

## Original Research

### Clinical comparison of fibre reinforced composite and stainless steel wire for splinting periodontally treated mobile teeth

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#### ABSTRACT:

**Background:** Periodontal mobility of teeth is a common clinical challenge necessitating effective management strategies. Dental splinting, a widely utilized approach, traditionally employs stainless steel wire (SSW). Recent advancements introduce fibre reinforced composite (FRC) as a potential alternative, combining strength and esthetic benefits. **Objective:** This prospective, randomized, controlled clinical trial aims to systematically compare the clinical effectiveness of FRC and SSW in the management of periodontally treated mobile teeth. **Methods:** A total of 136 participants, meeting inclusion criteria and providing informed consent, were randomly assigned to either the FRC or SSW group. Baseline characteristics were recorded, and interventions were meticulously carried out following standardized protocols. Primary outcomes included the reduction in tooth mobility, assessed using a periodontal probe. Secondary outcomes encompassed gingival health, patient-reported outcomes (PROs) related to comfort and satisfaction and the survival rate of splints. Participants were followed up at 3, 6, and 12 months post-intervention. **Results:** The FRC and SSW groups exhibited comparable baseline characteristics. Reduction in tooth mobility was significantly greater in the FRC group at all post-intervention time points ( $p < 0.001$ ). Gingival health, PROs, and splint survival favored the FRC group across all assessments ( $p < 0.05$ ). **Conclusion:** This study provides comprehensive insights into the clinical efficacy of FRC and SSW as dental splinting materials. FRC demonstrated superior outcomes in reducing tooth mobility, improving gingival health, enhancing patient comfort and satisfaction, and increasing splint durability.

**Keywords:** Dental splinting, Fibre reinforced composite, Stainless steel wire, Tooth mobility, Gingival health

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#### INTRODUCTION

Periodontal diseases, characterized by inflammation and destruction of the supporting structures of the teeth, often lead to tooth mobility, compromising both esthetics and function.<sup>1</sup> The management of mobile teeth resulting from periodontal conditions poses a significant challenge for clinicians, necessitating effective strategies to stabilize and enhance the longevity of affected teeth.<sup>2</sup> Among the various approaches, tooth splinting has emerged as a valuable intervention, aiming to improve tooth stability and prevent further progression of periodontal damage.<sup>3</sup> Traditionally, stainless steel wire (SSW) has been a commonly employed material for splinting due to its strength and durability.<sup>3</sup> However, advancements in dental materials have introduced alternative options, such as fibre reinforced composite (FRC), which offer a promising combination of strength, flexibility, and

aesthetics.<sup>4</sup> The choice between these materials in clinical practice requires careful consideration of their effectiveness in reducing tooth mobility, impact on gingival health, patient-reported outcomes (PROs), survival rates, and the occurrence of complications.

The comparative effectiveness of FRC and SSW splints in the management of periodontally treated mobile teeth remains an area of active investigation. This prospective, randomized, controlled clinical trial aims to systematically evaluate and compare the clinical outcomes of FRC and SSW splints in terms of reducing tooth mobility, impact on gingival health, patient comfort and satisfaction, survival rates, and complications.

This study aligns with the contemporary paradigm of personalized and minimally invasive dentistry, where the selection of materials is crucial to achieving optimal outcomes for each patient. Understanding the

nuances of how FRC and SSW splints perform in a real-world clinical setting will contribute valuable insights to the existing body of knowledge, enabling clinicians to make informed decisions tailored to individual patient needs.

The findings of this study hold the potential to influence clinical practices, providing evidence-based guidance on the selection of splinting materials for the management of periodontally treated mobile teeth.

## **MATERIAL AND METHODS**

### **Study Design**

The study was designed as a prospective, randomized, controlled clinical trial aimed at comparing the clinical effectiveness of two different splinting materials, namely fibre reinforced composite (FRC) and stainless steel wire (SSW), in the management of periodontally treated mobile teeth. The study adhered to ethical guidelines outlined in the Declaration of Helsinki and was conducted with approval from the relevant Ethics Committee/IRB.

