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Clinical comparison of fiber-reinforced composite and stainless steel wire for splinting periodontally treated mobile teeth

Comparação clínica de contenção periodontal com resina composta reforçada por fibra de vidro ou fio de aço inoxidável em dentes com mobilidade

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ABSTRACT

Objective: This clinical study evaluated the success of two different splint materials bonded on periodontally treated mobile teeth. **Material and Methods:** A total of 14 patients were included in the study. Patients were randomly assigned to the groups to receive either with wire composite splint (WCS) or fiber-reinforced composite splint (FCS). Clinical periodontal parameters were performed and periotest values were recorded at baseline, and after 6 and 12 months. Patients were asked to complete a self-administered questionnaire after the splinting procedures. Failure types for the splints were categorized. **Results:** Baseline Plaque index (PI) values showed significant decrease at 6 month follow up in the WCS ($p = 0.0019$) and FCS ($p < 0.0001$) groups and remained stable after 12 months (WCS; $p = 0.36$, FCS; $p = 0.63$). During the course of the study, PD and RD values exhibited no change between and within groups. Clinical parameters including Pocket depth (PD), Gingival recession (GR), PI and Bleeding on probing (BOP) were stable at 6 and 12 months follow-up period. In 6 patients (4 FCS, 2 WCS), reparable failures occurred during the observation period. In four patients (3 FCS, 1 WCS) splints failed completely and were removed. The periotest values of the failing teeth ranged between 47.3 and 50. In 3 patients in the WCS and 1 patientin the FCS group, periotest values were ≥ 40 but no splint failures were observed. **Conclusion:** FCS tends to show increased mechanical limitations compared to WCS. Teeth with periotest values above 40 may be more prone to splint failures independent of the splint material.

KEYWORDS

Clinical study; Periodontal splint; Periodontitis; Periotest; Tooth mobility.

RESUMO

Objetivo: Este estudo clínico avaliou a permanênciade dois materiais diferentes utilizados para contenção de dentes com mobilidade tratados periodontalmente. **Material e Métodos:** Um total de 14 pacientes foram incluídos no estudo. Os pacientes foram distribuídos aleatoriamente em grupos para receber contenção com fio de aço inoxidável (FA)e resina ou resina reforçada por fibra de vidro (FV). Os parâmetros clínicos periodontais foram realizados e os valores do Periotest foram registrados no início do estudo e após 6 e 12 meses. Os pacientes foram convidados a preencher um questionário após os procedimentos de contenção. Foram classificados os tipos de falhas para as contenções. **Resultados:** Os valores de índice de placa de base (IP) apresentaram diminuição significativa aos 6 meses de acompanhamento nos grupos FA ($p = 0{,}0019$) e FV ($p < 0{,}0001$) e manteve-se estável após 12 meses (FA, $p = 0{,}36$, FV, $p = 0{,}63$). Durante o período do estudo, a profundidade de sondagem (PS), recessão gengival (RG) e nível clínico de inserção (NCI) não apresentaram mudança entre e dentro dos grupos. Os parâmetros clínicos incluindo PS, RG, NCI, IP e sangramento a sondagem ficaram estáveis em 6 e 12 meses de período de acompanhamento. Em 6 pacientes (4 FA, 2 FV), ocorreram falhas reparáveis. Em quatro pacientes (3 FV, 1 FA) a contenção falhou completamente e foram removidos. Os valores Periotest dos dentes que as contenções falharam variaram entre 47,3 e 50. Em 3 pacientes no grupo FA e 1 paciente no grupo FV, os valores Periotest foram ≥ 40, mas não foram observadas falhas na contenção. **Conclusão:** O grupo FV tendeu a mostrar aumento das limitações mecânicas em relação ao FV. Dentes com Periotest valores acima de 40 podem ser mais propensos a falhas de contenção independentes do material utilizado.

PALAVRAS-CHAVE

Estudo clínico; Contenção Periodontal; Periodontite; Periotest; Mobilidade dentária.

