10.21608/adjc.2025.370318.1723 Advanced Dental Journal
Volume (8) | Issue 1| Pages 299-310 ©Faculty of Dentistry-Cairo University

Original Article

Clinical Evaluation of Digital Versus Conventional Techniques Restoring Ellis Class II Traumatized Central Incisors in Children: A Randomized Clinical Trial

Yomna Said Mohamed[1], Mahmoud Attia[2], Mohamed Shamel[3,4], Ruba El Damarisy[5], Marwa Salamoon[6]

[1]Department of Pediatric, Preventive and Community Dentistry, Faculty of Dentistry, Newgiza University, Giza, Egypt.
[2]Department of Fixed Prosthodontics, Faculty of Dentistry, MSA University, Giza, Egypt.
[3]Department of Oral Biology, Faculty of Dentistry, The British University in Egypt.
[4]Dental Science Research Group, Health Research Centre of Excellence, The British University in Egypt, El Shorouk City, Egypt.
[5]Department of Conservative Dentistry, Faculty of Dentistry, MSA University, Giza, Egypt.
[6]Department of Pediatric Dentistry, Faculty of Dentistry, MSA University, Giza, Egypt

Email: mohamed.shamel@bue.edu.eg

Submitted: 22-03-2025
Accepted: 21-05-2025

Abstract

Aim: This randomized clinical trial aimed to compare the clinical performance of digital and conventional techniques in restoring Ellis Class II traumatized central incisors in children. The study specifically evaluated Mini Veneers, Composite restorations, and Fragment restorations over a 12-month period.

Subjects and methods: A total of 60 pediatric patients were divided into three equal groups, each receiving one of the restorative techniques. Clinical parameters, including failure rates, color stability, adaptation, marginal discoloration, surface roughness, and biocompatibility, were assessed using Modified USPHS criteria at baseline and at 3, 6, 9, and 12 months.

Results: Mini Veneers showed superior performance, maintaining 100% success in color stability, marginal adaptation, and clinical success. Composites declined significantly, with clinical success at 85% failure by 6 months, while fragment restorations had the poorest outcomes at clinical success rate at 82%, in addition to notable roughness, and discoloration. Differences were statistically significant ($p < 0.05$), highlighting Mini Veneers' aesthetic and functional advantages.

Conclusion: Mini Veneers outperformed Composite and Fragment restorations in restoring Ellis Class II traumatized central incisors in children, demonstrating excellent durability, aesthetic stability, and biocompatibility over 12 months.

Keywords: Dental trauma, Ellis class II, mini veneers, fragment restoration, composite restoration, failure, color stability, marginal adaptation.

Introduction

Dental trauma (DT) frequently affects children and adolescents, with the upper incisors being the most commonly injured teeth. Enamel and dentin fractures are the most prevalent types of trauma in these age groups ***(Azami-Aghdash et al., 2015)***. Managing DT of the incisors and their supporting tissues presents a significant challenge and necessitates prompt assessment and treatment due to physical and psychological factors ***(Day et al., 2020).*** This is particularly crucial for young permanent teeth due to their ongoing development, as prompt and effective management can help prevent unwanted complications. Anterior tooth fractures can significantly impact a patient's appearance, making it essential to fully understand their aesthetic goals for successful treatment. The

initial treatment plan should prioritize the most conservative approach that meets the objectives of both the patient and the dentist ***(Raut and Fulzele, 2024).***

A Class II fracture is often a challenging case, presenting a dilemma between opting for conventional restoration or more extensive treatments like root canal therapy. Additionally, individuals with dental trauma tend to experience a higher incidence of dental caries compared to those without such trauma ***(Soares et al., 2017)***. It has been demonstrated that unfavorable fracture patterns, when restored, often show reduced resistance to labial forces similar to those from trauma. However, these restored fractures may exhibit greater resistance to horizontal traction forces encountered during activities like cutting or tearing food ***(Murchison et al., 1999).***

Different treatment approaches are used for Ellis Class II fractures, with conventional restorations, reattachment of fractured segments, and full veneer crowns being among the most common options ***(Jose et al., 2020).*** Patients with Ellis Class II fractures may present with sensitivity from exposed dentinal tubules, making it essential for dentists to possess comprehensive knowledge and practical experience to provide effective treatment ***(Jose et al., 2020).***

Treatment for dental trauma is sometimes neglected, which can lead to pain, challenges with speaking and chewing, and a considerable decline in the patient`s self esteem ***(Berlin-Broner et al., 2023).*** The aesthetics of the anterior teeth are crucial to human appearance and can be influenced by various factors, including the presence of fillings, tooth color, position, alignment, shape, and number ***(Bjelopavlovic et al., 2021)***.