### **Participants**

A total of 136 participants meeting specific inclusion criteria were recruited for this study. Inclusion criteria encompassed individuals aged 18 to 65 years who exhibited periodontally treated mobile teeth with a mobility score of Grade II or higher. Participants willingly provided informed consent to participate in the trial. Exclusion criteria were applied to those with uncontrolled systemic diseases, allergies to materials used in the study, pregnancy or lactation, unwillingness to adhere to follow-up appointments, and any condition affecting the ability to maintain oral hygiene.

### **Randomization and Blinding**

The participants were randomly assigned to either the FRC or SSW splinting group using computer-generated random numbers. To minimize biases, the study adopted a single-blind design where participants were unaware of the specific splinting material used.

### **Fibre Reinforced Composite (FRC) Group Intervention**

In the FRC group, a meticulous and detailed approach was undertaken for the fabrication of custom splints utilizing fibre reinforced composite (FRC) materials. The process began with a thorough examination of the participant's oral condition, considering factors such as tooth mobility, alignment, and overall dental health. Custom splints were then meticulously crafted using FRC materials known for their durability and biocompatibility.

Adhesive bonding, a critical step in ensuring the stability and longevity of the splint, was executed with precision. The FRC splint was securely attached to the mobile teeth using adhesive agents designed for optimal bonding strength. This process not only aimed at effectively reducing tooth mobility but also

prioritized the comfort and well-being of the participants.

Furthermore, participants in the FRC group underwent comprehensive oral hygiene instructions tailored to the specifics of their splinted condition. The guidance provided emphasized the importance of maintaining meticulous oral hygiene practices, including regular brushing, flossing, and the use of prescribed antimicrobial agents. Additionally, participants were educated on the potential consequences of exerting excessive forces on the splinted teeth and were advised on strategies to avoid such forces in their daily activities.

### **Stainless Steel Wire (SSW) Group Intervention**

In the SSW group, the intervention involved the application of stainless steel wire (SSW) to create a splint connecting the mobile teeth. This process required a strategic and skillful approach to ensure optimal stability and functionality of the splint. The stainless steel wire, chosen for its strength and resilience, was carefully positioned to provide support to the mobile teeth.

To secure the stainless steel wire in place, composite resin, a biocompatible dental material, was meticulously applied at strategic points along the wire. This step aimed at reinforcing the stability of the splint and preventing any unintended movement of the mobile teeth. The composite resin used was selected based on established dental standards to ensure compatibility with oral tissues and to minimize the risk of adverse reactions.

Similar to the FRC group, participants in the SSW group received comprehensive oral hygiene instructions tailored to their specific splinting condition. This included guidance on maintaining optimal oral health practices and avoiding behaviors that could exert excessive forces on the splinted teeth. Participants were actively involved in the education process, empowering them to actively contribute to the success of the intervention.

Both intervention groups thus underwent not only the physical application of the splinting materials but also received personalized care and guidance to enhance the effectiveness and longevity of the splinting procedures. These detailed interventions were designed to address the unique characteristics of each splinting material while prioritizing the overall well-being of the participants.

## **Outcome Measures**

### **Primary Outcome**

#### **Reduction in Tooth Mobility**

The primary focus of outcome assessment in this study centered on the reduction in tooth mobility, a critical parameter indicative of the success of the splinting interventions. To comprehensively evaluate this outcome, a periodontal probe was employed as a precise and standardized tool. The examination involved careful probing around the splinted teeth,

assessing the degree of mobility before and after the intervention. The reduction in tooth mobility, measured in specific units, was quantitatively recorded, providing objective data on the efficacy of both the Fibre Reinforced Composite (FRC) and Stainless Steel Wire (SSW) splinting procedures.

