ORIGINAL ARTICLE / *ARTICLE ORIGINAL*

Pedodontics / *Pédodontie*

EVALUATION OF FRACTURE RESISTANCE OF COMPOSITE RESIN AND GLASS IONOMER IN BEVELED VERSUS NON BEVELED CLASS II RESTORATIONS IN PRIMARY MOLARS: IN VITRO COMPARATIVE STUDY

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Introduction: The high viscosity Bulk-Fill composite (Tetric N ceram) and high viscosity glass ionomer cement (Equia Forte GIC) are the most used materials in class II cavities of primary molars. They have the advantages of being placed in a single layer of 4mm and therefore allow better ergonomics and speed of use. Until now, we find failures of restorations at the level of class II cavities of temporary teeth and many authors have tested the role of the bevel in improving the mechanical strength of restorations.

Objectives: The objectives of this study are: to test the role of the bevel in improving the fracture resistance of Bulk Fill composite restorations versus GIC of class II restorations in primary molars, and to test which material has better resistance to fracture.

Methods: One hundred temporary extracted molars are collected and randomly divided into four groups: Group I (non-beveled) and II (beveled) filled with Equia forte. Group III (non-beveled) and IV (beveled) filled with Bulk Fill Ivoclar Tetric N Ceram. The specimens were subjected to thermocycling from 5 to 55° for 10000 cycles. After artificial aging, an axial loading at a speed of 1 mm/min was applied until the specimens fractured.

Results: The statistical analysis reveals the following: an average of 442.2 N for group I and 498.80 N for group II. Thus, no statistical difference was observed between the groups restored with Equia Forte ($p\text{-value} > 0.05$). Whereas, the resistance to fracture for groups III (901.80N) and IV (2438.33N) with a $p\text{-value} < 0.001$ so there is significant difference between the two groups.

Conclusions: The bevel improves the fracture resistance of the BulkFillI Ivoclar restorations. Whereas, it does not influence the fracture resistance of the Equia Forte group. Bulk Fill Ivoclar Tetric N ceram has better resistance to fracture than Equia Forte GIC restorations.

Keywords: Composite resin, Dental cavity preparation, Flexural strength, Glass Ionomer Cement, Primary teeth.

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Conflicts of interest:
The authors declare no conflicts of interest.

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ÉVALUATION DE LA RÉSISTANCE À LA FRACTURE DE LA RÉSINE COMPOSITE ET DU VERRE IONOMÈRE AU NIVEAU DES CAVITÉS CLASSE II PRÉPARÉES AVEC ET SANS BISEAU SUR MOLAIRES TEMPORAIRES: ÉTUDE COMPARATIVE IN VITRO

Introduction: Le composite Bulk-Fill à haute viscosité (Tetric N ceram) et le ciment verre ionomère à haute viscosité (Equia Forte) sont les matériaux les plus utilisés dans les cavités de classe II des molaires temporaires. Ils ont l'avantage d'être réalisés en une seule couche de 4mm et permettent donc une meilleure ergonomie et rapidité d'utilisation. Jusqu'à présent, on retrouve des échecs de restaurations au niveau des cavités de classe II des dents temporaires et de nombreux auteurs ont testé le rôle du biseau dans l'amélioration de la résistance à la fracure des restaurations.

Objectifs: Les objectifs de cette étude sont :Evaluer le rôle du biseau dans l'augmentation de la résistance à la fracture des cavités classe II sur molaires temporaires des deux restaurations: Bulk Fill Tetric N Ceram Ivoclar haute viscosité et Equia Forte et de comparer la résistance à la fracture des restaurations classe II des deux matériaux.

Méthodes: Cent molaires temporaires extraites sont collectées et réparties aléatoirement en quatre groupes : Groupe I (sans biseaux) et II (biseauté) restaurés avec Equia forte. Groupe III (sans biseaux) et IV (biseauté) restaurés avec Bulk Fill Ivoclar Tetric N Ceram. Les échantillons ont été soumis à un thermocyclage de 5 à 55° pendant 10 000 cycles. Après vieillissement artificiel, une charge axiale à une vitesse de 1 mm/min a été appliquée jusqu'à fracture des éprouvettes.

Résultats: L'analyse statistique révèle ce qui suit : une moyenne de 442,2 N pour le groupe I et de 498,80 N pour le groupe II. Ainsi, aucune différence statistique n'a été observée entre les groupes restaurés avec Equia Forte (valeur $p > 0,05$). Alors que la résistance à la fracture pour les groupes III (901,80N) et IV (2438,33N) avec une valeur $p < 0,001$, il existe donc une différence significative entre les deux groupes.

Conclusions: Le biseau améliore la résistance à la fracture des restaurations BulkFill Ivoclar. En revanche, cela n'influence pas la résistance à la rupture du groupe Equia Forte. Bulk Fill Ivoclar Tetric N ceram a une meilleure résistance à la fracture que les restaurations Equia Forte GIC.

Mots clés: Ciment verre ionomère, Dents primaires, Préparation de la cavité dentaire, Résine composite, Résistance à la flexion.