Since the maxillary incisors are the most frequently injured teeth due to their prominent position, there is often a strong demand for restorations that are functional, aesthetically pleasing, and efficient in terms of time ***(Tinoco et al., 2020).*** According to the latest guidelines from the International Association of Dental Traumatology, crown fractures that affect only the enamel and dentine can be managed using a direct composite restoration or reattaching the fractured fragment with adhesive techniques ***(Bourguignon et al., 2020).*** When the fractured piece is intact, reattaching it is frequently favored in dental practice. This approach allows for the restoration of the tooth's original anatomy and color, and it functions quickly and efficiently ***(Choudhary et al., 2015, Sarapultseva and Sarapultsev, 2019)***. Unfortunately, there is limited clinical research on the long-term success of reattached fragments, and findings from laboratory studies may not always be directly applicable to real-world clinical situations ***(Haupt et al., 2023).*** Additionally, data on the durability of direct composite restorations in fractured anterior teeth are limited to only a few clinical studies. ***(Hoeppner et al., 2022, Dietschi et al., 2019).***

In addition to the previously discussed restorative methods, small partial glass restorations have been rising in popularity in recent years, including partial laminate veneers (PLVs), sectional veneers, and ceramic fragments ***(Ojeda et al., 2023, Ojeda et al., 2024).*** Partial laminate veneers (PLVs) are thin, shape-free glass-matrix ceramic fragments designed to repair small defects in anterior teeth. Unlike conventional laminate veneers, PLVs do not require tooth preparation or only require minimal preparation, thereby preserving the maximum amount of enamel structure **(Ojeda et al., 2023)**. Thus, retention relies completely on adhesion, which is primarily achieved by bonding to the conditioned glassy surface ***(Gresnigt et al., 2021).*** Despite their rising popularity, there is only a limited amount of literature on partial laminate veneers (PLVs), predominantly consisting of a few in vitro studies **(Blunck et al., 2020, Gresnigt et al., 2021)**. and case reports ***(Duran Ojeda et al., 2024, Rathee et al., 2023)***, without any current clinical information.

Given these data limitations, we conducted this clinical trial. This was especially relevant as current dental trends emphasized preserving as much healthy tooth structure as possible ***(Yu et al., 2019).*** Patients in all groups received a minimally invasive restoration that offered high aesthetic benefits and long-term success for their fractured incisors. This randomized clinical trial aims to assess the survival and success rates of three different types of conservative restorations applied to Ellis Class II traumatized central incisors by clinical evaluation of the patients.

Subjects and Methods

Sample size

In this study, the probability of achieving a color match (clinical success) in Group 1 was

found to be 0.98. Given that the estimated probability for Group 2 is 0.6, the required number of participants is 17 per group, assuming a power of 0.8. To account for a 15% dropout rate during follow-up, the sample size was adjusted to 20 participants per group. The sample size calculation was performed using a chi-squared test in the P.S. Power 3.1.6 software (version 3.1.2) from Vanderbilt University, Nashville, Tennessee. As a result, the total sample size consisted of 60 teeth.

Study setting

The trial was reported adhering to the guidelines set by CONSORT. The study was a randomized clinical trial where 3 arm parallel groups with a 1:1:1 allocation ratio were compared. The child participants, the legal guardian of each participating child, and the statistician were blinded. This study was conducted from December 2023 to December 2024 at MSA University's Faculty of Dentistry pediatric clinic. The MSA University Faculty of Dentistry's Ethics Committee approved the study protocol, which was assigned approval number NCT06299150. Before each treatment session, informed consent forms were signed by the patient's parents or guardians, and the participants were fully informed about the details of the study and any potential risks.

60 Ellis Class II recently traumatized central incisors were included in the study. The participants were between 8 and 18 years old.

Inclusion criteria: Eligible patients without systemic disorders, with no active caries or periodontal diseases, and available to be clinically reviewed for up to 1 year were included in the study.

Exclusion criteria:

- All Ellis Classification traumatized central incisors except for Ellis Class II
- Patients with uncontrolled active tooth decay or periodontal disease (i.e. 4+ mm probing depth and bleeding on probing).
- Poor oral hygiene and motivation.
- Patients with parafunctional habits (e.g., bruxism, biting on hard objects).
- Patients with debilitating illnesses or complicated medical conditions.

Patient Allocation and Randomization:

Patients were randomly assigned into three groups (n=20) using computer-generated randomization.

Three treatment groups were restored as follows:

Group I: Direct resin composite restoration (3M™ Filtek™,ESPE, st.Paul ,USA)

Group II: reattachment of broken fragments

Group III: Indirect CAD/CAM mini veneer

Outcome Measures:

1. Primary outcome:

Clinical success/ survival [Time Frame: 12 months] was evaluated using (a modified version of the United States Public Health Service (USPHS) criteria). To facilitate statistical analysis, USPHS scores were converted to numeric values. This scoring modification aligns with methods adopted in recent clinical studies (Ojeda et al., 2023)

- Each parameter was assessed using visual and tactile observations (probe and mirror).
- At the checkup visits (3, 6, 9, 12 months) standardized photographs and the restorations were clinically evaluated by an independent and calibrated clinician.
- The need for replacement and partial fractures (chippings) were defined as failures

2. Secondary outcomes: [Time Frame: 12 months].

- Colour change: using Trios 3 scanner via scan compare (yes or no binary)

Clinical procedures

The three treatment procedures required minimal or no preparation. However, before the beginning of the treatment, a 2% lidocaine with 1:100,000 epinephrine combination was used to provide local anesthesia to facilitate the application of a rubber dam for proper isolation the treated tooth.

Group I: Direct resin composite restoration

A silicone impression was taken for each fractured incisor with a polymer material to develop a diagnostic wax-up. A palatal silicone index was created from a canine-to-canine extension on the diagnostic wax-up. It was modified with a scalpel to remove buccal portions and provide a passive fit during restoration. The tooth surface was thoroughly cleaned. A wider bevel was created to hide the fracture line. All sharp edges were smoothed and rounded. Buccal and lingual enamel surfaces were etched with 37 % phosphoric acid for 15 seconds. A bonding agent was applied to the tooth structure with an ethanol-based total-etch adhesive system and was cured with visible light for 10 sec. (Mat Zainal and Abdullah, 2021) A standard VITA Shade Guide

was used for color matching. The palatal shell was initially formed using an A3 enamel shade followed by layering of an A2 body for the cervical part and an A2 enamel shade for the incisor edge area. Final finishing and polishing were done with a series of abrasive disks (Shofu Super Snap Mini Kit, Kyoto, Japan).

