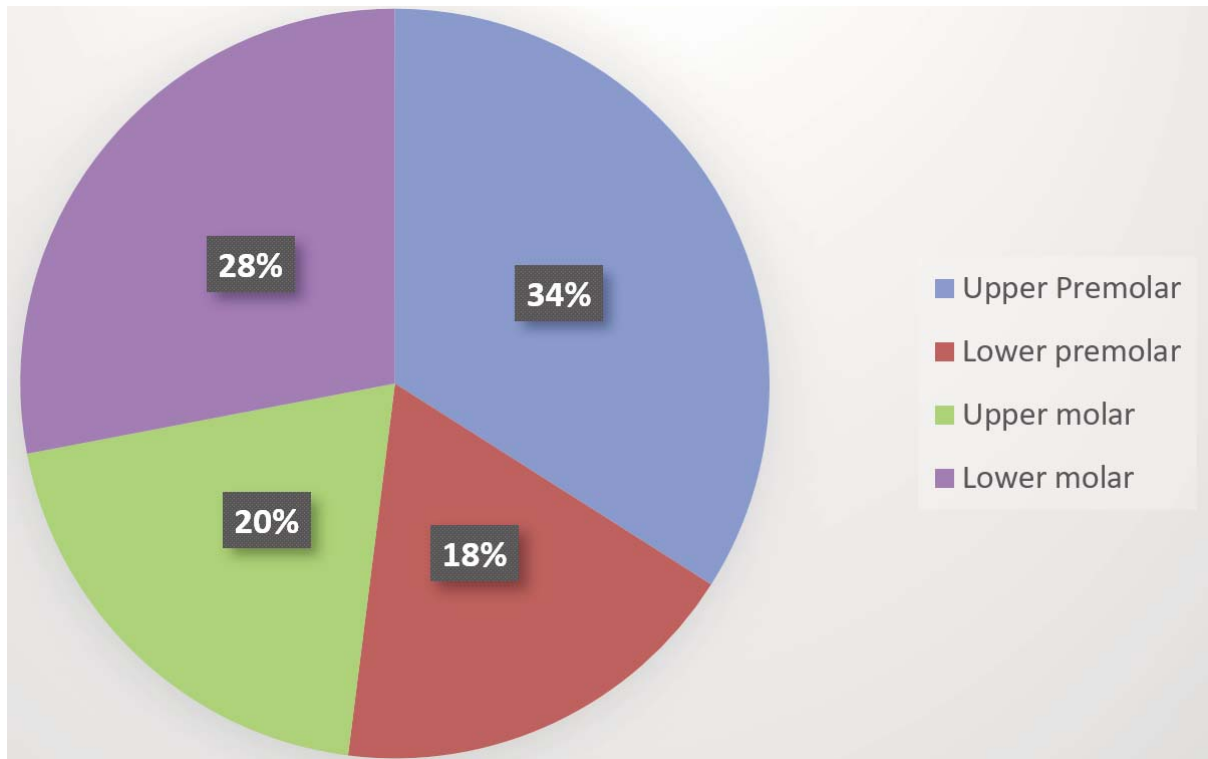


Figure-2: Distribution of teeth in study.

Table-2: Comparison of proximal contours of saddle contoured metal matrix group A and pre-contoured self adhesive matrix group B.

Variable N=60	Assessment criteria	Group A	Group B	P- value
Proximal contours clinical evaluation	Good	23(76.7%)	21(70%)	0.925
	Acceptable	7(23.3%)	9(30%)	
Proximal contours radiographic evaluation	Good	20(66.7%)	18(60%)	0.421
	Acceptable	10(33.3%)	12(40%)	
Overhangs assessed with floss	Absent	27(90%)	22(73.3%)	0.257
	Present	3(10%)	8(26.7%)	
Overhangs assessed with X-ray	Absent	26(86.7%)	24(80%)	0.361
	Present	4(13.3%)	6(20%)	

Table-3: Inter-group comparison of proximal contact tightness.

Variable n=60	Score	Group A	Group B	Chi-square value	P- value
Tightness of contact assessed with FDI score	Score 1	16(53.3%)	21(70.0%)	5.308	0.947
	Score 2	9 (30%)	3(10%)		
	Score 3	3 (10%)	4(13.3%)		
	Score 4	2 (6.7%)	1(3.3%)		
	Score 5	0	1(3.3%)		

FDI: Fédération Dentaire Internationale.

## Discussion

Composite is the material of choice for anterior aesthetic restorations and proximal-occlusal defects. However, getting the tight proximal contacts in composite class 2 is challenging due to its viscoelastic characteristics. The major criteria for successful treatment outcomes are operator expertise, insertion procedures, bonding regimens, and polymerisation techniques. Proximal contacts are significant in protecting the periodontium from injury. Loose proximal contacts are widely documented to contribute to food impaction, carious lesions, periodontal issues, and tooth displacement.<sup>20</sup> Various procedures and instruments have been designed to create more anatomically proximal interfaces. The key factor among these is the interproximal separation through a matrix system. D. Kampouropoulos et al.<sup>3</sup> showed that contact tightness significantly depended upon the type of matrix rather than its material and thickness. There are various instruments used to measure proximal contact tightness. Pressure Meter