Introduction

The restoration of the carious lesions is the most common procedure in pediatric dentistry, and the on-going high prevalence of caries indicates that this process is not simple [1, 2]. Given that carious lesions are very common in pediatric dentistry, the pediatric dentist is more often subject to perform class I and class II cavities [3]. The failures of the proximal restorations are related to many factors which are: the bacterial microleakage, poor sealing, lack of adhesion and most of the time fractures of the restorations [4]. Moreover, the high failure rate of the class II restorations on the primary molars, might be related to the behavior of the child during the procedure but also it can be related to the material, the working condition and the cavity shape before applying the restoration [5]. Currently, many recent studies are studying the geometric shape of the bevel in the control of microleakage, in the increase of adhesion and in the improvement of the fracture resistance [6, 7].

Currently, there is still no sufficient scientific evidence about the best filling material for the treatment of dental cavities in the primary teeth [8]. So, choosing the material during the clinical sessions depends on the patient's wish, the professional ability, the aesthetic factors, the cavity to be restored as well as a friendly technique [9].

Composite resins have become very popular for direct posterior restorations of primary teeth due to their main advantages as a conservative preparation, their aesthetic characteristics as well as their good clinical performance [5, 10, 11]. Furthermore, primary teeth present histological and morphological differences with permanent teeth such as the less mineralization that can lead to a reduction in the adhesion of the bonding agents to the tissues of primary teeth [12]. However, composite resins constitute a very sensitive technique, its application is influenced by the operators experience and the contamination during the application [13]. This is why, massive fillings resins "Bulk Fill" is more recommended when dealing with class II cavities for pediatric patients [14].

For glass ionomer cements (GIC), its usage as a definitive restorations are advised by some guidelines [15]. It is also an interesting option for its advantageous Bulk Fill property in restoring primary teeth of pediatric patients [16]. Added to that, it has an antibacterial activity, it is easy to manipulate and it has a capacity of fluoride release. On the other hand , the fracture of glass ionomer restorations is related to their compromised mechanical properties (toughness, brittleness, and low compressive strength), and it is a sensitive technique toward humidity and dehydration, so it needs a better cavity design to increase the resistance to fracture of the restorations [17].

Noticing that the concepts on the management of caries have shifted significantly over the past twenty years and despite that nowadays we favour minimal invasive dentistry and the only disadvantage related to bevel preparation is the removal of additional soft tissue; however, this is a small removal of dental structure, which is overcome by the improved sealing obtained for beveled cavities [18, 19]. This was firstly tested in 2008 by Fabio Herrman Coelho-De-Souza and coll on composite MOD restorations and the result was significant: bevels improved the fracture resistance.

To better analyze the bevel effect on the longevity of the restorations the aim of this study is to compare in vitro the fracture resistance of two different types of restorations :Tetric N-Ceram bulk fill composite and Equia Forte Glass Ionomer in two different cavity shapes: cavity preparation with and without bevel .

The first null hypothesis of the study is: There is no significant difference between the presence and absence of the bevel on the fracture resistance of the restoration.

And the second one is: There is no significant difference between the composite filling and the glass ionomer on the fracture resistance of the restoration.

Materials and methods

Ethical approval

This study received approval from the Research Ethics Committee of Saint Joseph University of Beirut, Lebanon (certificate number: USJ 2023-199).

Sample size, power and statistical analysis

To determine the sample size, a power analysis using G*Power software 3.1.9.7 for Windows (Heinrich Heine, Universitat Düsseldorf, Düsseldorf, Germany) was conducted for independent-samples T test to account for the comparison between two materials; a power of 0.95 and an alpha level of 0.05 were considered, and an effect size of 1.93 was calculated based on fracture resistance values derived from a previous study [21]. The minimum total sample size required for the comparison between two groups was eighteen primary teeth (Figure 1).

Study design and sample selection

One hundred extracted primary molars were collected for this study. These collected teeth are extracted for reasons not related to the study. All teeth were randomly divided into four groups.

Group I: Class II cavity without bevel restored with Equia Forte GIC with a sample size n=25 primary teeth.

Group II: Class II cavity with bevel restored with Equia Forte GIC with a sample size n=25 primary teeth.

Group III: Class II cavity without bevel restored with Bulk Fill high viscosity Tetric Ivoclar composite n=25 primary teeth.

Group IV: Class II cavity with bevel restored with Bulk Fill high viscosity Ivoclar composite n=25 primary teeth.

Specimens preparation

The primary molars were placed in aluminum cylinder and square containing a self-curing acrylic resin mixture. To reproduce the oral envi-

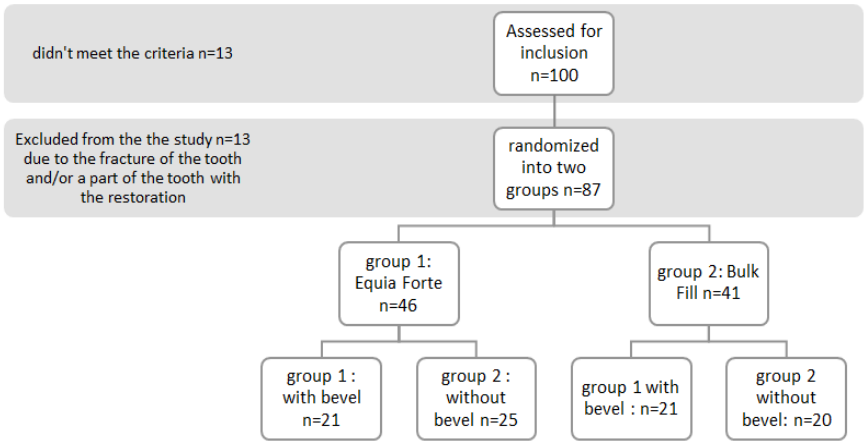

Figure 1. Workflow for inclusion and exclusion criteria

ronment, we had to mark the vestibular and lingual/palatal surfaces. The teeth were installed in the acrylic resin so as to have the occlusal surface parallel to the horizontal plane. In order to represent the height of healthy alveolar bone, the acrylic resin had to cover the teeth up to 1-2 mm below the cemento-enamel junction.