Group II: fragment reattachment

Tooth fragments were rehydrated before repositioning by storing them in distilled water for 30 min ***(Garcia et al., 2018).*** The remaining tooth structure and the tooth fragment were acid etched using 37% orthophosphoric acid for 15 sec. A bonding agent was applied to the tooth structure with an ethanol-based total-etch adhesive system and was cured with visible light for 10 sec. The adhesive system was then applied to the etched surface and was light-cured for 10 sec. The fractured segment was then accurately placed on the tooth, paying special attention to the fit between the segments. When the original position had been re-established, the flowable composite resin was applied to both parts of the fracture surfaces, and the fragments were reattached to their places. The overflowing resin composite was removed and cured with visible light for 20 sec from the labial and palatal surfaces. A 1-mm-deep chamfer was prepared along the fracture line on the buccal surface with a round bur. After surface etching and bonding, a layer of micro-hybrid composite (Filtek Z250™ 3M ESPE) was applied to the chamfer surface and subjected to visible light curing for 40 seconds per increment. The restored surface was finished and polished. A final evaluation for occlusion and esthetics was done.

Group III: Indirect CAD/CAM mini veneer

The fractured anterior tooth, class II, was assessed for vitality, and pre-apical radiographs were taken for each patient. After diagnosis and assessment, tooth preparation was performed using minimal invasive tooth reduction following the fracture pattern defect-oriented tooth preparation with a 0.5mm chamfer finish line along the defected area to receive bonded glass ceramic mini veneers, specifically Ivoclar Vivadent Pressable System E-Max (IPS e.max CAD) [EX (Ivoclar Vivadent, Schaan, Liechtenstein)]. The tooth preparation was carried out using a tapered diamond stone (Komet Tapered with Round Diamond Stone) with a rounded end, and the preparation was finished using a finishing stone to ensure there were no sharp angles in the preparation. The Trios 3 intraoral scanner was utilized to scan the tooth preparation, and the final STL file scans were sent to the 3Shape dental system CAD software for the design of the ceramic mini veneers. Shade selection was determined using shade measurements in the scanner for both adjacent teeth and the tooth preparation stump to be sent to the lab.

One week after the first patient visit, we received the mini veneer from the lab to check the fitting and shade. After verifying the fit, the mini veneers were treated with hydrofluoric acid (5%) (Vita Ceramic Etch, Vita Zahnfabrick, Bad Sackingen, and Germany) for 20 seconds to etch the ceramic for micro tags bonding, followed by rinsing with water and drying. A silane coupling agent (Bisco-Silane, Schaumburg, I1, USA) was then applied to the fitting surface for 1 minute, dried with air, and a layer of bonding agent (All Bond Universal, Etchant, Uni-Etch, BISCO Schaumburg, I1, USA) was applied to the fitting surface for wetting without curing. The tooth surface was treated using the total-etch technique as follows: the prepared surface was isolated using a rubber dam, cleaned, and polished with a polishing brush, etched with 30% phosphoric acid for 15 seconds, and a thin layer of bonding agent was applied and distributed with a clean polishing brush without curing. The mini veneers were loaded with translucent light-curing resin cement and gently applied to the tooth preparation. Any excess cement was removed with a brush, followed by complete curing using a light-curing device (The 3M ESPE LED curing light with a wavelength range of 450-470nm) was used for one minute, starting from the palatal surface and then moving to the labial and incisal edge. After curing, any excess cement was removed using a scalpel, and the patient was allowed to rest for 15 minutes. Intraoral scanning was then performed after cementation to track the shade of the tooth during recall visits every three months.

Postoperative instructions and follow-up assessments

Postoperative intraoral radiographs and instructions regarding preventing loading of the anterior teeth were given to each patient. All patients were scheduled for recall visits 3,6,9 and 12 months later. At each follow up visit, the

following clinical outcomes were measured: restoration clinical success, color changes, marginal adaptation and discoloration, surface roughness, wear of antagonists, postoperative sensitivity and caries.

Statistical analysis

Statistical analysis was performed using SPSS 20®, Graph Pad Prism®, and Microsoft Excel 2016. All quantitative data were presented as mean and standard deviation, while qualitative data were presented as frequency (N) and percentage (%). The quantitative data (age) was explored using the Shapiro-Wilk test and Kolmogorov-Smirnov test for normality which revealed that it originated from normal distribution; accordingly, a comparison between groups was performed using an Independent t-test. In qualitative data, all comparisons were performed using the Chi-square test and Fischer's exact test.

Results

Figure 1 presents clinical photographs illustrating the treatment outcomes for Ellis Class II traumatized central incisors. Images (A) and (B) show the teeth before and after conventional composite restoration, respectively. Images (C) and (D) depict the pre- and post-operative views of cases treated with mini veneers. Lastly, images (E) and (F) illustrate the condition of the teeth before and after fragment reattachment.

