



A Comparative Study of Temporary Splints: Bonded Polyethylene Fiber Reinforcement Ribbon and Stainless Steel Wire + Composite Resin Splint in the Treatment of Chronic Periodontitis

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ABSTRACT

The present clinical study was undertaken to determine the effects of splinting overunsplinted mobile teeth following periodontal surgery and compared the efficacy of two splinting materials, i.e. Ribbond ribbon + Composite with Stainless steel wire + Composite.

Materials and methods: Total of 30 patients (20 experimental and 10 control) formed the study group. Entire study was extended over a period of 12 weeks for each patient and treatment plan was divided into 8 phases. Healing response was monitored and application, durability, biocompatibility of splint material was assessed.

Results: Splint had a promising and beneficial effects on anterior teeth exhibiting Grade I to Grade II degrees of mobility. Experimental group showed a greater reduction in tooth mobility compared to control group. There was no significant difference in plaque index and Ribbond Ribbon reinforced with composite resin was an excellent material for application, patient comfort, resistance to fracture, biocompatible and esthetic acceptability.

Clinical significance: Splinting is recommended as an adjunct to periodontal surgery in the treatment of hypermobile teeth, especially in cases where patient discomfort is a prominent factor.

Keywords: Splinting, Stainless steel wire, Composite, Ribbond ribbon fiber.

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INTRODUCTION

The goal of dentistry is to obtain a healthy, functional and stable dentition within the patient desires, capabilities and health status.

Tooth mobility is one of the unwanted effects of periodontal disease. It is the movement of a tooth in a horizontal or vertical plane of space. All teeth have some degree of mobility. Increased tooth mobility may be caused by a variety of factors, which may be intrinsic or extrinsic.¹

Mobility is a sign of disease, not a disease entity that requires treatment. It is a sign of morphologic change.²

As 'Devan' has said, Our objective should be the perpetual preservation of what remains of the patient's masticatory apparatus rather than a meticulous restoration of what is missing.

The greatest challenge that mobile teeth present to the diagnostician is to make a decision as to their retention or extraction.

In addition to the treatment modalities for mobility (i.e. scaling and root planning, subgingival curettage, occlusal correction, pocket elimination procedures, etc.) splinting is one of the treatments. Tooth splinting continues to be a topic of controversy. It remains one of the most poorly understood and controversial areas of dental therapy.

A 'splint' is a device for supporting weakened tissues. Periodontal splints have been defined in a variety of styles. It is defined as a rigid or flexible device that maintains in position a displaced or movable part; also used to keep in place and protect an injured part.

A splint does not make loose teeth tight. Only the removal of disease and subsequent healing can achieve a real reduction in tooth mobility.³

It is imperative that occlusal stability and control of excessive occlusal forces be obtained first before splinting is attempted.⁴

The spectrum of available methods includes: Fixed, removable, combination, intracoronal and extracoronal devices, bonding with acrylic resins, wires, bands, plastics, composites, kits of prefabricated materials like fiber glass strands or polyaramid fibers that are buried in composite resin are available.

The latest member to enter in splinting material is the modification of polyethylene material through gas-plasma treatment – Ribbond. The high molecular weight fiber produced by this gas-plasma treatment is a lenowoven material that intimately reacts with composite resin, rather than being merely embedded in the resin. They are tough and durable and patented cross-link lock stitch lenoweave, which contributes to the strength and fracture toughness.⁵

As ‘Delabarre’ pointed out in 1819, It is much easier to extract a tooth than to determine whether it (extraction) is absolutely necessary.⁶

One very important clinical outcome of splinting is that stabilization of mobile teeth can restore the patient’s psychological and physical well-being—a patient who is afraid to eat properly with loose teeth will start eating once the teeth are stabilized.