Cavity preparation

For all the groups, the cavities were standardized, using same burs for preparations and same dimensions of the cavities. All the cavities were performed by the same operator. Starting by drawing the exact dimensions of the cavities on the occlusal and proximal surfaces with the permanent marker based on the following dimensions (Figure 2):

- 2 mm in depth (pulp wall-cervical wall).
- 4 mm in depth (occluso-gingival).
- 3 mm bucco palatal/lingual (of the cervical wall).
- 2.5 mm bucco palatal/ lingual (from the proximal occlusal part).
- 1.5 mm bucco palatal/lingual (at the level of the isthmus),

And 2 mm bucco palatal/lingual (at the level of the dovetail "queue d'aronde")

The cavities were prepared with a high speed handpiece with irrigation by a ball diamond bur (Intensiv Swiss dental products FGM 219) then by a pear bur (Intensiv Swiss dental products FGM 200). These burs are designed for paediatric dental use. The dimensions of the cavity were constantly assessed by a periodontal probe (Williams's periodontal probe) (Figure 3). Then, the axial walls were adjusted so as to have parallelism between them. For the group with bevel, the same procedure of the proximal cavity was designed with a diamond pear bur under irrigation. The bevel was created using a conical diamond bur (Intensiv Swiss dental product FGM D2) at 45° around the cavo-superficial angle. The bevel extent was 1 mm. The angle was measured continuously using a metal device made angled by 45° (This device was used to standardize the beveled cavo-superficial angle to the requested value) (Figure 4) [21].

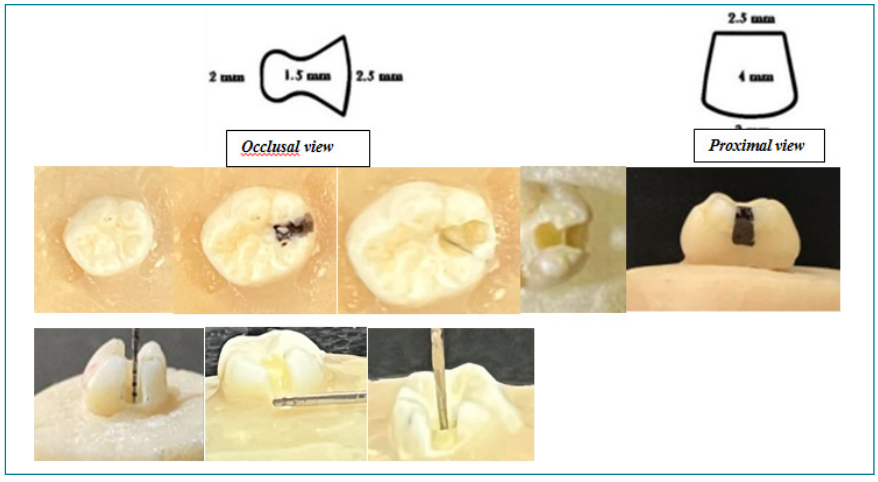

Figure 2. Occlusal and proximal views of the caviy preparations with standardization using the Williams periodontal probe and the permanent marker

Restoration with the Equia Forte GIC

The first two groups (group I and II) n=25 primary teeth into each group were prepared and ready for restorations. After rinsing the cavity with water, the cavity was dried by a jet of air, while maintaining a moist surface. The metal matrix applied to the Tofflemire matrix holder served as support to sculpt the proximal wall of the specimens. The product of choice for restorations comes in the form of predisposed capsules. This arrangement is qualified by the precise powder/liquid dosing and the ideal mixing. Subsequently, the pre-dosed capsule of EQUIA Forte® containing the powder-liquid ratio 0.40/0.13 was placed in the vibrator. The vibration of the cement lasted 10 s. After obtaining a uniform and thick consistency, the cement was introduced by a gun into the prepared cavities. Then, the restorations were sculpted to reproduce the anatomy of the primary molars. Finally, the teeth filled with EQUIA Forte® were stored at room temperature (23±2°C) for 24 hours.

Restoration with the bulk fill high viscosity composite: Ivoclar

Group III and group IV n= 25 primary molars. All the cavities were prepared and ready for restorations. The steps were done as the following:

- Applying the matrix band with the matrix holder tofflemire.
- Applying the etching 37% phosphoric acid gel N-etch Ivoclar vivadent for 15 sec.