Clinical Success

The clinical success rates data across the three treatment groups over the 12-month period are presented in Table (1), and a comparison between groups demonstrated an insignificant difference (p=0.06). Mini Veneer: Showed the most stable of all three treatments with 100% clinical success rate throughout the study, Composite: Showed 100% success rate till 6 months, then rate was decreased to 85%. Fragment: At 3 months follow up, the success rate was 85% which was further slightly reduced to about 82% at 6 months.

Color changes

The color change frequency and percentages of all groups are presented in figure 2. Comparison between different groups demonstrated that there was a significant difference between them (p=0.0001) as,

- Mini Veneer Group: Showed remarkable stability throughout the 12 months and maintained consistent distribution: 65% B1 shade and 35% A2 shade; no failures or color changes were recorded.
- Composite Group: Showed the most color variations over time, started with primarily C1 (45%) and A3 (40%), gradually darkened to darker shades (D3 and A3.5), by 12 months: 64.7% D3 and 35.3% A3.5., there was a failure (15%) at 6 months.
- Fragment Group: Started with diverse shade distribution, progressively converged to A3 shade, by 9 months and 12 months: 100% A3, experienced some failures (15-17.6%) in earlier months.

Modified USPHS-criteria

Adaptation, color changes, marginal discoloration, and roughness of all groups are presented in Figure 3.

Adaptation: Mini-veneers maintained optimal adaptation (100%) up to 6 months, then slightly deteriorated (65% score 0 at 12 months). Composites and fragments progressively declined, with fragments showing the poorest results (only 50% score 0 by 12 months).

Color Stability: Mini-veneers consistently maintained ideal color matching throughout the study period (100% score 0), except a temporary decline at 9 months (score 3), then recovered at 12 months. Composites showed rapid deterioration, reaching the worst score by 12 months (100% score 3), while fragments showed intermediate but variable results.

Marginal Discoloration: Mini-veneers preserved perfect margins throughout (100% score 0). Composites and fragments showed early and continuous deterioration, with fragments experiencing worst results (17.6% score 0, 64.8% score 1, 17.6% failure).

Surface Roughness: Mini-veneers maintained perfect smoothness throughout the year (100% score 0). Composites and fragments demonstrated increasing roughness and notable

failures from 3 months onwards, with fragments consistently showing poorest results.

Fracture pattern wear pattern, wear of antagonist, Caries, and post-operative sensitivity were presented in Figure 4.

Fracture Patterns: Mini-veneers remained fracture-free throughout the study. Fragment restorations showed a 15% fracture rate at 3 months, while composite restorations had a 15% fracture rate by 6 months. No new fractures occurred after 6 months.

Restoration Wear: Mini-veneers showed no wear throughout. Fragment restorations displayed wear (15%) from 3 months, and composite restorations showed wear (15%) at 6 months. No further wear was observed after 6 months.

Antagonist Wear: Mini-veneers caused no antagonist wear. Fragment restorations showed antagonist wear (15%) at 3 months, and composites had antagonist wear (15%) at 6 months. No additional antagonist wear occurred after 6 months.

Caries and Post-operative Sensitivity: Mini-veneers had no issues throughout. Fragment restorations showed issues (15%) at 3 months, with composites developing issues (15%) at 6 months. No further problems were observed afterward.

Figure 1: Photos illustrating the treatment for Ellis Class II Traumatized Central Incisors, (A) Before composite restoration, (B) After composite restoration, (C) Before Emax mini veneers, (D) After Emax mini veneers, (E) Before fragment restoration, (F) After fragment restoration.

Table (1): Frequency and percentages of clinical success among groups

Clinical Success	Mini veneer		Composite		Fragment		p-value
	N	%	N	%	N	%	
Baseline	**20**	**100**	**20**	**100**	**20**	**100**	**0.06**
After 3months	**2**	**100**	**20**	**100**	**17**	**85**	
After 6 months	**20**	**100**	**17**	**85**	**14**	**82**	
After 9 months	**20**	**100**	**20**	**100**	**14**	**82**	
After 12 months	**20**	**100**	**20**	**100**	**14**	**82**	

