The Assessment of Longevity and Efficacy of Different Types of Splints Used in Periodontal Therapy: A Single Center Epidemiological Retrospective Study

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Abstract

Splints are routinely used for occlusal force dissipation from the long axis of periodontally compromised teeth towards adjacent healthy teeth. This process causes forces generated from traumatic occlusion to be separated from underlying periodontium favouring regeneration of lost tissue. Splinting periodontally compromised teeth together causes the redistribution and redirection of functional and parafunctional forces to bring them within tolerance of the supporting tissue and to reduce mobility. However the common drawback of using splints include the lifespan of the splint without periodic modifications. The present study tries to relate the reduction of mobility in periodontitis cases from grade II to grade I using different splinting materials and the lifespan of the same. The present study was a single centered retrospective university based design, using patient records of Saveetha dental college, from 1st June 2019 till 1st March 2020 . The included patients were individuals with generalised/ localised chronic periodontitis, who had undergone non surgical periodontal therapy along with the use of provisional splints.The parameters assessed for two hundred and fifty eight patients included in the present study was longevity/lifespan of splints and the reduction in the degree of mobility. Our observations revealed that stainless steel wire composite splints were used 1.96 time more frequently than mesh reinforced composite splints, reduced grade II mobility to grade I mobility in teeth affected by periodontitis to a greater than composite resin wire mesh.($p<0.05$). Within the limits of this study splints were found to reduce mobility as an adjunct to periodontal therapy from grade II mobility to grade I mobility while using stainless steel wire composite resin splints among age groups of 20-40 years with a lifespan of 6 months 24% of the time .

Keywords- *attachment loss, composite resins, longevity, periodontitis, periodontal splints*

Introduction

Periodontal disease is of a chronic inflammatory nature characterized by gingival inflammation, loss of connective tissue attachment and destruction of alveolar bone. Progressive attachment loss around involved teeth eventually results in the increased mobility.[1,2] Increased tooth mobility adversely affects functions , aesthetics and patient comfort. Clinical management of such periodontally compromised teeth creates a dilemma in the operators hands to splint teeth or extraction followed by the use of dental prosthesis.

Periodontal literature suggests the prime reason for using splints includes primary or secondary trauma from occlusion, progressive mobility, migration or drifting due to periapical lesions.[3] Splinting is defined as the process of joining of two or more teeth into a rigid unit by

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means of a fixed or removable restorative device.[4] There are several types of splint and the choice of splint to be used depends upon the severity of mobility, the stage of treatment involved, and the anticipated outcomes. The types of splints can be broadly classified into removable-external, fixed- internal, cast metal resin bonded fixed partial dentures, combined splints with a fixed and removable component and endodontic splints. The materials commonly used include ligature wire, enamel bonded material like composite resin, welded bands, continuous clasps and night guards. [5] The objectives of splinting include the ability to provide occlusal rests, redirect occlusal forces, preserve the integrity of arch, stabilization of mobile teeth during surgery, prevent extrusion of unsupported teeth and most importantly to improve patient comfort around teeth. [6,7] Splinting is used routinely in both periodontal as well as restorative dentistry as a provisional means of managing mobility while simultaneously attempting to reduce its underlying cause.

Studies done by Clement Azodo showed an increase in the number of newly splinted cases in attempts of favouring regeneration for future periodontal and restorative dentistry using newer materials such as growth factors, plasma rich in growth factors, platelet rich fibrin and a future role of stem cells in regenerative therapy .[8–14]Considerable advances in the field of diagnosis of periodontal disease has also occurred adding a molecular biology as a factor to prior microbiological evidence alone.[15,16]Conventional research done on this topic usually involves case reports and case series justifying newer methods of splinting and aesthetic splints to retain teeth. [17,18] Periodontal literature has fewer clinical studies comparing different types of splints however studies assessing the longevity of splints justified their findings using a sample of 39 patients with 162 teeth and 57 patients with 227 teeth.[19,20] Considering the only source of comparison of clinical benefits from splints is not in the form of clinical trial with randomization it creates a large void in literature in terms of comparative benefits of different splints. The lack of such studies also creates difference in opinion in the usage of splints all together.