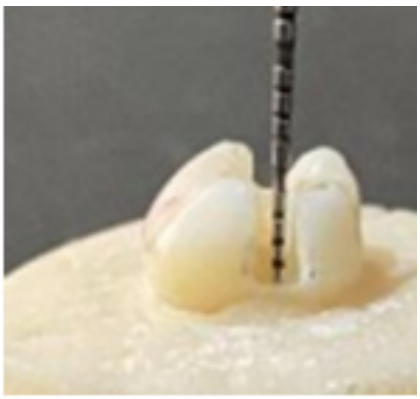

Figure 3. Williams periodontal probe used to standardize cavity.

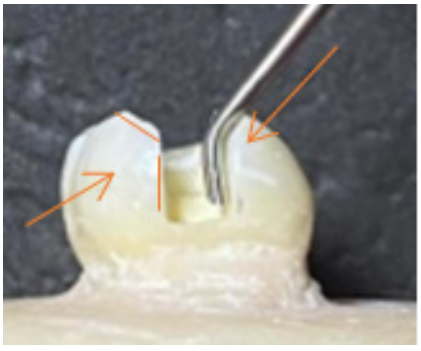

Figure 4. Metal device angled 45° to measure the beveled angle.

- Rinse and dry the cavity.
- Applying the bonding Universal Adhesive Ivoclar VivaPen which is the new efficient version that provides up to three times more applications per millilitre of contents compared with conventional bottles.
- DTE Lux E Curing Light 1000-1200 mw/cm2.
- Applying the Ivoclar Bulk Fill composite with a single layer followed by photopolymerisation.
- The teeth were stored at room temperature (23±2°C) for 24 hours.

Thermocycling

The specimens were subjected to thermocycling between 5°C and 55°C with a residence time of 30 s at each temperature. The fracture resistance was assessed after 10000 cycles of thermocycling.

Evaluation of fracture resistance

The fracture resistance of the restorations in the four groups was tested using the universal testing machine.

All the samples were placed successively at the level of the metal template of the machine. A conical steel cylinder was applied with a speed of 1 mm/min to the samples. The 2.5 mm diameter cone (metal template designed exactly according to the dimensions of the restorations) was used for primary molars. The loading force was directed towards the long axis of the tooth, and perpendicular to the occlusal plane. This axial load was applied until the restorations fractured. The break of the samples was confirmed by visual inspection. The display panel indicated recording the force in Newtons (N) applied until failure. In order to guide the current study, a pilot study (Table 1) was carried out on a sample of 4 teeth with a metal template of 4,5mm diameter and a Class II cavity with and without a bevel. The class II were performed on both proximal surfaces of each tooth and a cavity shape with and without a dovetail (queue d'aronde).

The data of the pilot study guided the current study by the following (Figure 5):

- The metal template of the Universal testing machine should be adapted to primary teeth with a 2.5mm diameter.
- The cavity shape with a dovetail showed better results in terms of resistance to fracture.
- Only one class II cavity should be performed on each tooth to decrease the fragility of the cavity walls.

Table 1. the data of the pilot study

samples	With bevel	Without bevel
Cavity shape without dovetail BulkFill	849 N	670 N
Cavity shape with dovetail Bulk Fill	1276 N	1104 N
Cavity shape without dovetail GIC EquiaForte	270 N	220 N
Cavity shape with dovetail GIC Equia Forte	543 N	340 N

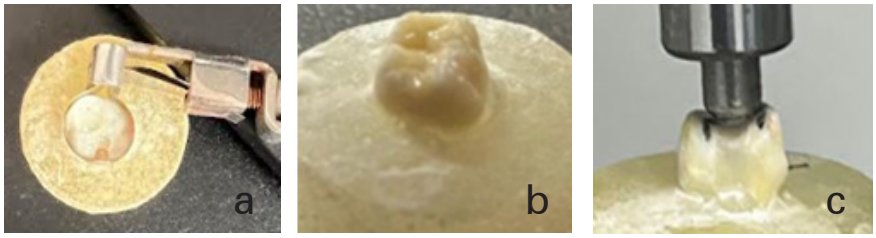

Figure 5. (a) tofflemire matrix, (b) Bulk Fill restoration, (c) universal testing machine

Statistical analysis

Statistical analysis was done using SPSS version 25.0. Quantitative data was presented using mean, median, standard deviation, minimum, maximum and the quartile. The Student T-test was used in the bivariate analysis to compare means between two groups. A p-value less than 0.05 is considered significant. When comparing between the two groups, the bulk fill group showed a higher mean (1688.80) than the Equia forte group (468.04). The box plot showed a higher resistance to fracture in the bulk-fill group.

Results

Out of one hundred extracted primary molars clinically assessed meeting the inclusion criteria, 13 primary molars were excluded from the study due to the fracture of the resin bloc during the assessment of the fracture resistance by the universal testing machine or the fracture of the tooth itself so 87 corresponding primary molars were eligible for inclusion in the study sample.

Table 2. Description of the resistance to fracture among the four groups.