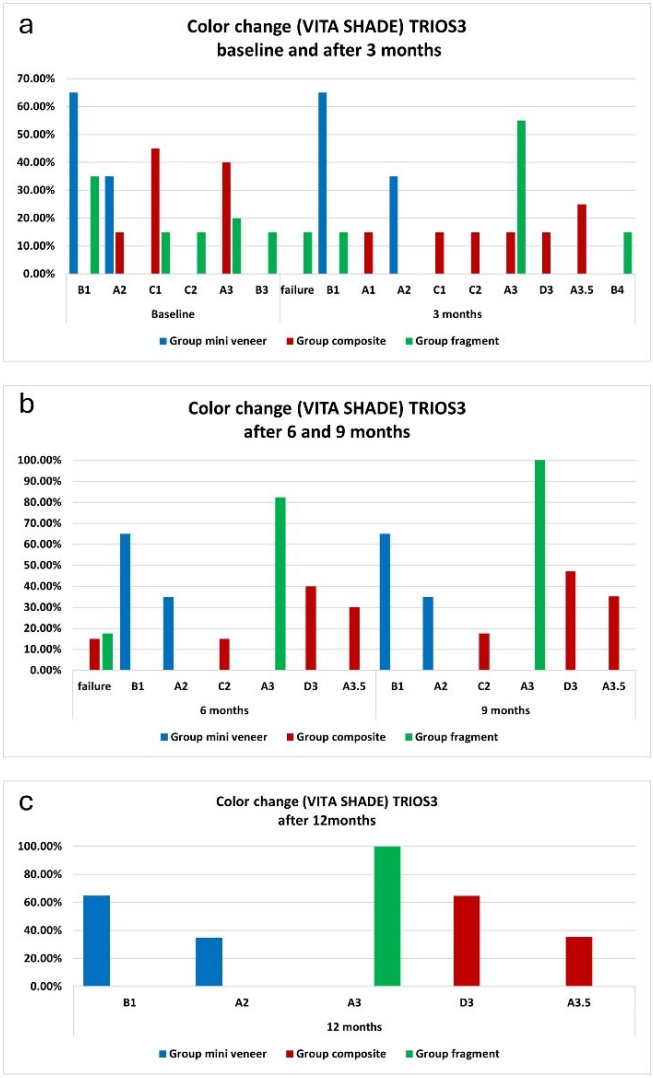

Figure 2: Bar chart showing color change (VITA SHADE) TRIOS3 at baseline and after 3 months (a), 6 and 9 months (b), and 12 months (c).

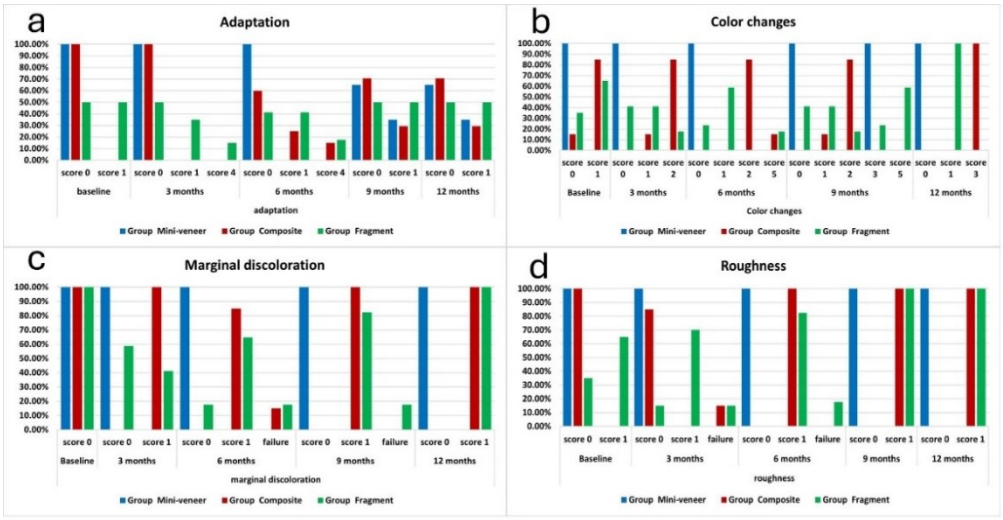

Figure 3: Bar charts showing adaptation, color changes, marginal discoloration, and roughness of all groups.

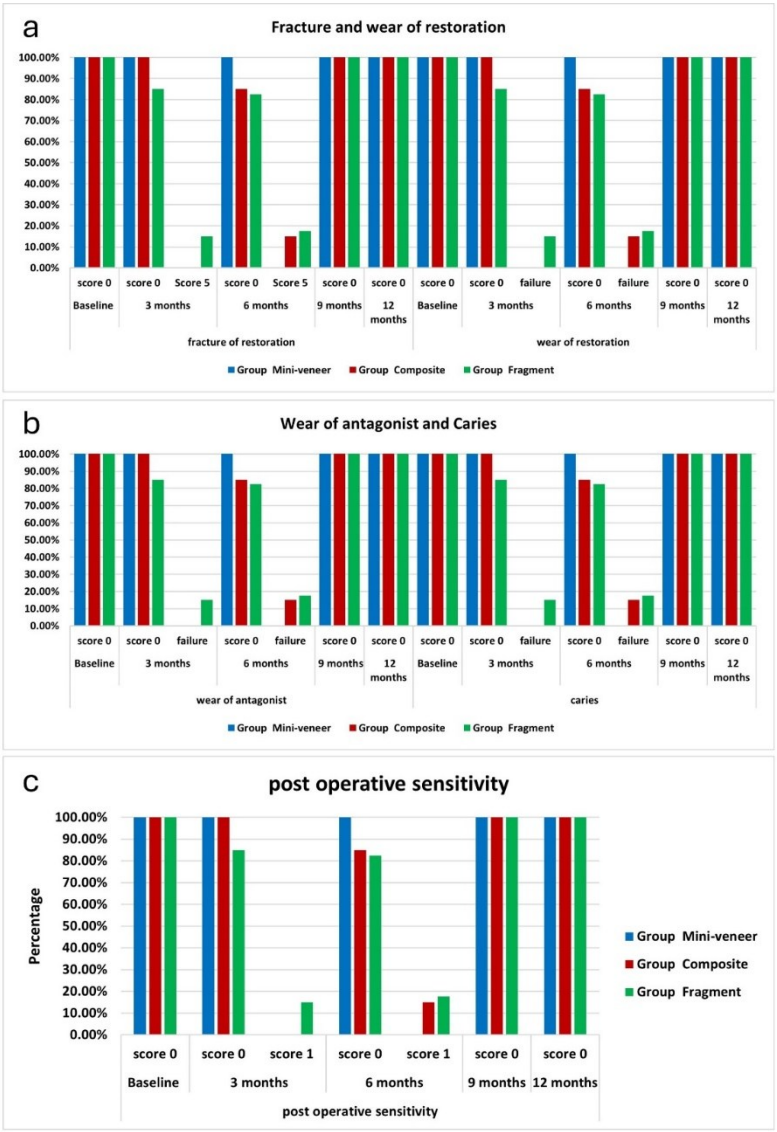

Figure 4: Bar charts representing fracture and wear pattern, wear of antagonist and caries, and post-operative sensitivity.

