Original Article

Assessment of anatomical contacts and contours of class II restorations using four different dental matrix systems: An *in vitro* comparative analysis

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Abstract

Context: The assessment of reestablishment of correct anatomic contour and proximal tightness with minimal gingival overhang of a class II restoration.

Aim: This *in vitro* study evaluated and compared the gingival overhang, contact, and contour anatomy achieved by four matrix systems for class II restorations.

Materials and Method: Standardized class II mesio-occlusal conservative cavities were prepared on two hundred typodont teeth and assigned into four groups ($n = 50$): Tofflemire, U Band system, Palodent V3 matrix system, and Walser Matrix system. The cavities were restored with composite and qualitatively analyzed for proximal contact tightness. The morphology of the overhang and contour was assessed using a Medit scanner and Mesh Labs by superimposition.

Statistical Analysis Used: Kruskal–Wallis nonparametric test of significance and Mann–Whiteny *U*-test for pair-wise comparison was used.

Results: The restorations showed statistically significant difference, with Walser matrix system and U Band demonstrating minimal overhang. No significant difference was observed for contact tightness among the groups ($P = 0.109$). Contours were assessed at the occlusal, middle, and cervical thirds. The Walser matrix system provided the best gingival contour ($P = 0.000$). The Palodent V3 matrix yielded the best contour at the middle ($P = 0.002$) and occlusal ($P = 0.036$) third with minimum deviation from optimal contour.

Conclusions: The sectional precontoured matrix system Palodent V3 system recreated the best proximal contour and contact anatomy, while minimal overhang was generated by the Walser matrix.

Keywords: Circumferential matrix system; class II restorations; Palodent V3 matrix System; sectional matrix system; U Band system; Walser System

INTRODUCTION

The primary objective of restorative dentistry is to restore the form and function of the stomatognathic system. Correct anatomic contact and contour play an important role in maintaining the integrity of the dental arch.[1] Inadequate contact results in food impaction, causing

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periodontal problems, leading to subsequent bone loss, initiating secondary decay, and causing migration of teeth. This leads to decreased restoration and tooth life, eventually resulting in clinical failure of restoration, leading to eccentric occlusion and temporomandibular dysfunction.[2,3]

The proximal contour determines the position of the interproximal contact area and provides an optimal size of the embrasure required to maintain a healthy gingival papilla.[4,5]

Class II cavities involve the occlusal and proximal surfaces of the teeth. Direct restoration of such cavities requires the use of a matrix system that creates a temporary wall against which the restorative material is packed to reestablish proper interproximal contact, form, and function. It also helps to shape the restorations and reduces gingival flash.[4-8]

The traditional circumferential matrix systems like the Tofflemire system originally introduced for amalgam restorations are the most used by dentists and taught at dental schools due to their low cost and efficiency.[9,10] However, with composites the circumferential matrices tend to flatten the matrix interproximally due to the tension generated in the band and because of the low resistance to deformation of the composite restorative material. This causes the migration of the contact toward marginal ridge, leading to lower strength of contact, potentiating food impaction.[4,11,12]

Precontoured sectional bands were introduced to help overcome these shortcomings. There are many companies offering different matrix bands and systems based on various principles. Palodent V3 Matrix System (Dentsply Sirona, Charlotte, North Carolina, United States) offers pre-contoured bands with sectional rings. The U dental matrix band (Maryland Dental Bands, Edgewater Dr. Lanark, IL, USA) is user user-friendly system with thin bands which can be placed in proximal areas with ease. The Walser matrix system (Dr. Walser Dental, Radolfzell, Germany) has an integrated spring that helps in maintaining appropriate tension in the band, leading to self-contouring in both the gingival and occlusal region without the usage of a wedge.[4,13]

Various authors have studied the reestablishment of contacts *in vitro* as well as *in vivo*.[6,11-20] However, none has compared the contour anatomy before and after restoration by three dimension (3D) scanning and overlapping.

The present study aimed to compare various matrix systems in their ability to successfully reestablish appropriate contact tightness, contour anatomy, and the gingival overhang. The significance of established contour and contact tightness will aid in bridging the gap in knowledge toward the efficiency of different matrix systems while considering the anatomy of the contour of the teeth.

The null hypothesis to be tested was that there is no difference in the proximal overhang, contact tightness, and contour of class II restorations re-established using traditional circumferential and newer sectional matrix systems.