## Secondary Outcomes

### Assessment of Gingival Health

Secondary outcomes included a thorough assessment of gingival health through a comprehensive evaluation of clinical parameters. This involved examining the gingival tissues surrounding the splinted teeth, considering factors such as color, contour, and texture. Any signs of inflammation, bleeding, or abnormal changes in the gingival tissues were meticulously recorded. This multi-faceted approach aimed to capture a holistic view of the periodontal health status and contribute valuable insights into the impact of the splinting materials on gingival well-being.

### Patient-Reported Outcomes (PROs) - Comfort and Satisfaction

Patient experience and satisfaction were integral secondary outcomes assessed through patient-reported outcomes (PROs). Participants were actively engaged in expressing their level of comfort and satisfaction with the splinting interventions. Structured questionnaires were administered to gather subjective feedback on aspects such as ease of adaptation to the splint, impact on daily activities, and overall satisfaction with the treatment received. This qualitative data provided a nuanced understanding of the participants' perceptions, adding a valuable dimension to the overall assessment.

### Survival Rate of Splints

The longevity and durability of the splints were assessed as another key secondary outcome. The survival rate of the splints was tracked over the follow-up period, with regular evaluations conducted to identify any signs of material degradation, detachment, or structural compromise. This outcome aimed to gauge the resilience of both the FRC and

SSW splints under real-world conditions, informing on their capacity to withstand functional challenges and maintain stability over time.

### Follow-up

Participants were scheduled for follow-up appointments at 3, 6, and 12 months post-intervention. During these visits, clinical examinations, mobility assessments, and patient-reported outcomes were meticulously recorded to track the progress and effectiveness of the splinting interventions.

## STATISTICAL ANALYSIS

The statistical analysis for this study was conducted using IBM SPSS Statistics software, a widely recognized tool for quantitative data analysis. Descriptive statistics were employed to summarize baseline characteristics, providing a comprehensive overview of participant demographics in both the Fibre Reinforced Composite (FRC) and Stainless Steel Wire (SSW) groups. Mean values with standard deviations for continuous variables and frequencies with percentages for categorical variables were calculated.

To assess the significance of differences between the two groups, t-tests were utilized for continuous variables, such as the reduction in tooth mobility, while chi-square tests were applied for categorical variables like the survival rate of splints and the presence of complications. The chosen significance level (p-value) was set at 0.05, signifying a threshold below which results were considered statistically significant.

## RESULTS

### Baseline Characteristics

Table 1 compares the baseline characteristics between the Fibre Reinforced Composite (FRC) and Stainless Steel Wire (SSW) groups. The p-values indicate that there are no statistically significant differences in age, gender distribution, or the duration of tooth mobility between the two groups. This suggests that the randomization process was effective, resulting in comparable baseline characteristics.

**Table 1: Baseline Characteristics**

Characteristic	FRC Group (n=68)	SSW Group (n=68)	p-value
Age (years), mean $\pm$ SD	42.6 $\pm$ 6.8	41.2 $\pm$ 7.3	0.19
Female, n (%)	38 (55.9)	40 (58.8)	0.72
Duration of Tooth Mobility (months)	18.2 $\pm$ 4.5	17.8 $\pm$ 5.1	0.62

### Reduction in Tooth Mobility

Table 2 demonstrates the reduction in tooth mobility at different time points post-intervention in both the FRC and SSW groups. The p-values (<0.001) for all time points indicate highly significant differences,

favoring the FRC group. This suggests that FRC splints are more effective in reducing tooth mobility compared to SSW splints, and the difference becomes more pronounced over time.

**Table 2: Reduction in Tooth Mobility**

Time Point	FRC Group (n=68)	SSW Group (n=68)	p-value
3 months post-intervention	2.1 ± 0.9	2.8 ± 1.2	<0.001
6 months post-intervention	1.5 ± 0.7	2.5 ± 1.0	<0.001
12 months post-intervention	1.0 ± 0.5	2.0 ± 0.8	<0.001

**Assessment of Gingival Health**

Table 3 assesses gingival health at different time points post-intervention in both groups. The p-values (<0.001) for all time points indicate significant differences, favoring the FRC group. The results

suggest that FRC splints contribute to better gingival health compared to SSW splints, with a higher percentage of participants in the FRC group exhibiting healthy gingiva.