Thus the aim of this study was to compare two different modalities of splinting (stainless steel wire reinforced composite resin splints and composite resin mesh splints) and the clinical scenarios where they had maximal lifespan without modification and reduction of mobility compared to demographic data over a period of 6 months.

Methodology

The current study was performed as a single centered retrospective university based design, using patient records of Saveetha dental college and hospital in Chennai from 1st June 2019 till 1st March 2020. Data was screened by two blinded investigators, where inter-examiner agreement was reached prior to inclusion of individuals into the study. The segregation of data was initiated after ethical approval from Saveetha university scientific review board.The included patients were individuals with generalised/ localised chronic periodontitis (chronic periodontitis diagnosed as per criteria of Armitage classification of periodontal diseases 1999). These patients had undergone non surgical periodontal therapy followed by splinting.

Individuals excluded from this study were based on (i)pregnancy or lactating mothers(ii) patients currently smoking (iii) patients with uncontrolled systemic diseases (iv) Incomplete data collection in terms of radiographic /periodontal status or broken appointments (v)Aggressive periodontitis as per Armitage classification of periodontal diseases 1999.

A total of two hundred and fifty eight patients were categorized into two groups based on the use of stainless steel wire composite splints and the other using Composite resin reinforced splints.Among these patients 211 cases were treated using stainless steel wire composite resin mesh and 47 cases were treated using composite resin mesh splints.

Age groups of patients included were subdivided for analysis and interpretation into group A (21-40 years) and groups B (41-60 years). Similarly the longevity of the splints were assessed over a period of 6 months and individuals included were subdivided into subgroups based on lifespan of 1 month, lifespan of 3 months and lifespan of 6 months.

The parameters assessed in this study included longevity/lifespan of splints and reduction in grade of grade II to grade I mobility as per Miller`s tooth mobility

index on subsequent review appointments recorded in the clinicians notes.

Statistical Analysis

Statistical package for social sciences version 23, software from the University of Stanford (Norman H. Nie, C. Hadlai, Hull and Dale H) was used for all statistical analysis of the present study.Chi square test was used to assess statistical significance which was found to be significant while comparing the reduction in grade of tooth mobility using stainless steel wire composite resin splints ($p<0.05$).(graph 1)The association between type of splint used and lifespan of the splint was also found to be statistically significant.(graph 2)

Results & Discussion

In the present study we observed that a total of two hundred and fifty eight cases were reviewed. Among these subjects, 211 were treated using stainless steel wire composite splints while remaining 47 were treated with composite resin mesh splints. (Table 1, Graph 1) Stainless steel wire composite splints were used 1.96 times more frequently than mesh reinforced composite splints.(Table 2) A total of 63 cases among 211 stainless steel wire composite splints had a lifespan of 6 months while 21 among 47 composite resin reinforced mesh splints cases had a longevity of 6 months.(Table 1,Graph 1)There was reduction in the grade of mobility using stainless steel wire composite resin splints in 85 cases and 12 cases in composite mesh reinforced splints.(Table 1) In the remaining cases it was found that no reduction in the degree of mobility was seen in 126 out of 211 cases using stainless steel wire composite resin splints and 35 out of 47 composite resin reinforced composite resin mesh splints.(Table 1) Similarly longevity of the splint for upto 3 months was seen in 160 cases between the age groups of 20 to 40 years, while 66 cases had a survival rate of splints for upto 6 months between the age group of 41-60 years.(Table 1, Graph 2) Stainless steel wire composite splints reduced grade II mobility to grade I mobility in teeth affected by periodontitis to a greater extent as compared to composite resin wire mesh.($p<0.05$) (Table 1)