MATERIALS AND METHODS

The manuscript of this *in vitro* study is written according to Preferred Reporting Items for Laboratory studies in Endodontology 2021 guidelines. The study protocol was approved by the Institutional Review Board with IEC/127/2022.

Specimen preparation

Two hundred left lower first molar typodont teeth (model no. COARMT36) (Confident Dental, Bengaluru, Karnataka, India) were used in this study. All teeth were serialized for easy identification.

Baseline values for proximal contact tightness and contour were established for all samples before cavity preparation. Assessment of contact tightness was done by the United States Public Health System (USPHS) criteria, using dental floss (Colgate Total Waxed Dental Floss). The dental floss was passed between the proximal contacts, and scored as 01 – Tight, 02 – adequate and 03 – loose based on the resistance observed to the floss.[6,16]

The tooth contour was determined by a 3D scan of the typodont teeth using Medit i500 intraoral scanner (Medit, Seoul, South Korea) (https://www.medit.com/dental-clinic-i500). The acquired data were converted to the standard tessellation language (.stl) format and imported into Mesh Labs (ISTI–CNR, Italy).

Standardized mesio-occlusal cavities with the proximal box of dimension 4 mm × 4 mm × 2 mm, the gingival seat of 0.8 mm width, and a corresponding conservative occlusal preparation were prepared using an FG245 Tungsten Carbide bur (Prima Dental, Gloucester, UK) [Figure 1b]. All cavities were prepared by a single operator and confirmed with an electronic vernier caliper (Mitutoyu corporation, Japan).

The teeth were then divided into 04 groups based on the matrix systems used for the restorations Group 1 – Tofflemire Universal Matrix (GDC fine crafted dental Pvt. Ltd., India), Group 2 – U Band Matrix System (Maryland Dental Bands, Edgewater Dr. Lanark, IL, USA), Group 3 – Palodent V3 Matrix System (Dentsply Sirona, Charlotte, NC, USA), and Group 4 – Walser System (Dr. Walser Dental, Radolfzell, Germany).

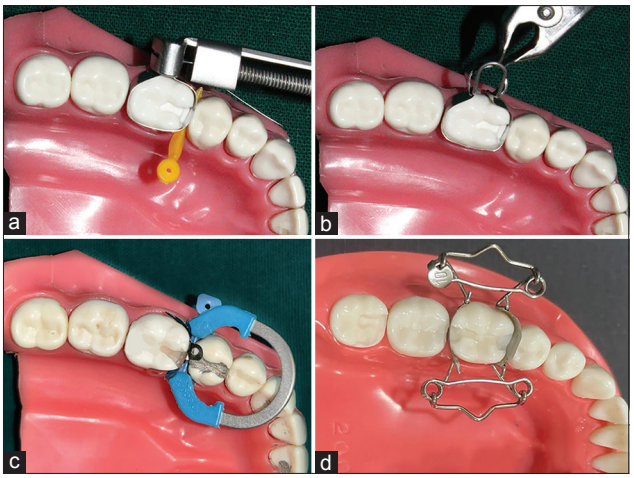

Figure 1: The placement of (a) Tofflemire Universal Matrix (b) U Band Matrix System (c) Palodent V3 Matrix System (d) Walser Matrix System

Medium-sized Palodent V3 Matrix System (Dentsply Sirona, Charlotte, NC, USA) wedges were used in groups where indicated.

Matrix band placement

Group 1 (Tofflemire Universal Matrix, GDC, India)

The Tofflemire retainer was held to have the slot on the head face upward. A circumferential flat matrix was looped and slipped through the diagonal slot on the vice of the retainer. This was secured in the retainer by turning the locking nut in a clockwise direction. The band was oriented with the retainer such that the open end of the retainer faces towards the gingiva, the loop was placed over the tooth being restored. The diameter of the matrix loop was adjusted around the sides of the tooth by turning the adjusting nut (long knob) in a clockwise direction. A wedge was placed from the lingual aspect with the base facing gingivally. The contact area of the matrix band was burnished using a Ball Burnisher BB22/23 (GDC, India) [Figure 1a].