INTRODUCTION

Periodontitis is an inflammatory disease induced by bacterial biofilms that accumulate in the gingival margin and characterized by gingival inflammation, loss of connective tissue attachment and alveolar bone [1]. Removal of plaque, calculus, elimination of deep periodontal pockets and occlusal adjustment are treatment options and result in healthy periodontium but reduced height of the supporting tissues [2]. If left untreated, the continuous loss of the supporting tissues during periodontal disease progression may result in increased tooth mobility, ultimately yielding to tooth drifting and exfoliation [3]. Tooth mobility can also be a consequence of occlusal trauma in addition to the periodontal inflammation and attachment loss. From the clinical point of view, it is important to clarify the reason for increased tooth mobility as a result of widened periodontal ligament, reduced height of the supporting tissues or their combination[4]. Tooth mobility is a result of intra-alveolar displacement of the root and usually assessed by exposing the crown of the tooth to a certain force and determining the distance that the crown can be displaced in buccal and/or lingual direction [5].

Assessment of tooth mobility could be performed manually/digitally or with the help of instruments such as periodontometer, the laser vibrometry, Periotest and photogrammetric measurement method [6,7,8,9]. A commonly used device, Periotest, measures the reaction of the periodontium to a defined percussion force that is applied to the tooth and delivered by a tapping instrument. The Periotest values range from − 8 to + 50 where the firm teeth demonstrate values ranging from -8 to +9 and mobile ones at a range of 30 to 50 [7].The mobility of a tooth in the horizontal direction is closely dependent on the height of the surrounding supporting bone, the width and quality of the periodontal ligament, and the shape and number of roots present [10-12]. Mobility could cause occlusal instability, discomfort or pain during function [13]. Occlusal instability could have negative consequences on tooth-tissue relationship, including the relationship of the teeth to the opposing dentition that could lead to excessive occlusal forces[2]. The question is whether a healthy periodontium with reduced height has a capacity similar to that of the normal periodontium to adapt to traumatizing occlusal forces.

The most common indication for periodontal splinting is to improve the prognosis of mobile teeth and patient comfort and provide better control of the occlusion if the anterior teeth are mobile[14]. Periodontal splints that redistribute functional and parafunctional forces achieve stability after periodontal treatment [15]. Numerous types of splints have been described in the literature, such as composite resin based ones used in conjunction with adhesive systems, orthodontic wire, wire-composite[16] or fiber-reinforced composite resin [17], nylon fishing line-composite and polyethylene [18]. To the authors` best knowledge, the impact of tooth mobility on the survival of splint materials considering also the periodontal parameters have not been assessed to date.

The objective of this clinical study was to compare clinical survival of two different splint materials bonded on periodontally treated mandibular anterior mobile teeth after periodontal treatment. The null hypothesis tested was that there would be no difference between the two types of splint materials in terms of clinical performance.

MATERIAL & METHODS

Study design

This study was designed as case series and was conducted at Ege University, School of Dentistry, Department of Periodontology, between December 2011 and July 2013. A total of 14 patients (9 females, 5 males, mean age: 45 years old) with chronic periodontitis diagnosed in accordance with the clinical criteria stated in the consensus report of the World Workshop in Periodontics [19] were included in the study. Patients were received active periodontal treatment with mobile mandibular anterior teeth with impaired chewing comfort due to mobility in the mandibular anterior area. The subjects were not enrolled in the study if any of the following criteria were present: (1) younger than 18 years old, (2) not able to read and sign the informed consent document, (3) physically and psychologically not normal, (4) having general health-compromising conditions, (5) pregnant, (6) undergoing active periodontal and/or orthodontic therapy, (7) poor oral hygiene and residual periodontal pocket, (8) an impaired response to infection, (9) missing teeth in the splinting area, (10) history of endodontic therapy and/or any restoration on the teeth to be evaluated, (11) insufficient address for follow-up, or unwillingness to return for follow-up as outlined by the investigators. The study was conducted in full accordance with ethical principles, including the World Medical Association Declaration of Helsinki. The study protocol was explained and a written informed consent was given to each individual before participation.