Observations obtained from the present study showed a higher tendency of reduction of grade II mobility to grade I mobility in periodontitis patients where stainless steel wire composite resin mesh over a period of 6 months.(Graph 1) It was also observed that Reduction of tooth mobility from Miller`s grade II mobility to grade I mobility was seen 1.578 times more frequently after using splints.(Table 2) Similar findings were seen by Forsberg and Hagglund in 1958, where reduced mobility was seen after splinting upto 90 days using stainless steel wire composite resin splints.[21]

Goldberg on the other hand performed measurements on 10 patients using modified muhlemann periodontometer (custom instrument patented by Dr. Goldberg) to assess mobility after scaling and root planing. His results revealed 25% decreased mobility immediately after scaling and root planing, while there was a decrease of 40-50% within 3 months, 50% within 6 months of occlusal adjustments.[22] Rateitschak et al suggested that additional incorporation of splints or orthodontic appliances increased mobility in the first month followed by a gradual decrease after 2-3 years.[23]

Studies comparing splint materials and thickness on tooth mobility have shown significantly less tooth mobility with direct composite splints and no difference between stainless steel wire composite splints and nylon based splints.[24,25] A possible explanation for these findings obtained could be due to custom manipulation of stainless steel wire along buccal contour of teeth while composite resin mesh splints on the other hand may set without appropriate adaptation to tooth surface leaving voids conventionally filled with flowable composite resin acting as a weak link in splints. A consensus based on available literature can be summarised as splinting done provisionally while treating the underlying periodontal cause for tooth mobility. The available literature also suggests stainless steel wire composite resin splints reduce mobility to a greater extent than composite resin mesh splints but is used less frequently due to unaesthetic appearance. A similar explanation was given by Lindhe and Nyman in 1975 stating tooth mobility with splints remained unaltered or slightly reduced only after periodontal therapy was done for periodontal pockets.[26,27]However since the advent of subperiosteal implants in comprehensive treatment plans,the use of splints have been questioned as an unnecessary additional load on periodontally compromised teeth abutment teeth.[28] Splints and removable prosthesis are kept as a last alternative in case of proximity to vital structures

such as arteries and nerves aside from aesthetics.[29,30]

Splinting does not completely eliminate occlusal stress , functional stimuli exerted in the long axis of the teeth supply functional stimulation.[31] The function of a splint is to distribute and redirect functional and parafunctional forces to bring them within tolerance of the supporting tissue and to reduce mobility.[5]

Limitations of the present study include lack of correlation of the severity of periodontitis and extent of bone regeneration resulting in reduction of mobility in periodontitis patients from grade II to grade I. No biomarkers were used to assess extent of healing and inflammation in periodontal tissue such as fibroblast growth factor 2, endothelin-1, cytokines.[32–35]

Future scope in the present study are towards newer techniques in splinting teeth or newer biomaterials such as quartz, nylon, ethylene fiber which can be used as a substitute with both mechanical properties and aesthetics related to composite resin.[36–38] Longitudinal clinical trials with standardised treatments like scaling alone, scaling and root planing alone with and without the use of splints are required to confirm their role in periodontal therapy and not just as an adjunct to conventional periodontal therapy.