AIMS AND OBJECTIVES

This study was undertaken to:

- (a) Determine the effect of splinting of mobile anterior teeth overunsplinted mobile anterior teeth following periodontal therapy, with respect to parameters like **Tooth mobility**. (b) Determine the effect of external splint placement on oral hygiene maintenance assessed by **Plaque index**.
- To evaluate the advantage between Ribbond Ribbon and Stainless Steel Wire which are reinforced in light cure composite resin as a temporary splint, with respect to the following criteria:
 - Durability and resistance to fracture
 - Esthetic appearance
 - Improvement of masticatory comfort
 - Economical and practical feasibility

MATERIALS AND METHODS

A total of 30 chronic periodontitis patients were selected for the study with one of the clinical sign being Grade I to Grade II mobility of upper or/and lower anterior teeth. The patients were divided into two broad groups:

Group I—control group (without splinting)

Group II—experimental group

Group A: Stainless steel wire + composite splint

Group B: Ribbond ribbon + composite splint.

CRITERIA FOR SELECTION OF PATIENTS

Only those patients who met the following criteria were included in the sample:

- Cases of chronic periodontitis
- Mobility of anterior teeth (upper or lower) with at least two teeth having a mobility greater than 1° (modified miller index)
- An occlusion that could be adjusted to be mutually protective to the opposing arch
- Vital teeth without endodontic lesions
- No malalignments or cross-bites
- No prior periodontal surgery, orthodontic correction or prosthetic replacement
- No history or obvious signs of parafunctional activity
- No known systemic illness
- Suitable candidates for periodontal surgery
- Periodontal defects amenable to correction
- Willingness and ability to visit the hospital for periodic follow-up.

These patients were randomly allotted to control and experimental groups. Cases were screened carefully, selecting only willing patients. A written, informed consent was obtained from every patient after explaining the experimental nature and purpose of the study.

ARMAMENTARIUM

Gloves, mask, mouth mirror, Williams calibrated probe, tweezers, cotton rolls, scissors, cheek retractor, plastic instrument, acid etchant, adhesive bond, light cure composite, curing light, wire cutter, plier, ribbond ribbon and 26-gauge wire (Figs 1 and 2).

PROCEDURE

The entire study spanned over a period of 12 weeks for each patient. The treatment plan for every patient was divided into 8 phases as shown in Table 1.

Clinical Parameters Assessed

- Tooth mobility index (Modified Miller Index, 1975).⁷ (Fig. 3).
- Plaque Index (Silness and Loe, 1964)⁸ and
- Subjective and objective criteria for splint assessment.

Subjective and Objective Criteria for Splint Assessment

The following were the criteria observed for evaluation of the splint:

- Fracture of the composite
- Esthetics
- Biocompatibility
- Patient comfort.



Fig. 4: Stainless steel wire + composite splint



Fig. 5: Ribbond ribbon + composite splint

with the hardened adhesive surface using a plastic filling instrument. Desired length of wire was adapted labially/lingually and polymerized with the light rod. The duration of exposure to the light was determined according to the manufacturer’s instructions. This process was continued till all the available surface area was covered.

- The occlusion was checked and any occlusal contact on the splint was eliminated. The patients were given instructions for meticulous oral hygiene and splint maintenance. The use of a Proxa Brush and antiseptic mouthwash were advised and recommended.⁹⁻¹⁵

Construction of Ribbond Ribbon + Composite Splint (Direct Technique) (Fig. 5)

- Measure the teeth and cut the length of ribbon
- Prepare lingual surfaces and labial interproximals of the teeth for bonding
- Apply composite in labial interproximals
- Prepare the ribbon for bonding
- Apply filled composite on the teeth
- Adapt ribbon to the teeth
- Shape and light cure the composite
- Add a smoothing layer of composite resin and light cure
- Occlusion was checked and any occlusal contact on the splint was eliminated.⁹⁻¹⁵

RESULTS

Group A: Stainless steel wire + composite splint

Group B: Ribbond ribbon + composite splint

A total of 180 anterior teeth were treated, 120 (80 mobile, 40 firm) in the experimental group and 60 (40 mobile, 20 firm) in the control group. In the experimental group, 20 splints (10 composite + stainless steel wire and 10 fiber reinforce composite) were fabricated at week -1 (16 lower

and 4 upper) involving 40 mobile and 20 firm abutment teeth (Table 2).

Number of patients enrolled	30 (10C + 20E)
Number of patients completed	30 (10C + 20E)
Males	17
Females	13
Age range (in years)	35 to 55
Average age (in years)	45

C: Control group; E: Experimental group

The statistical analysis contain mean, standard deviation (t-value) and standard error mean (p-value) for each parameter of the study (Table 3).