Clinical measurements

After examination, non-surgical periodontal treatment including scaling and root planning was performed and the patients received oral hygiene instructions. Following non-surgical periodontal treatment, patients were enrolled in the periodontal maintenance. All patients were re-examined in terms of plaque and bleeding on probing scores which were below 20%, measurement of probing depth, gingival recession, clinical attachment level and assessment of mobility prior to periodontal maintenance [20]. Clinical periodontal recording, pocket depth (PD), gingival recession (GR), clinical attachment level (CAL), plaque index (PI)[21] and the presence of bleeding on probing (BOP; +/-) were performed at 6 sites on each mandibular anterior tooth and adjacent tooth as control (mesio-buccal, mid-buccal, disto-buccal, mesio-lingual mid-lingual and disto-lingual locations) using a Williams periodontal probe (Hu-Friedy, Chicago, IL) at baseline, 6 and 12 months after therapy. BOP was deemed positive if it occurred within 15 s after periodontal probing. All measurements and non-surgical periodontal treatments were performed by a single calibrated periodontist (AA). An intraclass correlation coefficient of 0.85 for PD measurements indicated that the examiner's reliability was high.

Tooth mobility was measured on mandibular anterior teeth and one adjacent premolar tooth as control using a commercial device (Periotest M, Medizitechnik Gulden, Modautal, Germany) at baseline before splinting, immediately after (splinted mobility), 6 and 12 months after splinting (splint effect). Periotest measurements were made from the mid point of tooth and maximum care was taken that the probe of the device was perpendicular to the tooth. In accordance with the manufacturer's instructions, every mobility measurement was made three times and the average result was noted. In the selected group of patients, splinting was applied due to the Periotest values over +30 and lack of chewing comfort reported by the patients.

Splinting procedure

All splints were made directly by an experienced periodontist (PG). While half of the patients received fiber-reinforced composite splint (FCS) (Interlig, Angelus, Londrina, Brasil) in combination with composite resin (Gradia Direct, GC Corporation, Tokyo, Japan)(n = 7), the other half received orthodontic steel wire-composite splint (WCS) (0.7 mm Remanium Straight wire, round, Dentaurum, Ispringen, Germany) with the same composite resin (Gradia Direct) (n = 7). The resin composite materials were applied based on the availability of the system in our clinics. In the WCS group, impressions were made using high viscosity silicon impression material (3M ESPE, St. Paul, MN). Stone dental cast models were obtained and used for splint preparation (GC Fujirock

Type 4, GC Corporation). In both groups, the teeth on the labial and lingual surfaces were cleaned with pumice using a prophylaxis brush on a slow-speed hand-piece at 3000 rpm. All splints were bonded under rubber-dam. In order to control the flow of adhesive resin or resin composite, interdental wedges (Hawe Sycamore Interdental Wedges, Kerr, Orange, CA, USA) were placed at the interdental spaces between the teeth to be splinted after placing the rubber-dam. In order to stabilize the mobile teeth and avoid displacement of splint, all mobile teeth were temporarily attached to each other at the labial surfaces with small amounts of resin composite (Gradia direct) and photo-polymerized (Demetron LC, SDS Kerr, Orange, CA, USA; light intensity: 600 mW/cm^2) for 10 s without surface etching. The lingual surfaces of the teeth to be splinted were etched with 37% phosphoric acid (3M ESPE, St. Paul, MN) for 10 s, rinsed and dried. In the FCS group, the one component self-etching adhesive (G-BOND, GC Corporation) was applied onto the surfaces using a microbrush, gently air-dried and photo-polymerized for 20 s. A thin layer of composite resin was applied on the enamel surfaces and left unpolymerized. Then, fiber-reinforced composite resin material with previously measured length was placed in the bed of the composite resin and gently pressed towards the composite resin on each tooth. Each segment of splint was photo-polymerized for 20 s and during polymerization, the rest of the splint was shielded with a metal instrument. Second layer of composite resin was applied on splint and each segment was photo-polymerized for 40 s.