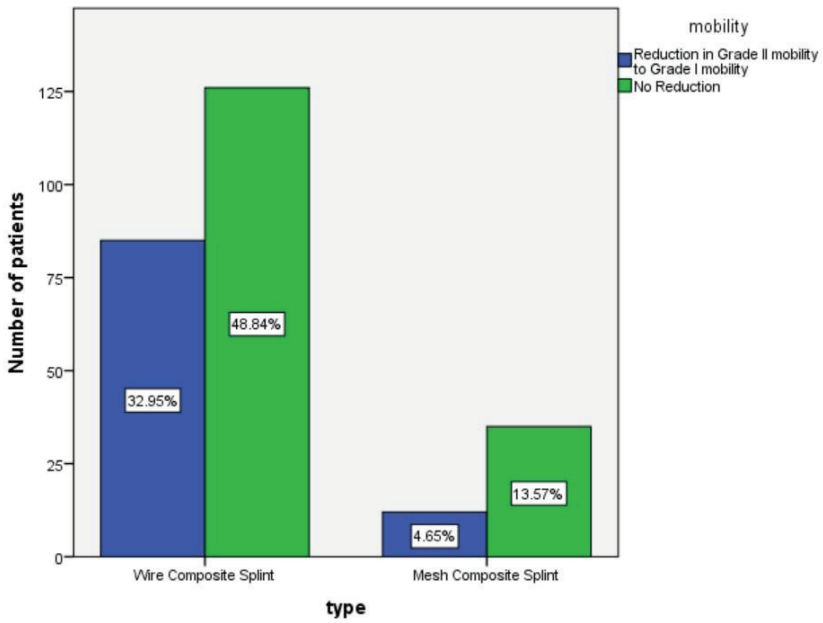
Legends:

Age groups	**Lifespan of 1 month without modifications**	**Lifespan of 3 months without modifications**	**Lifespan of 6 months without modification**	**Total**
20 - 40 years	14	160	18	192
41-60 years	0	0	66	66
Total	14	160	84	258
Type of splint				
Wire composite splint	8	140	63	211
Mesh composite splint	6	20	21	47
Mobility				
Type of Splint	**Reduction in Grade II mobility to Grade I mobility**	**No Reduction in mobility**	**Total**	
Wire composite splint	85	126	211	
Mesh composite splint	12	35	47	

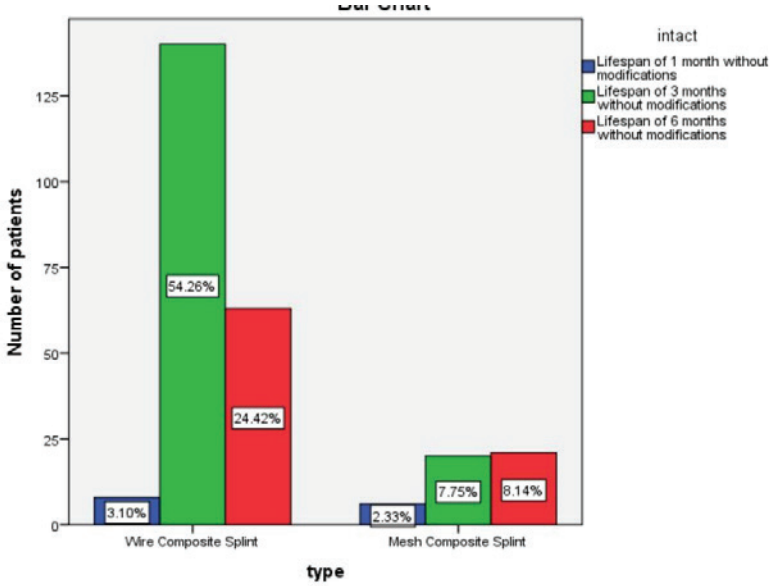
TABLE 1- Tabulation of all Descriptive data collected from the study based on age of the patient and lifespan of the splint, type of splints and age groups of patients, type of splint and reduction of mobility.

Feature	Value	95% Confidence Interval	
		Lower	Upper
Odds ratio for type of splint (stainless steel wire composite splint/ mesh reinforced composite splint)	1.968	0.966	4.006
For the cohort of Reduction in grade II tooth mobility to grade I tooth mobility using splints	1.578	0.943	2.641
For the cohort of No reduction in tooth mobility using splints	0.802	0.656	0.980