Group 2 (U Band Matrix System, Maryland Dental Bands, Edgewater Dr. Lanark, IL, USA)

The MOD type band was placed, keeping the open end of the band on the buccal side. The clamp included was placed for better adaptation of the U Band to the tooth. A wedge was placed in from the lingual embrasure with the base facing gingivally [Figure 1b].

Group 3 (Palodent V3 Matrix System, Dentsply Sirona, Charlotte, NC, USA)

Using the Pin-Tweezers supplied in the system, a Palodent V3 matrix of size 5.5 mm precontoured sectional metal matrix was placed on the mesial aspect of the teeth. The wedge was placed from the buccal embrasure on the mesial side of the tooth using Pin-Tweezers, and the ring was placed on top of the wedge to provide separation from the adjacent teeth and to contour and hold the band properly in place [Figure 1c].

Group 4 (Walser System, Dr. Walser Dental, Radolfzell, Germany)

Using the forceps supplied with the matrix system, the O-Shaped No. 9 matrix was slipped and inserted in interdental space. The forces were relaxed when the band met resistance from the typodont jaw [Figure 1d].

All the restorative procedures were performed by a single operator using Universal Micro Hybrid Composite (Dentsply Sirona, Charlotte, North Carolina, United States). Increments of 2 mm thickness were placed following the oblique layering technique. Each increment was cured for 20 s from the occlusal direction at 1 mm distance using a QHL75 Curing Light (Dentsply Sirona, Charlotte, North Carolina, United States) with light intensity 450 mW/cm^2. The restorations were additionally postcured for 20 s buccally and lingually following matrix band removal.

No finishing or adjustment was done for restorations to avoid occlusal and proximal surface changes. The samples were then assessed for proximal overhang, contact tightness, and contour anatomy.

Evaluation of the proximal overhang, contact tightness, and contour anatomy

Two evaluators were trained to assess the restorations for the three variables. The evaluators were blinded by the type of matrix system used. The test was repeated by the same evaluators after 1 week.

Assessment of proximal contact tightness

The dental floss was wrapped around the index fingers and passed between the proximal contacts. The resistance observed was graded as per the scoring criteria explained earlier.

Qualitative assessment of Anatomy of proximal contour and overhang

The reestablished contour and overhang for the restored tooth [Figure 2a and b] was evaluated by scanning the restored teeth using the Medit i500 intraoral scanner.

The 3D reconstructed models were aligned for comparison before tooth preparation and after restoration [Figure 2c]. The differences between them were qualitatively analyzed by an independent examiner. The proximal surface of restorations was divided into three parts by placing the image on a graph paper that isolated the occlusal, middle, and gingival thirds for analysis according to the following criteria: 01 = Deficient material, 02 = Optimum, 03 = Excess material.

Statistical analysis

The data were tabulated into MS Excel spreadsheet (Version 2108) and analyzed using SPSS version 26 (IBM, New York, United States). Data analysis was carried out using descriptive statistics and other relevant tests of significance. The *P* value was set at 0.05 to be significant, and $P < 0.01$ was considered as highly significant. The confidence level was set at 95%, and the power of the study was fixed at 80%. Kappa statistics were done to assess the intra examiner reliability for each of the three criteria. The kappa value was found to be showing substantial to fair agreement in all the groups.

The values of the contact tightness, contour anatomy, and overhang of the four groups of matrix systems were compared using Kruskal–Wallis nonparametric test of significance. The values were further analyzed using the Mann–Whitney *U*-test to understand the pair-wise comparison of the groups for the three variables.

RESULTS

The results are represented as mean ranks and mean values of the groups for the three studied variables. A mean rank closer to 100 or mean values closer to 2.00 are suggestive of an optimum and balanced restoration.

While mean rank values less or more than 100 suggest that the values in the data set are closer to deficient or excessive, respectively.

The values of overhang, contact, and contour created by the four matrix systems are depicted in Table 1. A highly significant difference was found among the mean ranks of the four groups for the overhang ($P = 0.000$). No significant difference for the reestablished proximal contact tightness among the four matrix systems ($P = 0.109$).

The values of the contour anatomy reestablished at the occlusal ($P = 0.036$), middle ($P = 0.002$), and gingival thirds ($P = 0.000$) showed a highly significant difference among the groups.

The results of the overhang created were further analyzed using the Mann–Whitney *U*-test of significance, where all groups depicted a significant difference except between U bands and Walser band system [Table 2].