Discussion

Three techniques for restoring Ellis class II fractures in permanent central incisors of children were compared in the present clinical trial. The mini Veneers showed excellent stability, with a 100% success rate recorded throughout the 12-month follow-up. This result aligns with findings by Ojeda et al. (2023), who demonstrated that partial laminate veneers exhibit strong clinical performance and reliable long-term survival rates. The superior outcomes observed with mini veneers could be due to their structural strength, precise fit, and reliable adhesive bonding to enamel surfaces.

On the other hand, clinical success rates were observed to be reduced starting at the 6-month evaluation period of the composite restoration. These results correspond with the findings of previous studies indicating the moderate long-term reliability of composite restorations. A clinical study by Demarco et al. (2015) highlighted early failure patterns, emphasizing that composite restorations may be more susceptible to marginal degradation and discoloration, negatively impacting their durability.

Similarly, the fragment Reattachment group showed a reduced clinical success rate but an earlier stage starting at 3 months. The success rate continued to be reduced to about 82% at the 6-month evaluation which was a slightly lower rate than that found in the composite restoration. This observation is consistent with studies such as Macedo et al. (2008), which reported comparable failure rates for adhesive fragment reattachments, primarily attributed to adhesive bond limitations and stresses placed on the restoration interface. The results of the current study highlight the superiority of CAD/CAM mini veneers in clinical performance compared to composite restoration and fragment Reattachment.

The current findings partially align with those reported by Haupt et al. (2023), who observed that 50% of restorative failures in the reattachment group occurred within the first year post-treatment. However, for composite restorations 50% of failures were observed within 1.5 to 2 years, which differs from our results, where failures in the composite group were detected earlier—within the first 6 months. This indicates a possibly lower short-term survival rate in our composite group compared to their findings.

Moreover, Bissinger et al. (2021) reported a significantly higher restoration loss rate of approximately 40% for fragment reattachments. This supports our findings where the fragment group exhibited a 17.6% failure rate by 6 months, suggesting early vulnerability and a tendency toward reduced longevity compared to other restorative options.

The exceptional color stability of Mini Veneers, which retained a consistent shade distribution throughout the study, underscores their clear aesthetic benefits. The composite and fragment groups exhibited notable discoloration and darkening over time. The composite group transitioned from lighter shades (C1 and A3) at the start to darker shades (D3 and A3.5) by the 12-month mark, while the fragment group eventually shifted entirely to A3 shades.

On the other hand, the mini veneers showed no significant color change ($p=0.0001$) over the present study period. Recent research has examined the color stability of E-max veneers under several situations. E-max CAD veneers exhibited enhanced color stability relative to hybrid ceramics such as Vita Enamic following thermal cycling ***(El-Malah et al., 2019)***. Light-cure and dual-cure amine-free resin cements exhibited significant color stability with E-max CAD veneers over an 8-month ***(ElKomy et al., 2019) .***

The results of the adaptation and marginal discoloration in this study were consistent with the color changes where the mini veneers showed a superior follow up results compared to the other treatment methods. The initial perfect adaptation noticed by the E-max CAD veneers was maintained throughout the study period. However, composite restoration and fragment Reattachment showed a decline in the marginal adaptation over the first 6 months period.

The differences found in the marginal adaptation between the three methods can be related to the material characteristics and to the manufacturing methods. The digitalized method of producing the mini veneers guarantees an accurate fit that promotes the

adaptation of the veneer to the tooth surface which enhances the resistance to marginal discoloration. Moreover, the ceramics used in the fabrication of the crowns provide enhanced durability that aids in resisting the environmental conditions that might lead to discoloration ***(Dederichs et al., 2021).***

On the other hand, composites are more vulnerable to loss of marginal adaptation and to discoloration owing to the polymerization shrinkage and low wear resistance of the composites. Moreover, the fragment Reattachment treatment depends mainly on the nature and strength of the adhesive bonding of the fractured part. This potentially might lead to inferior adaptation and increased susceptibility to discoloration ***(Bissinger et al. 2021).***

The surface roughness revealed consistent results for the mini veneers, which kept a smooth surface for over 12 months. On the other hand, composite and fragment restorations showed a continuing increase in surface roughness. Moreover, the wear pattern observed in the antagonists of the mini veneers was negligible as opposed to the progressive wear pattern found in the composite and fragments. The difference in the surface roughness and wear patterns between the mini veneers and other groups might be attributed to the difference in the material properties. The results are consistent with many studies showing that the E max lithium disilicate glass ceramic veneers show high polishability and smooth surfaces ***(Dederichs et al., 2021).*** This material is fabricated and finished using milling techniques, resulting in a homogenous surface with insignificant surface irregularities. On the other hand, several previous research has shown that composite restorations are liable to increased surface roughness owing to the material`s composition and the low efficiency in the finishing process that results in difficulty in achieving a smooth surface ***(Demarco et al. 2015; Durán Ojeda et al. 2024).***