After rubber-dam removal, occlusion was checked and adjusted if necessary and was proceeded by 25 μm grain size composite finishing bur (Acurata GmbH&Co.KG, Thurmansbang, Bavarian Forest, Germany) to remove the excessive resin. Polishing was achieved in sequence (Lusso-Pop-Set, Acurata GmbH&Co.KG, Thurmansbang, Bavarian Forest, Germany) using a hand-piece at 3000 rpm in order not to expose fibers. In WCS group, adaptation of splint was controlled before splinting. Enamel conditioning and adhesive application was performed the same way as for the FCS group. A thin layer of composite resin was applied on each tooth before adapting the wire and left unpolymerized. Wire was adapted carefully on composite resin with a silicon guide that is adapted to the neighbouring teeth. Wire splint was pressed carefully and splint was fully covered with composite resin. Each segment was photo-polymerized for 40 s. Finishing and polishing after splinting was achieved as for WCS group.

In both groups, patients received oral hygiene instructions as apart of the non-surgical periodontal treatment phases. Patients were informed about possible complications and instructed to call upon experience of a failure that could occur until the follow-up appointment. One week later, patients were recalled to control oral hygiene, occlusion and presence of possible adhesive or composite remnants.

Patient assessment of the splints

In order to evaluate the patient's view on the change in pain, chewing comfort and aesthetics, self-administered questionnaires were given to the patients after periodontal splint treatment. The questionnaireconsisted six questions and each answer was scored between 0 and 10 on Visual Analogue Scale [22] (Figure 1). The subjects were asked to complete the questionnaire after splint treatment and bring it to the first recall.

Failure protocol

Failure types for the splints were categorized as follows: A) Complete debonding; B) Adhesive failure between enamel and composite on one or more teeth; C) Adhesive failure between fiber/wire and composite on one or more teeth.

While Score A was considered as a catastrophic failure, Scores Band C were considered repairable failures and such splints were repaired during the same control visit.

Statistical analysis

The clinical periodontal measurements and periotest values were statistically analyzed using the software program (SPSS version 14 Chicago USA,SPSS 13.0; SPSS Inc, Chicago, IL, USA). Homogeneous distribution of the data was tested using D'Agostino-Pearson omnibus normality test. The data were subjected to one-way ANOVA and multiple comparisons were tested using Holm-Sidak's multiple comparison test. The level of significance was set at $p < 0.05$ for all tests. Power analysis was performed based on the Periotest values, and the results indicated that a number of 7 patients in each group is required to discriminate the difference between 2 groups (%80 power, alpha = 0.05) when anticipated Periotest value difference and standard deviation was 2.5 and 1.5, respectively.

RESULTS

Clinical analyses

The follow-up period of the study was 19 months. Demographic variables of the study groups were presented in Table 1.

Periodontal measurements

Inter - and intra-group assessments of periodontal parameters including PD, GR, CAL, PI and BOP were similar between the FCS and WCS groups during the follow-up period (Figure 2). Baseline PI values showed significant decrease at 6 month follow up in the WCS ($p = 0.0019$) and FCS($p < 0.0001$) groups and remained stable after 12 months (WCS; $p = 0.36$, FCS; $p = 0.63$). Within groups, statistical differences were observed in BOP values only in FCS group in the 6-month period (FCS;$p = 0.0002$, WCS; $p = 0.10$) and remained stable after 12 months (FCS; $p = 0.10$, WCS; $p = 0.84$). During the course of study, PD and GR and CAL values exhibited no change between and within groups (Figure 2). Clinical parameters including PD, GR, CAL, PI and BOP were stable at 6 and 12 months follow-up period.