DISCUSSION

Recreation of a harmonious interdental anatomy for Class II cavities is a challenge and dependent on several criteria. The most important of which are proximal contact tightness and the contour morphology.[2,3,13,19,20] Achieving these is significantly dependent on the appropriate selection of a matrix system that would allow the support, alignment, and stabilization of the dentition, thereby protecting the interdental gingival papilla from food lodgment, periodontal disease, and development of approximal carious lesions.[2,3] Currently, there are many matrix systems available with different designs and mechanisms that assist the operator toward achieving the desired outcome.

Resin-based composites are the material of choice for the restoration of anterior and posterior teeth. This

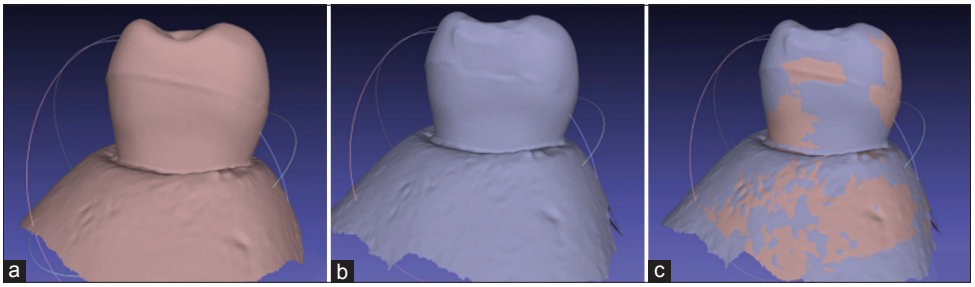

Figure 2: (a) Three dimension (3D) scan of unprepared tooth (orange) (b) 3D scan of prepared and restored tooth (blue) (c) Superimposition of the prepared and restored tooth versus unprepared tooth

Table 1: Comparison of the mean values, mean rank for overhang, contact, and contour reestablished among the four groups of matrix systems

Variable	Group I	Group II	Group III	Group IV	*P*
Overhang, mean value (mean rank)	1.7600 (81.96)	1.7600 (98.07)	2.2000 (120.56)	1.9800 (101.41)	0.000†
Contact, mean value (mean rank)	95.73 (95.73)	102.90 (102.90)	89.88 (89.88)	113.49113.49)	0.109 (NS)
Contour, mean value (mean rank)					
Occlusal	2.4200 (108.41)	2.3800 (104.67)	2.0800 (82.38)	2.4000106.54)	0.036*
Middle	2.3800 (114.59)	2.1600 (95.34)	1.9800 (80.63)	2.3600 (111.44)	0.002†
Gingival	1.7000 (80.24)	1.8800 (96.68)	2.1800 (121.70)	1.9600 (103.38)	0.000†

*$P<0.05$ is statistically significant, †$P<0.01$ is highly significant. Kruskal–Wallis test of significance used. NS: Not significant

Table 2: Pair-wise comparison of the overhang of the four groups of matrix systems used in the study

Group	*n*	Mean value	Mean rank	Sum of ranks	*P*
Group 1	50	1.76	46.09	2304.50	0.026*
Group 2	50	1.94	54.91	2745.50	
Group 1	50	1.76	41.28	2064.00	0.000†
Group 3	50	2.20	59.72	2986.00	
Group 1	50	1.76	45.59	2279.50	0.025*
Group 4	50	1.98	55.41	2770.50	
Group 2	50	1.94	44.52	2226.00	0.005†
Group 3	50	2.20	56.48	2824.00	
Group 2	50	1.94	49.64	2482.00	0.642
Group 4	50	1.98	51.36	2568.00	(NS)
Group 3	50	2.20	55.36	2768.00	0.035*
Group 4	50	1.98	45.64	2282.00	

*$P<0.05$ is statistically significant, †$P<0.01$ is statistically highly significant. Mann–Whitney *U*-test of significance used. NS: Not significant

is due to its acceptable clinical performance owing to superior mechanical and esthetic properties. The most challenging factor while restoring class II restorations is the establishment of acceptable proximal contact and contours due to its viscoelastic nature that allows for a passive placement of the material and application of limited force against the matrix before polymerization.[11,21-23]

This *in vitro* study aimed to qualitatively analyze the overhang, contour anatomy, and contact tightness recreated by Tofflemire matrix system, U band system, Palodent V3, and the Walser matrix system when restored with universal micro-hybrid composite. The null hypothesis of the study was partially rejected, as the choice of the matrix system used significantly influenced the proximal overhang and contour anatomy created without significantly governing the proximal contact tightness.