The results have been done under statistical package for social science (SPSS) Windows version 10.0 for statistical analysis.

Group	Phase	Tooth mobility mean value	Plaque index mean value
Control without splinting	-2	1.0830	1.0730
	-1	1.0490	0.6600
	8	0.7350	0.7000
	9	0.6690	0.7000
Group A Stainless steel wire + composite splint	-2	1.0910	1.0100
	-1	1.0910	0.5800
	8	0.5860	0.9800
	9	0.4660	0.8100
Group B Ribbond ribbon + composite splint	-2	1.1340	0.8900
	-1	1.1340	0.5300
	8	0.6080	0.8000
	9	0.5090	0.6300

OBSERVATIONS

Tooth Mobility

- The degree of mobility is decreased in both the groups (experimental and control) at the end of final phase,

though this decrease was pronounced in the experimental group. Not a single tooth in the experimental showed any residual mobility. In other words, there was a decrease in mobility in both groups.

- There was more reduction in tooth mobility of experimental group when compared to control group, i.e 28.47%.
- Whereas in experimental group more reduction of tooth mobility in 'Steel group' of 36.11% compared to 'Ribbond group' of 35.42%.

Plaque Index

- There was a remarkable fall in the Plaque index mean values in the experimental as well as control group from phase 2 (before oral prophylaxis) to phase 1 (after oral prophylaxis)
- The plaque index value for control group exhibited a slight increase at phase VIII (after flap surgery and splint removal) and phase IX (final data collection). Whereas steel group exhibited a remarkable increase in at phase VIII (after flap surgery and splint removal) and slight decrease at phase IX (final data collection)
- Ribbond group exhibited same increase as in steel group but not so severe. But, statistically there is no significance in Plaque scores between experimental and control group.

Splint Assessment

Nine partial fractures of the splint occurred on the lingual aspect in 'Steel group' at phase 3, 6 and 8. In Ribbond group only '2' fractures of the splint occurred at phase 3.

There were '14' instances of reversible discoloration of the composite resin in steel group. In Ribbond Group '13' instances of reversible discoloration of the composite resin occurred. But none of irreversible staining.

All 20 patients in the experimental group (10-Steel and 10-Ribbond) reported an improvement of masticatory comfort after placement of the splint.

'Steel' and 'Ribbond' splints have showed good compatibility with the gingival tissues and oral mucosa. No adverse reactions were seen.

DISCUSSION

In patients, selected for this study, however, the mobility of the teeth was attributable to local inflammatory causative factors only; the stringent criteria for selection excluded all other possible etiologic factors such as traumatic occlusion, inadequate root length, periapical pathosis, systemic disturbances, parafunctional habits, prosthetic replacements, orthodontic treatment or prior periodontal surgeries.

This clinically controlled study was undertaken to determine the effects of splinting overunsplinted mobile teeth following periodontal surgery and compared the efficacy of two splint materials, ribbond ribbon + composite and stainless steel wire + composite. The efficacy of these techniques as well as the advantages and limitations of these splint materials were evaluated.

For the purpose of systematic statistical analysis, only 'four phases' are taken into consideration in control and experimental groups. They are phase 2, phase 1, phase 8 and phase 9.

Effects of Splinting on the Various Parameters (Mobility and Plaque Index)

Though the present study did not evaluate splinted and unsplinted segments in the same patient, the experimental and control groups were well-matched, as reflected by the similar baseline levels of tooth mobility and oral hygiene status.

There was a greater reduction in mobility in the splinted group (37% Steel group and 35% Ribbond group] than in the unsplinted group (28%). Splinting reduced the mobility of teeth with an initial score of 1 ½ to 2° to about 1° at the end of the observation period. After removal of the splint, in spite of persistent mobility, no tooth had that high a residual mobility that entailed extraction of the tooth. Also, the splint had no apparent injurious effect on the firm abutment teeth.

Several workers have reported similar results with the use of splints. Schmid et al¹⁶ reported an average decrease of 51% in mobility of 183 mobile teeth splinted using polyester ligature and composite resin and evaluated clinically after 1 years.