Groups	N	Minimum	Maximum	Mean ± SD	Q1	median	Q3
I: GIC without bevel	25	84.00	872.00	422.20 ± 254.32	206.00	405.00	685.00
II: GIC with bevel	21	194.00	947.00	498.80 ± 198.64	395.50	472.00	599.50
III: Bulk Fill without bevel	20	675.00	1374.00	901.80 ± 193.02	756.00	876.00	984.25
IV: Bulk fill with bevel	21	1686	3000	2438.33 ± 413.51	2056.00	2373.00	2863.50

There is a statistically significant difference between the two groups with a p-value<0.001 with a higher resistance to fracture in the bulk fill group. Concerning the cavity preparations, the bevelled cavity using the bulk fill Ivoclar restorative material showed the highest resistance to fracture between the four groups with a mean of 2438.33N while the lowest resistance to fracture among the four groups was the the Equia forte group without bevel with a mean of 442.2N . To better analyse the effect of the bevel on the resistance to fracture of the restoration, the two groups (bulk fill and Equia forte) each group statistically analysed with or without a bevel during the preparation. In the Equia Forte group they were no statistically difference between with or without the bevel with a p-value = 0.402. Ivoclar Vivadent Tetric N-Ceram Bulk Fill group showed a statistically difference when the cavity shape is with or without a bevel preparation, with a higher resistance to fracture in the group where the bevel was added to the cavity shape.

Discussion

According to the American Dental Association, any restorative material applied in the posterior teeth must have at least 90% of retention rate after 18 months of clinical service to become fully accepted as a definitive restorative material[22]. The main benefits of Bulk Fill composites and Equia Forte restorations are the timesaving and the efficiency enhancement and these factors are so important when dealing with children.

Added to that, the main advantages and beneficial effects of the bevel preparation in composite restorations are the following:

- Removal of the aprismatic layer of enamel, which favours the acid etching by the increase of the etched surface area.
- Favours the wettability and the surface energy of the substrate.
- Reduction of microleakage.
- Improvement in the marginal seal leading to enhancement of the aesthetics by masking the interface between enamel and composite.

All of these lead to a better retention of the restoration [23- 28]80 box-only Class II cavities were prepared mesially and distally in 40 extracted human molars using four different oscillating diamond coated instruments: (A.

In the literature, the information given on the bevel is still under discussion: Some researchers and clinicians believe that cavo-superficial bevelling establishes a less conservative approach by eliminating healthy tooth structure. In a clinical study, Coelho-De-Souza & coll. demonstrated that the beveled cavity shape did not influence the mechanical performance of post-composite restorations after 1 year. Also an in vitro study, Soliman & coll. (2016) [29] showed that the bevel was not able to improve the qualities of large proximal class II composite restorations. Therefore, the bevel is not recommended in large Class II box cavities where the residual enamel is already weak.

In the Equia forte group, there is no statistically difference between the presence or the absence of the bevel in the cavity shape p-value=0.402 (the first null hypothesis cannot be rejected in the Equia Forte Group), while in the tetric N-Ceram high viscous Bulk fill: the fourth group with the beveled cavities showed a higher resistance to fracture than the third group without bevel with p-value<0.001, so there is a statistically difference between the two groups (the first null hypothesis is rejected in the Tetric N-ceram groups).

To the authors best knowledge this is the first study to compare the resistance to fracture of composite resin and glass ionomer in beveled versus non beveled tooth preparation of Class II restorations in primary molars.

A recent study published in 2023 demonstrated that the bevel for GIC restorations are generally not recommended due to the inherent fragility of the material when placed in insufficient volume in the cavity. Beveling involves removing a portion of the tooth structure at an angle, which can compromise the bulk and strength of the GIC restoration. Added to that, a recent study published in 2023 showed no statistically significant difference in fracture resistance in Equia Forte Glass Ionomer restorations between beveled versus non-beveled cavity preparations [30, 31]. *Apel Z & coll* in 2021 also recommended the use of a bevel during class I and class II composite cavity preparation [32]. Also, *Niek J & coll* established that a bevel satisfy an optimal marginal seal in small box-type Class II composite restorations [33]. Also, *Mondelli & coll* (2019) found a significant improvement in the fracture resistance of composite restorations[34]. These results were demonstrated in our experimental study, where beveled cavities did not statistically influence the mechanical strength of the restorations in Equia Forte group while it increased the resistance to fracture in the Tetric N ceram Bulk Fill group.

When vertical force is applied by the Universal Testing Machine on the restorations, the compressive and tensile stresses occur between the enamel and the restorative product. This is caused by the difference in the modulus of elasticity and mechanical properties between the product and the tooth structure [32]. The modification of the cavity architecture allows a gradual braking of the dispersion of these stresses at the level of the interference between the walls of the cavity and the restoration product. Subsequently, the beveled cavity allows better distribution of forces [34].

In the literature, studies have demonstrated that the orientation of the prisms influences the mechanical resistance of the restorations. *Carvalho & coll*. (2000) have demonstrated that tensile strength is increased when the enamel prisms have a perpendicular orientation to the restorative product [35]. Thus, the bevel could improve the tensile strength.

Moreover, cavo-superficial beveling made it possible to obtain a larger surface area of exposed enamel in conjunction with the restoration product. As a result, it increases the adhesion of the product to the dental structure.

The present study shows that when comparing the resistance to fracture, the tetric N-Ceram high viscous Bulk fill shows a higher resistance to fracture compared to the Equia Forte either the cavity shape is beveled or not beveled (the second null hypothesis is rejected). These results are similar to a clinical study published in 2020 found that after one and two year recall periods, the survival rate for the two resin composite materials filled in bulk or used in layers was significantly higher than EQUIA Forte[36]. Same to a randomized prospective clinical study published in 2019 that aimed to evaluate the efficiency of a bulk-fill composite resin, a conventional composite resin and a reinforced glass ionomer in class II cavities and resulted in a higher clinical performance of bulk fill composite resins and conventional composites [37].