The reestablished contour for the restored teeth compared by overlapping the 3D reconstruction models before and after restoration provided qualitative data and proved to be a beneficial, nondestructive method to study contour morphology.

The results showed a statistically significant difference at the occlusal ($P = 0.036$), middle (0.002), and gingival (0.000) thirds of the restored teeth.

The best gingival contour was achieved by Walser matrix band (mean rank 103.38 and mean value = 1.96) followed by U band system (mean rank 96.88 and mean value = 1.88), Palodent V3 system (mean rank 121.70 and mean value = 2.18), and Tofflemire system (mean rank 80.24 and mean value = 1.7). The high spring force of the Walser matrix system in the tangential and cervical direction prevents the overpacking of restorative material. Furthermore, the concave tooth flanks of the matrix allow better adaptation of the matrix cervically. The U band system with a MOD matrix and a clip resulted in improved and tight adaptation.

The Palodent matrix system, with its thin precontoured sectional matrices utilizes the principle of mechanical separation of the tooth. The placement of the ring causes tension between teeth after matrix placement, allowing tooth displacement that creates a place for restorative material and helps to establish optimum contact and contour.[23] The tofflemire presented with the most deficient gingival contour. This was due to the use of a due to the straight and noncontoured shape of the matrix band that resulted in a more coronally placed contact point and a straighter anatomic proximal emergence, leading to a flat contour.[23,24] Furthermore, the tofflemire circumferential matrices were primarily designed to restore teeth with amalgam rather than composite.[5,11]

The Palodent matrix system provided the best contour at the middle third (mean rank 80.63 and mean value 1.98), followed by U Bands (mean rank 95.34 and mean value 2.16), Walser matrix system (mean rank 111.44 and mean value 2.36) and Tofflemire matrix system (mean rank 114.59 and mean value 2.38).

However, all matrix systems presented with an excess at the occlusal third, which is a challenge with most matrix systems. Overall, the Precontoured bands provided better adaptation when compared to the noncontoured matrix system, these results were similar to results from previous studies.[11,14,16,20,22,23] In the present study, The Palodent V3 Matrix System gave the lowest deviation from optimum with a mean Value of 2.08.

The overlapping of the 3D reconstructed proximal surfaces before and after filling provides a precise evaluation of the contour produced by the matrix system. The Mesh Lab allows automatic recording and alignment of the anatomical structures, based on the best fit. The superimposed. stl virtual models were assessed by the evaluators and graded for subjective analysis.

Similar results were concluded from a comparable study by Kumari *et al*.[25] which qualitatively assessed the proximal contour by comparing the pre- and post-operative samples visually followed by the quantitative assessment of contour using a stone jig with the impression of the distal surface of the restored tooth. The proximal contour was evaluated by measuring the area and the depth of concavity.

The formation of gingival overhangs during direct class II restorations is a common occurrence. Although various authors have outlined the damaging effects of gingival overhangs only a few have studied and correlated the production of overhang with the type of matrix system used.[6,11,15,16,20] The gingival overhang of the restorations presented a statistical difference between the different matrix bands ($P = 0.000$).

The band with the least or no overhang was found to be Walser matrix system (mean value of 1.98 and mean rank of 101.41), followed by U Band (mean value of 1.94 and mean rank of 98.07); Tofflemire (mean value of 1.76 and mean rank of 81.96) had deficient material in the gingival third, probably because of the stiffness and lack of contour of the band. These results concur with studies by Loomans *et al*.[13] where similar results were achieved with the use of Walser system and Chuang *et al*.[20] who found that Tofflemire had deficient material.

The palodent matrix system had the most overladen material. This could be attributed to operator challenges in effectively using the matrix band, possibly due to the learning curve involved. However, they contradict studies by Durr-E-Sadaf *et al*.[16] and who found adequate adaptation in the gingival third by Palodent system.

The reestablished contact tightness was not influenced by the type of matrix system used. The proximal contact tightness was evaluated by the USPHS criteria.