Forsberg and Hagglund¹⁷ observed a slight decrease in postsurgical tooth mobility up to 90 days. Goldberg¹⁸ reported a 45 to 50% reduction in postsurgical mobility after 3 months, Lindhe and Nyman¹⁹ stated that tooth mobility remained unaltered or decreased slightly 1 year after surgical pocket elimination.

Recently, Forabosco and coworkers suggested that the therapy by means of splinting improved the prognosis of teeth affected by periodontal disease; occlusal trauma and dental mobility cause the aggravation of periodontal lesions.²⁰

In an *in vitro* study by Berthold and colleagues found that flexible or semirigid splints such as the titanium trauma splint and wire-composite splints are appropriate for splinting teeth with dislocation injuries and root fractures, whereas rigid splints such as wire-composite and the titanium ring splint can be used to treat alveolar process fractures.²¹

Another *in vitro* study compared five different splint systems [polyethylene fiber-reinforced splint (Ribbond THM, Ribbond Inc., Seattle, WA, USA), resin splint (RS), wire-composite splint (WCS), button-bracket splint (BS) and titanium trauma splint (TTS) and concluded that the highest flexibility are the TTS and the Ribbond THM as they exhibit a lower energy variation needed for splint deformation compared with the other materials that were examined.²²

In the present study, though there was a substantial decrease in the number of mobile teeth in the splinted group, the actual magnitude of the splint-induced reduction of tooth mobility was relatively small. This could possibly be explained by the fact that only 6 teeth were incorporated in most splints. Making the splints longer would probably have reduced tooth mobility further.

In view of all the above findings, this present study lends itself to the conclusion that splinting has a promising and beneficial effect on tooth mobility, and should be advocated as an adjunct in the treatment of hypermobile teeth, especially where patient discomfort is a prevailing factor.

Plaque Index

There is a higher degree of plaque control in the unsplinted teeth as compared to splinted teeth. But statistically, no difference between the groups.

Evaluation of the Splint Material and Splinting Technique

The clinical results of the present study with these splints, i.e. stainless steel wire + composite and ribbon ribbon + composite, that they were successful in immobilizing teeth, were durable in function, and were well-tolerated by the patients. But overall patient's acceptance and satisfaction was excellent in ribbon group. Initially, a few patients were aware of the slight bulk of material on the lingual surface, but adaptation to this was rapid.

In a study by Schmid et al¹⁶ reversible staining occurred in 35 of 39 splints made of polyester-ligature and composite resin.

Limitations of the Study and Future Scope

There were a few limitations of this study that warrant mention to enable a balanced insight into this experimental work, and to provide avenues for further research.

- The period of the present study was restricted to 15 weeks only
- There may have been a slight degree of biologic variability between the experimental and control sites

- The present study was limited to evaluation of periodontally diseased mobile anterior teeth only, due to the limitations of the material under study
- A radiographic evaluation was not done due to the shorter duration of the study.

SUMMARY AND CONCLUSION

The conclusions drawn from the present study within reasonable margins of safety are as follows:

- Splint had a promising and beneficial effects on anterior teeth exhibiting grade I to grade II degrees of mobility. The experimental group showed a greater reduction in the tooth mobility as compared to the control group. Thus, splinting is recommended as an adjunct to periodontal surgery in the treatment of hypermobile teeth, especially in cases where patient discomfort is a prominent factor
- There was no significant difference in the Plaque index between splinted and unsplinted teeth, though there was marginally greater plaque accumulation in the splinted group
- Ribbond ribbon reinforced composite resin was an excellent material for splinting with respect to patient comfort, durability, resistance to fracture, bio-compatibility and esthetic acceptability.

Recently, Wakabayashi et al suggested that fixed splinting can decrease the periodontal load on premolars with reduced periodontal support, but may increase the load on the splinted tooth.²³

Moserdale reviewed indications and techniques of splinting and concluded that when used correctly, periodontal splinting can greatly improve the comfort, prognosis and outcome for a patient with serious periodontal disease. But used incorrectly, splinting can cause further deterioration in periodontal health.²⁴

Thus, splinting when performed accurately has a promising and beneficial effect on anterior teeth exhibiting tooth mobility and patient discomfort. Hence, splinting is recommended as an adjunct to periodontal surgery in the treatment of hypermobile teeth.

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