No fractures were recorded in the mini veneers in the current study over 12 months as opposed to a rate of 15% and 17.6 % in the Composite and fragment groups, respectively. These results are consistent with other studies showing that lithium disilicate glass ceramic has high flexural strength, enabling it to be used efficiently in the oral cavity to withstand functional forces ***(Lima et al., 2023; Shetty et al., 2023).*** Moreover, the biocompatibility results in the current study further supporting the advantageous use of the mini veneers to restore Ellis class II fractures. The lack of postoperative sensitivity and caries found with the use of the mini veneers is consistent with studies showing that the material properties and bonding techniques of lithium disilicate glass-ceramic contribute to a biologically compatible type of treatment ***(Demarco et al., 2015; Durán Ojeda et al., 2024).***

Conclusion:

Mini Veneer emerged as the most stable and reliable treatment across all parameters, with no failures, color changes, fractures, or significant wear throughout the study. Composite and Fragment groups demonstrated notable deterioration in color stability, marginal discoloration, and surface roughness, with higher failure rates by 6 months.

Conflict of Interest:

The authors declare no conflict of interest.

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

Ethics:

The MSA University Faculty of Dentistry's Ethics Committee approved the study protocol, which was assigned approval number NCT06299150

Data Availability:

Data will be available upon request

Clinical trial registration:

The trial was registered on (24/11/2024) at https://clinicaltrials.gov with the ID (NCT06299150).

CRediT statement:

Author 1: Writing - review & editing, Writing - original draft.

Author 2: Data curation, Conceptualization, Project administration, , Methodology.

Author 3: Methodology, Writing - original draft, Writing - review & editing.

Author 4: Investigation, Formal analysis, Data curation.

Author 5: Data curation, Conceptualization, Project administration, , Methodology

Author 6: Writing - review & editing, Writing - original draft.

References

Azami-Aghdash, S., F. Ebadifard Azar, F. Pournaghi Azar, A. Rezapour, M. Moradi-Joo, A. Moosavi, and S. Ghertasi Oskouei. (2015). 'Prevalence, etiology, and types of dental trauma in children and adolescents: systematic review and meta-analysis', Med J Islam Repub Iran, 29: 234.

Berlin-Broner, Yuli, Lina Al Bawaliz, and Liran Levin. (2023). 'Implications of Post-Traumatic Treatment of Immature Maxillary Incisors', International Dental Journal, 73: 337-45.

Bissinger, R., D. D. Müller, M. Reymus, Y. Khazaei, R. Hickel, K. Bücher, and J. Kühnisch. (2021). 'Treatment outcomes after uncomplicated and complicated crown fractures in permanent teeth', Clin Oral Investig, 25: 133-43.

Bjelopavlovic, Monika, Michael Weyhrauch, Christina Erbe, Franziska Burkard, Katja Petrowski, and Karl Martin Lehmann. (2021). 'Influencing Factors on Aesthetics: Highly Controlled Study Based on Eye Movement and the Forensic Aspects in Computer-Based Assessment of Visual Appeal in Upper Front Teeth', 11: 6797.

Blunck, U., S. Fischer, J. Hajtó, S. Frei, and R. Frankenberger. (2020). 'Ceramic laminate veneers: effect of preparation design and ceramic thickness on fracture resistance and marginal quality in vitro', Clin Oral Investig, 24: 2745-54.

Bourguignon, C., N. Cohenca, E. Lauridsen, M. T. Flores, A. C. O'Connell, P. F. Day, G. Tsilingaridis, P. V. Abbott, A. F. Fouad, L. Hicks, J. O. Andreasen, Z. C. Cehreli, S. Harlamb, B. Kahler, A. Oginni, M. Semper, and L. Levin. (2020). 'International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations', Dent Traumatol, 36: 314-30.

Choudhary, A., R. Garg, A. Bhalla, and R. K. Khatri. (2015). 'Tooth fragment reattachment: An esthetic, biological restoration', J Nat Sci Biol Med, 6: 205-7.

Day, Peter F., Marie Therese Flores, Anne C. O'Connell, Paul V. Abbott, Georgios Tsilingaridis, Ashraf F. Fouad, Nestor Cohenca, Eva Lauridsen, Cecilia Bourguignon, Lamar Hicks, Jens Ove Andreasen, Zafer C. Cehreli, Stephen Harlamb, Bill Kahler, Adeleke Oginni, Marc Semper, and Liran Levin. (2020). 'International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 3. Injuries in the primary dentition', Dent Traumatol, 36: 343-59.

Dederichs, M., Fahmy, M. D., An, H., Guentsch, A., Viebranz, S., & Kuepper, H. (2021). 'Comparison of Wear Resistance of Prefabricated Composite Veneers Versus Ceramic and Enamel', Journal of Prosthodontics, 30(8): 711–19.

Demarco, F. F., M. B. Corrêa, M. S. Cenci, R. R. Moraes, and N. J. M. Opdam. (2015). 'Longevity of posterior composite restorations: not only a matter of materials', Dent Mater, 31: 87-101.

Dietschi, Didier, Cyrus Shahidi, and Ivo Krejci. (2019). 'Clinical performance of direct anterior composite restorations: a systematic literature review and critical appraisal', The International Journal of Esthetic Dentistry, 14(3): 252-70.

Elkomy, M., El-guindy, J., & Taymour, M. (2019). 'Color stability of emax CAD laminate Veneers cemented with light cure versus dual cure amine free adhesive resin cement (Randomized Controlled Clinical Trial)', Egyptian Dental Journal, 65(2): 1469-75.