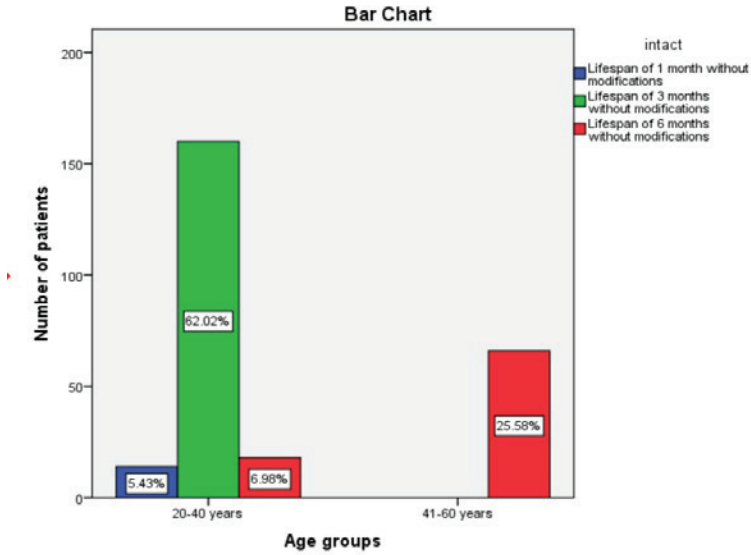
Table 2- Odds ratio calculated for independent findings; Stainless steel wire composite splints are used 1.968 times more frequently then mesh reinforced composite splints; Reduction of tooth mobility from Miller`s grade II mobility to grade I mobility is seen 1.578 times more frequently after using splints; No reduction in Millers mobility is seen 0.802 times after using splints.



Graph 1- Bar graph illustrates reduction of mobility and type of splint used in the present study, where X-axis denotes type of splint used to treat patients namely stainless steel wire composite splints and mesh reinforced composite splints; Y axis denotes number of patients treated with splinting; Blue colour in legends denotes cases with reduction of Miller`s grade II tooth mobility to grade I tooth mobility while green colour denotes no reduction in tooth mobility. Chi square test was used and the association between type of splint and reduction of mobility was found to be statistically significant. (X^2 value 3.56, p value 0.041($p<0.05$)). The reduction in tooth mobility was higher in the patients where stainless steel wire composite was used than composite reinforced mesh type of splints.



Graph 2- Bar graph illustrates the type of splint used and lifespan of splints without modification at different periods of time. X-axis denotes type of splint used to treat patients namely stainless steel wire composite splints and mesh reinforced composite splints; Y axis denotes number of patients treated with splinting; Blue colour in legends denotes cases where the splint was modified less than 1 month after fabrication, green denotes cases where the splint was modified within 3 month of fabrication, red denotes cases where the splint was modified within 6 months of fabrication. Chi square test was used and the association between type of splint and lifespan of splint without any modifications over 1 month, 3 months and 6 months was found to be statistically significant. (X^2 value 11.809, p value 0.003($p<0.05$)) The longevity of the splints for upto 6 months after fabrication without any modification was higher in the stainless steel wire composite splints.



Graph 3- Bar graph illustrates age of patients and type of splint used in the present study, where X-axis denotes age group of patients from 20-40 years and 41-60 years; Y axis denotes number of patients treated with splinting;Blue colour in legends denotes cases where the splint was modified less than 1 month after fabrication, green denotes cases where the splint was modified within 3 month of fabrication, red denotes cases where the splint was modified within 6 months of fabrication. Chi square test was used and the association between age of patients and lifespan of splint was found to be statistically significant. (X2 value 189.044, p value 0.00 ($p<0.05$)). There was a higher lifespan of splints among patients belonging to the age group of 41 to 60 years which was highly statistically significant.

Conclusion

Within the limits of this study splints were found to reduce tooth mobility as an adjunct to periodontal therapy from grade II mobility to grade I mobility using stainless steel wire composite resin splints among age groups of 20-40 years with a lifespan of upto 6 months 24% of the time.

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Ethical Clearance: It is taken from "Saveetha Institute Human Ethical Committee" (Ethical Approval Number- SDC/SIHEC/2020/DIASDATA/0619-0320)

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