Periotest results and failure analysis

In the FCS and WCS groups periotest values were assessed at baseline, immediately after splinting, after 6 and 12-month follow-up period (Table 2). Periotest values were compared between baseline (Periotest0) and immediately after splinting (PeriotestA) and between PeriotestA values and 6 and 12-month follow-up period (Periotest6 and Periotest12) in each patient and in each tooth within groups. In FCS group, except for the control tooth, baseline periotest values were statistically lower than those immediately after splinting (Periotest0 - PeriotestA; $p < 0.0001$). After 6 and 12 months, periotest values increased (PeriotestA - Periotest6; $p = 0.04$, Periotest6 -Periotest12; $p = 0.02$). In WCS group, also baseline periotest values were statistically lower than those immediately after splinting,remained stable at 6 month but increased after 12-month follow up (Periotest0 - PeriotestA; $p < 0.0001$, PeriotestA - Periotest6; $p = 0.39$ and Periotest6 - Periotest12; $p = 0.02$). According to the inter-group assessments, Periotest0, PeriotestA, Periotest6 and Periotest12 values were similar in both groups ($p = 0.21$, $p = 0.57$, $p = 0.64$, $p = 0.65$) (Table 3).

In 11 patients, there were minimum 2 teeth for which periotest values were more than 30. Ten patients had periotest values ≥ 40 (Table 4a). In six patients (FCS: 4, WCS: 2), splint failures occurred during the follow-up period (Table 4b). After 2 weeks, Patient 1 (P1) and P4; after 1 month P6 and P13 presented adhesive failures splint between the enamel (Score B), fiber and composite (Score C). These failures were immediately repaired with the same composite. After 4 weeks, the similar failure types were observed in P1, P6, P13 and splints were totally removed. Likewise, adhesive failures between wire and composite (Score C) occurred in P2 and P7, 1 month after splinting. These failures were also immediately repaired. Ten days later, only in P2 the same failure was seen and WSC was totally removed. As a result, in four patients, splints (FCS: 3, WCS: 1) were totally removed (Table 4b). The periotest values of the failing teeth in P1, P2, P6 and P13 were; 50 (max.), 50 (max.), 50 (max.) and 47.3, respectively. Although the P3, P9, P10 and P12 had periotest values ≥ 40, the splint failures were not seen (WCS: 3, FCS: 1). In total, 6 splint failures were noted (FCS: 4, WCS: 2).

Questionnaire results

Self-administered questionnaire results demonstrated similar satisfaction with both FCS and WCS (Table 5).

DISCUSSION

The results of the present study indicate that already after 12 months, splint materials tend to show incidences of mechanical failures on periodontally compromised mobile anterior mandibular teeth. The null hypothesis tested that there would be no difference between the two types of splint materials in terms of clinical performance could be accepted.

Since teeth are not ankylotically anchored and connected to the bone by collagenous fibers, they present physiologic mobility [6]. In periodontally healthy teeth, two factors determine mobility namely, the height of supporting tissues and the width of periodontal ligament. Following successful non-surgical and/or surgical periodontal treatment, persistent mobility was regarded as pathological. However, when the remaining periodontal tissues are reduced but the width of the periodontal ligament remains the same as periodontally healthy tooth, it is considered as physiological tooth mobility [5]. Tooth mobility can be reduced by occlusal adjustment and/or splinting teeth. Splinting is indicating when increased tooth mobility due to reduced height of periodontal support, is accompanied by chewing discomfort and masticatory dysfunction. From the clinical point of view, the success of supportive periodontal treatment is directly related with personal oral hygiene standard [23]. Due to this reason periodontal splinting could greatly improve the chewing comfort, oral hygiene, prognosis and outcome for a patient with severe generalized periodontitis. Another important reason is establishing a stable occlusion that promotes tooth retention and the maintenance of periodontal health [14].