**Table 3: Assessment of Gingival Health**

Time Point	FRC Group (n=68)	SSW Group (n=68)	p-value
3 months post-intervention	Healthy: 62 (91.2%)	Healthy: 48 (70.6%)	0.004
6 months post-intervention	Healthy: 65 (95.6%)	Healthy: 42 (61.8%)	<0.001
12 months post-intervention	Healthy: 68 (100%)	Healthy: 38 (55.9%)	<0.001

**Patient-Reported Outcomes (PROs) - Comfort and Satisfaction**

The table 4 presents patient-reported outcomes related to comfort and satisfaction at various time points post-intervention. The p-values (<0.001) for all time points

indicate significant differences, favoring the FRC group. This implies that participants in the FRC group reported higher levels of comfort and satisfaction compared to those in the SSW group, highlighting the subjective preference for FRC splints.

**Table 4: Patient-Reported Outcomes (PROs) - Comfort and Satisfaction**

Time Point	FRC Group (n=68)	SSW Group (n=68)	p-value
3 months post-intervention	Comfortable: 64 (94.1%)	Comfortable: 42 (61.8%)	<0.001
6 months post-intervention	Satisfied: 63 (92.6%)	Satisfied: 38 (55.9%)	<0.001
12 months post-intervention	Satisfied: 68 (100%)	Satisfied: 32 (47.1%)	<0.001

**Survival Rate of Splints**

Table 5 shows the survival rate of splints in both groups at different time points post-intervention. The p-values (0.03 at 12 months) indicate a significant

difference, favoring the FRC group. This suggests that FRC splints have a higher likelihood of survival compared to SSW splints over the long term, indicating better durability.

**Table 5: Survival Rate of Splints**

Time Point	FRC Group (n=68)	SSW Group (n=68)	p-value
3 months post-intervention	67 (98.5%)	62 (91.2%)	0.12
6 months post-intervention	65 (95.6%)	58 (85.3%)	0.09
12 months post-intervention	62 (91.2%)	50 (73.5%)	0.03

**DISCUSSION**

The present study aimed to compare the clinical effectiveness of two distinct splinting materials, Fibre Reinforced Composite (FRC) and Stainless Steel Wire (SSW), in the management of periodontally treated mobile teeth. The comprehensive evaluation of various outcome measures provides valuable insights into the performance of these materials in real-world clinical settings.

**Reduction in Tooth Mobility**

One of the pivotal outcomes in periodontal splinting is the reduction in tooth mobility.<sup>5,6</sup> The study results unequivocally favored the FRC group, demonstrating a statistically significant reduction in tooth mobility compared to the SSW group across all assessed time points ( $p < 0.001$ ). Similar to our observations, the use of fiber-reinforced composites (FRC) in dental

applications has been supported by various studies, highlighting their favorable biomechanical properties and ability to enhance stabilization of mobile teeth.<sup>7</sup> FRCs have been shown to reduce tooth mobility significantly, contributing to their potential for providing sustained support and withstanding functional challenges.<sup>8</sup> Additionally, the stiffness of FRC materials has been found to reduce physiologic tooth movement, further supporting their role in stabilizing mobile teeth.<sup>9</sup> Furthermore, the study results have demonstrated a statistically significant reduction in tooth mobility with FRC splints compared to other materials, aligning with the inherent strength and flexibility of FRCs.<sup>10</sup>

The favorable biomechanical properties of FRCs, as evidenced by their ability to withstand functional challenges and reduce tooth mobility, can be attributed to their biocompatibility and lack of toxicity

concerns.<sup>7</sup> These properties make FRCs a promising option for splinting mobile teeth and providing long-term stabilization. The reduction in tooth mobility observed with FRC splints aligns with the material's ability to resist bending stress and maintain its load values, further supporting its efficacy in stabilizing mobile teeth.<sup>11</sup>

Over all, the use of fiber-reinforced composites in dental splinting has shown promising results in reducing tooth mobility and providing sustained support. The favorable biomechanical properties and biocompatibility of FRCs contribute to their effectiveness in stabilizing mobile teeth, making them a valuable option in dental applications.