On the other hand, a recent study published in 2024 showed statistically significant differences between EQUIA Forte and Tetric EvoCeram (in marginal staining between with proportions of 'clinically excellent' restorations of 76% and 60%, respectively) [38]Croatia; Izmir, Turkey; Belgrade, Serbia; and Milan, Italy. A total of 180 patients requiring two class-II two-surface restorations in the molars of the same jaw were recruited. The teeth were randomly restored with either a nano-hybrid resin composite (Tetric EvoCeram, Ivoclar Vivadent. These are probably related to the known shrinkage of the composite resin material, leading to compromised marginal adaptation[38]Croatia; Izmir, Turkey; Belgrade, Serbia; and Milan, Italy. A total of 180 patients requiring two class-II two-surface restorations in the molars of the same jaw were recruited. The teeth were randomly restored with either a nano-hybrid resin composite (Tetric EvoCeram, Ivoclar Vivadent. Also, a recent five year clinical research published in 2023 studying three high-viscous glass-ionomer restorative materials in small class II cavities did not show any significant difference compared to the composite resin restorations[39]each with four class II restorations, were enrolled in this trial. A total of 160 restorations were placed, 25% for each material, as follows: three high-viscosity conventional glass ionomer restorative systems (Ketac Universal Aplicap, EQUIA Forte and Riva Self Cure HV. However, this higher success of the HVGIC can be related to the smaller size of the cavities [39]each with four class II restorations, were enrolled in this trial. A total of 160 restorations were placed, 25% for each material, as follows: three high-viscosity conventional glass ionomer restorative systems (Ketac Universal Aplicap, EQUIA Forte and Riva Self Cure HV. In addition, a clinical research published in 2020 assessing the EQUIA Forte performance with a 24 months follow up in extended class II cavities: the retention rate of Equia forte was acceptable (93.7%) and similar to the resin composite tested [40]. Same to a clinical in vivo research in 2020 studying the clinical performance of Equia Forte versus Tetric N Ceram in class II carious primary molars with a 12 months follow up didn't show any significant difference in terms of the three following parameters: aesthetic, functional and biological [41].

To better increase the resistance to fracture of the Equia Forte group, we might use the chlorhexidine (CHX) as a disinfectant in the cavity before applying the restoration and this is confirmed by a recent study published in 2022 : it was demonstrated that the cationic part of the CHX residual binds to negatively charged phosphate in dentin which may have potentially impaired the bonding ability of GIC-based materials to tooth structures [42]. Also, several studies found that using CHX with polyacrylic acid which is a component found in the liquid of the GIC lead to an increase of the GIC bond strength [43- 45].

Furthermore, this study was conducted in vitro, and it did not evaluate the aesthetic properties because its objective is the assessment of the resistance to fracture but the difference in the appearance and the opacity between the two materials is clear. Equia Forte isn't available in shades as the composite resin. Also, the composition and structure of the two materials are different; the GIC is rougher and cannot be polished with polishing rubbers and pastes, so the colour match, surface gloss, lustre and translucency are not comparable to composite resin materials. In this study, the materials are used in the posterior region and on temporary molars so the aesthetic appearance of the restoration is not as important as if it was in the anterior region, but it does not mean that the aesthetic component in the posterior region should be disregarded [38]Croatia; Izmir, Turkey; Belgrade, Serbia; and Milan, Italy. A total of 180 patients requiring two class-II two-surface restorations in the molars of the same jaw were recruited. The teeth were randomly restored with either a nano-hybrid resin composite (Tetric EvoCeram, Ivoclar Vivadent.

Conclusion

In terms of success and survival rates, both the glass Hybrid restorative material and the bulk fill resin composite have demonstrated satisfactory performance and can be used as restorative materials in the posterior primary teeth.

The significance in the composite group is probably related to the bonding agent, since the bevel provides additional surface area for bonding and adhesion of the restorative material to the tooth structure. The increased bonding surface facilitates a stronger bond, improving the longevity and durability of the restoration. So, as a solution of the high failure rate of class II restorations we can assume that adding a bevel, was found to have a better influence on resistance to fracture of the restoration; unless it is created as follows: 45^0 at the cavo-superficial angle and not exceeding 1mm.

On the other hand, beveled margins are not recommended for GIC restorations and this can be related to the inherent fragility of the material when placed in an increased volume in the cavity. Beveling involves removing a portion of the tooth structure at an angle, which can compromise the bulk and strength of the GIC restoration.

Adding a bevel requires 3 minutes of preparation and results in: creating mechanical interlocking and improvement in the stability and retention of the restoration.