**Table-4:** Correlation of proximal contours and overhangs in the study groups.

Spearman's rho		Group A contours clinical evaluation	Group A contours radiographic evaluation	Group A overhangs radiographic assessment	Group A overhangs clinical evaluation	Group B contours clinical evaluation	Group B contours radiographic evaluation	Group B overhangs radiographic assessment	Group B overhangs clinical evaluation
Group A proximal contours clinical evaluation	rho	1	-0.223	-0.079	-0.216	-0.017	0.032	0.079	0.154
	p-value	-	0.236	0.679	0.251	0.928	0.866	0.679	0.415
Group A Proximal contours radiographic evaluation	Rho	-0.223	1	0.236	-0.347	0.309	0.144	0	-0.053
	p-value	0.236	-	0.21	0.061	0.097	0.447	1	0.78
Group A overhangs radiographic assessment	Rho	-0.079	0.236	1	-0.131	-0.024	0.45	-0.167	-0.201
	p-value	0.236	0.21	-	0.491	0.899	0.812	0.379	0.287
Group A overhangs clinical evaluation	Rho	0.216	-0.347	-0.131	1	-0.171	0.12	0.049	0.207
	p-value	0.251	0.061	0.491	-	0.366	0.527	0.797	0.272
Group B proximal contours clinical evaluation	Rho	-0.017	0.309	-0.024	-0.171	1	.653*	-0.218	-0.263
	p-value	0.928	0.097	0.899	0.366	-	0	0.247	0.16
Group B Proximal contours radiographic evaluation	Rho	0.032	0.144	0.045	0.12	.653*	1	-0.102	-0.277
	p-value	0.866	0.447	0.812	0.522	0	-	0.591	0.138
Group B overhangs radiographic assessment	Rho	0.079	0	-0.167	0.049	-0.218	-0.102	1	0.264
	p-value	0.678	1	0.379	0.797	0.247	0.591	-	0.159
Group B overhangs clinical evaluation	Rho	0.154	-0.053	-0.201	0.207	-0.263	-0.277	0.264	1
	p-value	0.415	0.78	0.287	0.272	0.16	0.138	0.159	-

measures the tightness through a 0.05mm metal strip.<sup>21</sup> Another device designed at the University of Tokushima in South Korea finds proximal contact strength (PCS) in Newtons of force.<sup>22</sup> These devices are not commercially available and their use in the clinical environment is challenging. As such, other methods based on clinical and radiographic assessment were developed to evaluate the proximal contacts and contours.

The contacts and contours are mostly taken as the same entity, but the contact tightness is mostly determined by the methodology used for proximal restoration, whereas contours are determined by a modification of the inner surface of the matrix band. There are no matrix devices that were completely effective to prevent the incidence of inaccurate proximal contours<sup>19</sup>. For clinical evaluation, the use of the radiographic method is ideally performed

at baseline. A study<sup>23</sup> found that pre-contoured matrix bands generated better contours and prevented food impaction than straight matrix bands in class II restoration. The current study utilised both pre-contoured matrix bands; saddle and self-adhesive strips.

In the present study, a transparent pre-contoured self-adhesive matrix with a thickness of 0.075mm was used. The matrix strips were available for molar and premolar with the adhesive ends. The strips were used without any retainer with the anatomical wedges without any impact on polymerisation and composite shrinkage. The transparent nature also facilitated material placement and handling. The saddle contoured matrix is a newly introduced system which is ideal for large axial angle defects that cannot be contoured with a conventional matrix system. The clip can be inserted into the tubes of

matrix edges for stability. The adaptation of a matrix band is convenient and similar to a sectional matrix.

In the current study, the FDI criterion was used to evaluate the proximal contact tightness with the help of dental floss, and scoring was done by the scoring guidelines. Kakollu Sudha et al.<sup>24</sup> adopted the same criterion for scoring proximal contact tightness in pre-contoured self-adhesive matrix strips. Dental floss seems to be a practical approach in the clinical scenario to assess the nature of proximal contacts, but variation in the size, direction of force, and type of floss can affect the outcomes. To overcome the procedural inaccuracies, a standardised wax nylon floss with a length of 14 inches was used by the trained single operator. The saddle matrix generated a better score in proximal contact tightness, but there was no significant difference between the two groups. Kakollu Sudha et al. concluded that the proximal contact tightness of two different matrix band materials was not significantly different<sup>24</sup>. Kampouropoulos et al.<sup>3</sup> concluded that no technique was ideal for reconstructing the proximal contact characteristics of a healthy tooth. Pre-wedging, space assessment, interdental clearance, correct selection, placement and matrix band stabilisation are all critical steps in this protocol.<sup>25</sup>

In the current study, the clinical evaluation of proximal contours had a significant difference in both groups, but radiographically there was no significant difference between metal and self-adhesive strips. There was no significant difference in restorative overhang emergence between the two groups. From each group, almost 10-30% of the teeth developed overhangs. It is most likely due to the matrix band and wedge placement technique rather than any other variable. The results correlate to pre-wedging performed in both groups to achieve the interdental separation essential to compensate for the matrix's thickness, and careful stabilisation of the matrix against adjacent tooth contact during the restoration procedure may have contributed to comparable results in both groups.<sup>[p=]-[</sup>

The current study has some limitations, as it had only two groups of comparison, and a conventional matrix group should have been introduced to bring more insightful data about class II contours. Besides, the study used the subjective response of a single operator.

## Conclusion

Proximal contacts and contours were found to be critical for the success of class II composite restoration. The recontoured matrix generated more anatomical natural contacts. The self-adhesive strips had an easy and convenient application with the same quality of contacts

as the saddle metal matrix, but the saddle metal matrix could reproduce better, though non-significant, clinical contours.

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**Conflict of Interest:** None.

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#### Author's Contributions

**NS:** Conception, drafting, data collection and analysis.

**SAK:** Conception and final approval.