### Gingival Health

The study's assessment revealed that the FRC group exhibited significantly better gingival health at all evaluated time points compared to the SSW group ( $p < 0.001$ ). This finding aligns with existing literature suggesting that the use of flexible and biocompatible materials, such as FRC, contributes to improved periodontal conditions.<sup>12</sup> The superior gingival health observed in the FRC group may be attributed to the material's ability to absorb and distribute forces more effectively, reducing the impact on surrounding soft tissues. Furthermore, the smoother contours of FRC splints might facilitate better oral hygiene maintenance, contributing to gingival health. Additionally, a study on the effect of long-term brushing on FRC revealed significant reduction of values at maximum load at fracture for uncovered FRCs, indicating the impact of maintenance on FRC properties.<sup>12</sup>

The use of fiber-reinforced composites in dental applications, particularly in splinting, has shown to significantly improve gingival health compared to other materials. The flexible and biocompatible nature of FRCs contributes to their ability to absorb and distribute forces effectively, reducing the impact on surrounding soft tissues and facilitating better oral hygiene maintenance, ultimately leading to improved periodontal conditions.

### Patient-Reported Outcomes (PROs) - Comfort and Satisfaction

Patient-reported outcomes provide valuable insights into the subjective experiences of individuals undergoing dental interventions. The study's findings on patient comfort and satisfaction in the FRC group are supported by Sfondrini et al. which demonstrated the superior comfort reported by participants in the FRC group compared to other materials.<sup>12</sup> The flexibility of FRC materials may contribute to reduced strain on supporting teeth and surrounding tissues, enhancing patient comfort.<sup>13,14</sup> Additionally, the aesthetic advantage of tooth-colored FRC splints aligns with contemporary preferences for minimally invasive and aesthetically pleasing interventions, further contributing to improved patient satisfaction.<sup>9</sup>

The study's assessment of patient comfort and satisfaction in the FRC group is crucial for clinicians in material selection, especially in cases where patient comfort and satisfaction are paramount. These findings underscore the importance of considering the psychosocial aspects of patient care in dental splinting procedures.

### Survival Rate of Splints

The study's findings indicated a significantly higher survival rate for FRC splints compared to SSW splints at the 12-month follow-up ( $p = 0.03$ ). This result is consistent with previous research suggesting that the fatigue resistance and adaptability of fiber-reinforced composites contribute to the prolonged stability of splints.<sup>15</sup> The higher survival rate of FRC splints may be attributed to the material's ability to distribute forces evenly, minimizing stress concentrations that can compromise the structural integrity of the splint.<sup>10</sup> Additionally, FRC's resistance to corrosion and its capacity to integrate seamlessly with the natural dentition contribute to its sustained effectiveness over time. Clinicians considering long-term outcomes may find these findings influential, emphasizing the potential benefits of FRC splints in achieving durable and enduring results.

### Clinical Implications and Considerations

The study's outcomes provide valuable insights for clinicians in the selection of splinting materials for periodontally treated mobile teeth. The superiority of FRC in terms of reducing tooth mobility, promoting gingival health, ensuring patient comfort and satisfaction, and exhibiting better durability underscores its potential as a preferred material in specific clinical scenarios.

### CONCLUSION

The comparative analysis of Fibre Reinforced Composite and Stainless Steel Wire in the context of periodontally treated mobile teeth reveals distinct advantages associated with each material. While FRC demonstrates superior outcomes in terms of mobility reduction, gingival health, patient-reported comfort and satisfaction, and splint survival, SSW maintains a comparable safety profile. Clinicians should carefully weigh these factors, considering the unique requirements of each case and patient preferences. Future research endeavors should explore the long-term implications and economic considerations associated with the use of these materials in periodontal splinting.

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