References

1. Ricketts D, Lamont T, Innes NP, Kidd E, Clarkson JE.: Operative caries management in adults and children. Cochrane Database Syst Rev. 2019 Jul 24;7(7):CD003808.
2. Benzian H, Daar A, Naidoo S. Redefining the non-communicable disease framework to a 6 × 6 approach: incorporating oral diseases and sugars. Lancet Public Health. 2023 Nov;8(11):e899–904.
3. Alhabdan YA, Albeshr AG, Yenugadhati N, Jradi H. Prevalence of dental caries and associated factors among primary school children: a population-based cross-sectional study in Riyadh, Saudi Arabia. Environ Health Prev Med. 2018 Nov 30;23(1):60.
4. Prabhakar AR, Raju OS, Kurthukoti AJ, Satish V. Evaluation of the clinical behavior of resin modified glass ionomer cement on primary molars: a comparative one-year study. J Contemp Dent Pract. 2008 Feb 1;9(2):130–7.
5. Chisini LA, Collares K, Cademartori MG, de Oliveira LJC, Conde MCM, Demarco FF, et al. Restorations in primary teeth: a systematic review on survival and reasons for failures. Int J Paediatr Dent. 2018 Mar;28(2):123–39.
6. Qadir H A, EL-Wassefy N A, Abdullah A M, Hamama H H.Effect of Different Bevel Designs on Microleakage and Shear Bond Strength of Class IV Composite Restoration: A laboratory Study. Mans J Dent. 2022; 9(1): 1-3.
7. Zhang L, Ye N, Aregawi WA, Fok A. Effect of Bevels on Load Capacity of Composite-Restored Incisors. Dent Mater. 2022;38:e48.
8. Yengopal V, Harneker SY, Patel N, Siegfried N. Dental fillings for the treatment of caries in the primary dentition. Cochrane Database Syst Rev. 2009 Apr 15;(2):CD004483.
9. Pires CW, Pedrotti D, Lenzi TL, Soares FZM, Ziegelmann PK, Rocha R de O. Is there a best conventional material for restoring posterior primary teeth? A network meta-analysis. Braz Oral Res. 2018 Mar 1;32:e10.
10. Scottish Dental Clinical Effectiveness Programme. Prevention and management of dental caries in children. 2018.
11. Ferracane JL. Buonocore Lecture. Placing dental composites--a stressful experience. Oper Dent. 2008;33(3):247–57.
12. Schaffner M, Lussi A. Developmental and Histological Aspects of Deciduous and Young Permanent Teeth. In: Neuhaus KW, Lussi A, editors. Management of Dental Emergencies in Children and Adolescents 1st ed. Wiley; 2019.
13. Martins LC, Oliveira LRS, Braga SSL, Soares CJ, Versluis A, Borges GA, et al. Effect of Composite Resin and Restorative Technique on Polymerization Shrinkage Stress, Cuspal Strain and Fracture Load of Weakened Premolars. J Adhes Dent. 2020;22(5):503–14.
14. Bellinaso MD, Soares FZM, Rocha R de O. Do bulk-fill resins decrease the restorative time in posterior teeth? A systematic review and meta-analysis of in vitro studies. J Investig Clin Dent. 2019 Nov;10(4):e12463.
15. American Academy of Pediatric Dentistry. Pediatric restorative dentistry. The reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2023. pp. 443–56.
16. Gindri LD, Cassol IP, Fröhlich TT, Rocha R de O. One-year clinical evaluation of class II bulk-fill restorations in primary molars: a randomized clinical trial. Braz Dent J. 2022;33(6):110–20.
17. Iftikhar N, Devashish null, Srivastava B, Gupta N, Ghambir N, Rashi-Singh null. A Comparative Evaluation of Mechanical Properties of Four Different Restorative Materials: An In Vitro Study. Int J Clin Pediatr Dent. 2019;12(1):47–9.
18. Schwendicke F, Walsh T, Lamont T, Al-Yaseen W, Bjørndal L, Clarkson JE, et al. Interventions for treating cavitated or dentine carious lesions. Cochrane Database Syst Reviews. 2021;2021:7.
19. Coelho-De-Souza FH, Camargo JC, Beskow T, Balestrin MD, Klein-Júnior CA, Demarco FF. A randomized double-blind clinical trial of posterior composite restorations with or without bevel: 1-year follow-up. J Appl Oral Sci Rev FOB. 2012;20(2):174–9.
20. Rajagopal S, Sharma S. Comparative Evaluation of Marginal Leakage of Various Bevel Designs Using Direct Composite Restoration in Fractured Anterior Teeth: An In Vitro Study. Cureus 2024 Mar 25.
21. Kutuk Z, Ozturk C, Cakir F, Gurgan S. Mechanical performance of a newly developed glass hybrid restorative in the restoration of large MO Class 2 cavities. Niger J Clin Pract. 2019;22(6):833-841.
22. Schwendicke F, Kniess J, Paris S, Blunck U. Margin Integrity and Secondary Caries of Lined or Non-lined Composite and Glass Hybrid Restorations After Selective Excavation In Vitro. Oper Dent. 2017;42(2):155–64.
23. Ada Council On Scientific Affairs, Ada Council On Dental Benefit Programs. STATEMENT ON POSTERIOR RESIN-BASED COMPOSITES. J Am Dent Assoc. 1998 Nov;129(11):1627–8.
24. Brackett WW, Browning WD, Brackett MG, Callan RS, Blalock JS. Effect of restoration size on the clinical

performance of posterior "packable" resin composites over 18 months. Oper Dent. 2007;32(3):212–6.