El-Malah, E. Abd El-Aziz, S, and Hassan, Suad. (2019). 'Evaluation of Marginal Accuracy and Color Stability of Lithium Disilicate Laminate Veneer Compared to Hybrid Ceramic Veneer', Al-Azhar Journal of Dentistry, 6(3).

Garcia, F. C. P., D. L. N. Poubel, J. C. F. Almeida, I. P. Toledo, W. R. Poi, E. N. S. Guerra, and Lvml Rezende. (2018). 'Tooth

fragment reattachment techniques-A systematic review', Dent Traumatol, 34: 135-43.

Gresnigt, Marco M. M., Mari M. Sugii, Karin B. F. W. Johanns, and Stephan A. M. van der Made. (2021). 'Comparison of conventional ceramic laminate veneers, partial laminate veneers and direct composite resin restorations in fracture strength after aging', Journal of the Mechanical Behavior of Biomedical Materials, 114: 104172.

Haupt, Franziska, Christopher Meyerdiercks, Philipp Kanzow, and Annette Wiegand. (2023). 'Survival analysis of fragment reattachments and direct composite restorations in permanent teeth after dental traumatic injuries', 39: 49-56.

Hoeppner, Márcio Grama, Fabio Martins Salomão, Flávia Emi Nakashima, Flávia Barroso Castelani, Lucas Fernando de Oliveira Tomaz Ferraresso, Amanda Vessoni Barbosa Kasuya, and João Felipe Besegato. (2022). 'Direct Resin Composite Restoration in Anterior Tooth: 10 Years of Clinical Follow-Up', International Journal of Odontostomatology, 16: 525-31.

Jose, Jerry, Ajitha P, and Haripriya Subbaiyan. (2020). 'Different Treatment Modalities followed by Dental Practitioners for Ellis Class 2 Fracture – A Questionnaire-based Survey', Open Dent J, 14: 59-65.

Lima, K. D. C., Vivanco, R. G., Rodrigues, P. R. B., Caetano, A. L. P., & Pires-de-Souza, F. C. P. (2023). 'Long-term effect of firing protocols on surface roughness and flexural strength of lithium disilicate glass-ceramic', Brazilian Dental Journal, 34(5): 79–86.

Macedo, G. V., P. I. Diaz, C. A. de O Fernandes, and A. V. Ritter. (2008). 'Reattachment of anterior teeth fragments: a conservative approach', J Esthet Restor Dent, 20: 5-18.

Mat Zainal, M. K., and D. Abdullah. (2021). 'Re-attachment of a Fractured Maxillary Central Incisor: A Case with Two Years Follow-up', Iran Endod J, 16: 131-36.

Murchison, D. F., F. J. Burke, and R. B. Worthington. (1999). 'Incisal edge reattachment: indications for use and clinical technique', Br Dent J, 186: 614-19.

Ojeda, G. D., L. Z. Naves, A. Oosterhaven, R. Kleinsman, A. Bäumer-König, G. Körner, M. Wendler, and M. Gresnigt. (2023). '8-year multicenter retrospective study on partial laminate veneers', J Prosthodont Res, 67: 206-13.

Ojeda, G.D., R. A. Bresser, M. Wendler, and M. M. M. Gresnigt. (2024). 'Ceramic partial laminate veneers in anterior teeth: A literature review', J Prosthodont Res, 68: 246-54.

Rathee, M., S. Divakar, P. Jain, S. Chahal, and S. Singh. (2023). 'Anterior esthetic rehabilitation with full and partial veneers using conventional and digital techniques: A case series', J Conserv Dent Endod, 26: 601-07.

Raut, A. A., and P. Fulzele. (2024). 'The Aesthetic Restoration of Anterior Tooth Fracture Using the Template Technique: A Case Report', Cureus, 16: e68758.

Sarapultseva, M., and A. Sarapultsev. (2019). 'Long-term results of crown fragment reattachment techniques for fractured anterior teeth: A retrospective case-control study', J Esthet Restor Dent, 31: 290-94.

Shetty, D., Shetty, G., & Shetty, N. (2023). 'Evaluation of the Influence of Acid Etching Technique on Surface Roughness and Fracture Strength of Heat-Pressed Lithium-disilicate Veneers', Journal of Health and Allied Sciences NU, 14(3): 380-85.

Soares, T. R., T. K. Fidalgo, A. S. Quirino, D. M. Ferreira, T. K. Chianca, P. A. Risso, and L. C. Maia. (2017). 'Is caries a risk factor for dental trauma? A systematic review and meta-analysis', Dent Traumatol, 33: 4-12.

Tinoco, J. V., Jurado, C. A., Sayed, M. E., Garcia Cortes, J. O., Kaleinikova, Z., Hernandez, A., Alshabib, A., & Tsujimoto, A. (2020). 'Conservative approach for management of fractured maxillary central incisors in young adults', Clinical Case Reports, 8(12): 2692–2700.

Yu, H., Y. Zhao, J. Li, T. Luo, J. Gao, H. Liu, W. Liu, F. Liu, K. Zhao, F. Liu, C. Ma, J. M. Setz, S. Liang, L. Fan, S. Gao, Z. Zhu, J. Shen, J. Wang, Z. Zhu, and X. Zhou. (2019). 'Minimal invasive microscopic tooth preparation in esthetic restoration: a specialist consensus', Int J Oral Sci, 11: 31.