This is a traditional and the most used method, where the floss is snapped interproximally to assess the tightness of contact. Various authors have previously used the above method for both *in vitro* and *in vivo* studies.[6,12,26,27] In the present study, contacts of all the restorations were found to have no statistically significant difference among them ($P = 0.109$). However, U Band (mean rank 102.90) restored the most favorable contacts compared to original unprepared typodont. This was followed by Tofflemire (mean rank 95.73), Palodent V3 system (mean rank 89.88), and Walser system (mean rank 113.49).

These results are contrary to results from other *in vitro* and *in vivo* studies where sectional thin, dead soft matrices produced better contact tightness than circumferential systems.[19,20] Furthermore, the method for the assessment of contact tightness is of subjective nature, lacks sensitivity in detecting any minor alterations in the proximal contact tightness.[20,27,28]

The newer methods of evaluating proximal contact tightness include the use of tooth pressure meter, digital force gauge, and use of standardized metal blades or strips of shim stock of varying thickness (shim stock strips).[18,23,29-32]

When considering the ease of use by the Operator, the Walser matrix system was found to be less technique-sensitive and the most comfortable to use. Being extremely consistent with its placement due to the integrated tensioning mechanism of its spring design causing the formation of a tight collar at the gingival region resulted in virtually no overhang. This was followed by the U band system and Palodent V3 system. The circumferential Tofflemire matrix system was the most cumbersome to use due to its complicated design, presence of multiple moving parts, and specific application and removal method.

The limitation of this study included that the thickness of the matrix bands was not taken into consideration, and the proximal contact assessment was done using traditional method of contact assessment. Future recommendations for analyzing the above-studied variables may include quantitative analysis by assessing the change in volume before and after the restoration. Or placing multiple points on the proximal aspect of the tooth and creating a mesh that can be compared with the original to analyze changes.

CONCLUSIONS

The establishment of optimum proximal contour and contact with minimal overhang for a class II restoration is essential and dependent on the selection of the matrix system. Within the limitations of this study, it can be concluded that Palodent V3 matrix system provided the best contour at the occlusal and middle third, while the Walser Matrix System provided the best gingival contour with minimal overhang. However, all matrix systems established nearly similar proximal contact tightness.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Tolba ZO, Oraby E, Abd El Aziz PM. Impact of matrix systems on proximal contact tightness and surface geometry in class II direct composite restoration *in-vitro*. BMC Oral Health 2023;23:535.
2. Hancock EB, Mayo CV, Schwab RR, Wirthlin MR. Influence of interdental contacts on periodontal status. J Periodontol 1980;51:445-9.
3. Jernberg GR, Bakdash MB, Keenan KM. Relationship between proximal tooth open contacts and periodontal disease. J Periodontol 1983;54:529-33.
4. Raghu R, Srinivasan R. Optimizing tooth form with direct posterior composite restorations. J Conserv Dent 2011;14:330-6.
5. Loomans BA. Proximal Contact Tightness of Posterior Composite Resin Restorations [Dissertation]. Nijmegen, the Netherlands: Radboud University; 2006.
6. Khan A, Fatima Z, Siddiqui S, Khan R, Chowdhary D, Anwar SZ. Comparison of contact and contour for posterior teeth using three different matrix system – An *in vivo* study. J Pharm Negat Results 2022;13:2167-80.
7. Eakle WS, Bastin KG. Dental Materials: Clinical Applications for Dental Assistants and Dental Hygienists. 4th ed. St. Louis, Missouri: Elsevier Health Sciences; 2019.
8. Torres CR, Zanatta RF. Composite restoration on anterior teeth. In: Torres CR, editor. Modern Operative Dentistry. Switzerland:Springer International Publishing; 2020. p. 465-575.
9. Wilson NH, Lynch CD. The teaching of posterior resin composites: Planning for the future based on 25 years of research. J Dent 2014;42:503-16.
10. Gomes IA, Filho EM, Mariz DC, Borges AH, Tonetto MR, Firoozmand LM, *et al. In vivo* evaluation of proximal resin composite restorations performed using three different matrix systems. J Contemp Dent Pract 2015;16:643-7.