25. Coelho-de-Souza FH, Camacho GB, Demarco FF, Powers JM. Influence of restorative technique, beveling, and aging on composite bonding to sectioned incisal edges. J Adhes Dent. 2008 Feb;10(2):113–7.
26. Hoelscher DC, Gregory WA, Linger JB, Pink FE. Effect of light source position and bevel placement on facial margin adaptation of resin-based composite restorations. Am J Dent. 2000 Aug;13(4):171–5.
27. Opdam NJ, Roeters JJ, Kuijs R, Burgersdijk RC. Necessity of bevels for box only Class II composite restorations. J Prosthet Dent. 1998 Sep;80(3):274–9.
28. Peixoto RTR, Poletto LT de A, Lanza MD, Buono VTL. The influence of occlusal finish line configuration on microleakage of indirect composite inlays. J Adhes Dent. 2002;4(2):145–50.
29. Soliman S, Preidl R, Karl S, Hofmann N, Krastl G, Klaiber B. Influence of Cavity Margin Design and Restorative Material on Marginal Quality and Seal of Extended Class II Resin Composite Restorations In Vitro. J Adhes Dent. 2016;18(1):7–16.
30. Fikani A, Nasr L, Khoury E, Freiha M, Kaloustian M, Abi Zeid Daou F, Chaaya M, Khoury M.The Effect of Bevel on Fracture Resistance of GIC Restorations in Primary Molars: In Vitro Study. International Arab Journal of Dentistry: Vol. 14: Iss. 2, Article 5. 03 Nov 2023.
31. Ekta Choudhary, Garima Joshi, Farheen Khan . Bevels And Flares for Different Restorations: A Narrative Review. Tuijin Jishu/Journal of Propulsion Technology ISSN: 1001-4055 Vol. 44 No. 3 (2023).
32. Apel Z, Vafaeian B, Apel DB, Hussain A. Occlusal stresses in beveled versus non-beveled tooth preparation. Biomed Eng Adv. 2021 Dec;2:100010.
33. Opdam NJM, Roeters JJM, Kuijs R, Burgersdijk RCW. Necessity of bevels for box only Class II composite restorations. J Prosthet Dent. 1998 Sep;80(3):274–9.
34. Mondelli J, Rizzante FAP, Valera FB, Roperto R, Mondelli RFL, Furuse AY. Assessment of a conservative approach for restoration of extensively destroyed posterior teeth. J Appl Oral Sci. 2019;27:e20180631.
35. Carvalho RM, Santiago SL, Fernandes CA, Suh BI, Pashley DH. Effects of prism orientation on tensile strength of enamel. Journal of Adhesive Dentistry. 2000 Dec 1;2(4):251257.
36. Balkaya H, Arslan S. A Two-year Clinical Comparison of Three Different Restorative Materials in Class II Cavities. Oper Dent. 2020 Jan 1;45(1):E32–42.
37. Balkaya H, Arslan S, Pala K. A randomized, prospective clinical study evaluating effectiveness of a bulk-fill composite resin, a conventional composite resin and a reinforced glass ionomer in Class II cavities: one-year results. J Appl Oral Sci Rev FOB. 2019;27:e20180678.
38. Miletić I, Baraba A, Krmek SJ, Perić T, Marković D, Basso M, et al. Clinical performance of a glass-hybrid system in comparison with a resin composite in two-surface class II restorations: a 5-year randomised multi-centre study. Clin Oral Investig. 2024 Jan 20;28(1):104.
39. Wafaie RA, Ibrahim Ali A, El-Negoly SAE, Mahmoud SH. Five-year randomized clinical trial to evaluate the clinical performance of high-viscosity glass ionomer restorative systems in small class II restorations. J Esthet Restor Dent. 2023 Apr;35(3):538–55.
40. Gurgan S, Kutuk Z, Ozturk C, Soleimani R, Cakir F. Clinical Performance of a Glass Hybrid Restorative in Extended Size Class II Cavities. Oper Dent. 2020 May 1;45(3):243–54.
41. Shagale AM, Aby H, Prabhakar A, Bm D, Reddy GS. Clinical performance of Equia Forte: A glass hybrid GIC versus Tetric N Ceram; a bulk fill composite in class II carious primary molars: A 12 month split mouth clinical trial. Int J Appl Dent Sci. 2020 Oct 1;6(4):435–40.
42. Borompiyasawat P, Putraphan B, Luangworakhun S, Sukarawan W, Techatharatip O. Chlorhexidine gluconate enhances the remineralization effect of high viscosity glass ionomer cement on dentin carious lesions in vitro. BMC Oral Health. 2022 Mar 5;22(1):60.
43. Jaidka S, Somani R, Singh DJ, Shafat S. Comparative evaluation of compressive strength, diametral tensile strength and shear bond strength of GIC type IX, chlorhexidine-incorporated GIC and triclosan-incorporated GIC: An in vitro study. J Int Soc Prev Community Dent. 2016 Apr;6(Suppl 1):S64-69.
44. Sheikh Hasani Y, Paryab M, Saffarpour A, Kharazifard MJ, Shahrabi M. The Effect of Disinfection with Chlorhexidine on the Shear Bond Strength of Equia Resin-Modified Glass Ionomer Cement to Dentin in Permanent Teeth after Two Thermocycling Protocols. J Dent Shiraz Iran. 2017 Dec;18(4):265–71.
45. Wadenya R, Menon S, Mante F. Effect of chlorhexidine disinfectant on bond strength of glass ionomer cement to dentin using atraumatic restorative treatment. N Y State Dent J. 2011 Jan;77(1):23–6.