11. Sankhyan V, Makkar S, Negi S, Gupta S, Jain A, Arora G. Comparison of proximal contact and contours of class II restoration in premolars and molars restored with three different matrix systems using FDI criteria: An *in vivo* study. J Conserv Dent Endod 2024;27:913-9.
12. Al-Otaibi F, Al-Zughaibi M, Al-Otaibi G. Usage of matrix band by dental students in class II restorations. J Adv Med Dent Sci Res 2019;7:69-74.
13. Loomans BA, Opdam NJ, Bronkhorst EM, Roeters FJ, D eter CE. A clinical study on interdental separation techniques. Oper Dent 2007;32:207-11.
14. Wirsching E, Loomans BA, Klaiber B, D aibe CE. Influence of matrix systems on proximal contact tightness of 2- and 3-surface posterior composite restorations *in vivo*. J Dent 2011;39:386-90.
15. Gilmour AS, James T, Bryant S, Gardner A, Stone D, Addy LD. An *in vitro* study on the use of circumferential matrix bands in the placement of class II amalgam restorations. Br Dent J 2008;204:E10.
16. Durr-E-Sadaf, Ahmad MZ, Gaikwad RN, Arjumand B. 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: A randomized controlled clinical trial. Indian J Dent Res 2018;29:459-64.
17. Almushayti M, Arjumand B. Operators' ease and satisfaction in restoring class II cavities with sectional matrix versus circumferential matrix system at Qassim University dental clinics. Cureus 2022;14:e20957.
18. Peskersoy C, Sener M, Gurses OB, Erbil E, Turkun M. Evaluation of proximal contact tightness and contact area of posterior composite resin restorations. Appl Sci 2024;14:8335-45.
19. Loomans BA, Opdam NJ, Roeters FJ, Bronkhorst EM, Burgersdijk RC, D rger CE. A randomized clinical trial on proximal contacts of posterior composites. J Dent 2006;34:292-7.
20. Chuang SF, Su KC, Wang CH, Chang CH. Morphological analysis of proximal contacts in class II direct restorations with 3D image reconstruction. J Dent 2011;39:448-56.
21. Anantula K, Vankayala B, Yadav SS. Proximal contact tightness of direct class II composite resin restorations with various matrix systems: A systematic review. J Conserv Dent Endod 2024;27:11-6.
22. Peumans M, Van Meerbeek B, Asscherickx K, Simon S, Abe Y, Lambrechts P, *et al.* Do condensable composites help to achieve better proximal contacts? Dent Mater 2001;17:533-41.
23. Owens BM, Phebus JG. An evidence-based review of dental matrix systems. Gen Dent 2016;64:64-70.
24. Bailey O. Sectional matrix solutions: The distorted truth. Br Dent J 2021;231:547-55.
25. Kumari S, Raghu R, Shetty A, Rajasekhara S, Padmini SD. Morphological assessment of the surface profile, mesiodistal diameter, and contact tightness of class II composite restorations using three matrix systems: An *in vitro* study. J Conserv Dent 2023;26:67-72.
26. Akhtar Q, Danyal S, Zareen S, Ahmed B, Maqsood M, Azad AA. Clinical evaluation of proximal contact points in fixed prostheses. J Coll Physicians Surg Pak 2015;25:702-4.
27. Abbassy KM, Elmahy WA, Holiel AA. Evaluation of the proximal contact tightness in class II resin composite restorations using different contact forming instruments: A 1-year randomized controlled clinical trial. BMC Oral Health 2023;23:729.
28. Ren S, Lin Y, Hu X, Wang Y. Changes in proximal contact tightness between fixed implant prostheses and adjacent teeth: A 1-year prospective study. J Prosthet Dent 2016;115:437-40.
29. Hansen PA, Atwood A, Shanahan M, Beatty M. The accuracy of clinician evaluation of interproximal contacts using different methods. J Prosthet Dent 2020;123:284-9.
30. Oh SH, Nakano M, Bando E, Shigemoto S, Kori M. Evaluation of proximal tooth contact tightness at rest and during clenching. J Oral Rehabil 2004;31:538-45.
31. Patel J, Shah NC, Dedania M, Choudhary D, Bharti N, Jain A. Comparative clinical evaluation of correct anatomic contour and tight contact in class II direct composite restoration using two newer contact forming instruments. J Conserv Dent Endod 2024;27:1135-40.
32. Loomans BA, Opdam NJ, Roeters FJ, Bronkhorst EM, Burgersdijk RC. Comparison of proximal contacts of class II resin composite restorations *in vitro*. Oper Dent 2006;31:688-93.