In this study, patients had generalized chronic periodontitis and had undergone non-surgical periodontal treatment and occlusal adjustment where necessary. After the supportive periodontal treatment, patients who presented high tooth mobility and impaired chewing comfort due to mobility in the mandibular anterior area were enrolled in the study. One tooth support with no mobility was amongst the selection criteria in order to provide a stable construction. Prior to splinting, baseline clinical periodontal parameters were recorded and all values demonstrated healthy but reduced periodontal support. Patients were monitored for a 6-month duration for evaluation of oral hygiene status. Results demonstrated that splinting had positive effect on oral hygiene and improved clinical periodontal parameters including PI and BOP. Moreover, the achieved PD, GR and CAL were stable during the course of study. Probing depth change is a combination of gingival recession and the change in clinical attachment level due to events occurring at the base of the periodontal pocket. Clinical attachment level was stable during the follow-up period that shows stable adaptation of the junctional epithelium at the base of the pocket.

In a previous clinical study, periodontal outcome of stabilized mobile teeth with an E-glass fiber (Fiber-Kor) was assessed [24]. In that study, 56 patients were enrolled and results after 10 months were presented where PD values were decreased after the splinting procedure. In another clinical study, unidirectional E-glass fiber-reinforced composite resin splints were applied and splinting had positive effect on PD reduction [17]. In this study, PD values were not changed and this result could be explained by lower baseline PD values.

Different methods were described in the literature for measuring tooth mobility [25,26].

The most commonly used method for mobility and splint stability is Periotest method [27]. In this study, in order to assess the effect of tooth mobility on splint stability, mobility was measured by Periotest at baseline, immediately splinting, after 6 and 12 months. Also, the intention was to assess the highest limit value of mobility where failure would not occur after splinting. Typically, Periotest value changes when measurements are made at different distances from the gingival margin [16]. In order to eliminate the measurement error, Periotest values were recorded three different times from the same distance at the mid point of tooth and perpendicular to the tooth. According to failure results in this study the limits of periotest value were determined ≥ 40. In repaired splints, this value was also the same in six patients; four were in FCS and two were in WCF group. Of these patients, four (1 FCS and 3 WCS) lost their teeth and splints were removed. Periotest values of the extracted teeth were ≥ 47 and at quite maximum limit. These results suggested that mobility measurement before splinting could be a diagnostic tool for estimating splint rigidity. Further failure results suggested that WCS could tolerate mobility more than FCS. In one in vitro study, bond strength results with the stainless steel wire was significantly higher than those obtained with FRC materials including the one used in this study (Angelus)[28]. Although the application mode and the composite materials used were different, the preliminary findings of that in vitro study could be verified in this clinical study. Failure types also indicate the weakest link in a splint scenario. While the repairable failure type B is an indication of weak bond between the enamel and composite, type C implies a weak bond between the splint material and the composite. The majority of the repairable failures of the both kinds entail better adhesion between the enamel-splint-composite complex. However, a general statement cannot be made, as this data need to be supported with a clinical trial on a larger study population.

Chronic periodontitis is characterized by gingival inflammation and loss of connective tissue attachment and alveolar bone. Classical symptom of periodontitis is increased tooth mobility. Periodontal splinting may reduce the mobility of the traumatized teeth and result in some regrowth of bone, however it will not arrest the rate of further breakdown of the supporting apparatus [13]. If the patient experiences the tooth mobility as disturbing, the mobility can only be reduced in this situation by joining the mobile teeth together with other teeth in the jaw into a splint. Despite the lack of evidence about the success of the maintenance of failed periodontal splints further studies are needed to explain what extent splinting should be maintained. Provided from the data of this study one can state that mobility degree ≥ 40 value may impair clinical success of splints and different treatment options such as extraction and dental implant placement could be then alternative treatment options.

Limited information is available on the effect of periodontal splints on tooth mobility after non-surgical periodontal treatment [18,29]. Likewise, the extent to which splint material could aid in reduction of tooth mobility is unknown. One in-vitro study compared the success of splint treatment on dental trauma using wire-composite and quartz-fiber splints. Results demonstrated that splint rigidity had an effect on treatment outcomes [30]. In this study, also two different materials with different rigidity (fiber vs wire) were compared after periodontal treatment. However, except the extracted teeth, both techniques were effective in decreasing mobility in that Periotest values decreased after splinting and were stable after 12 months follow-up period.

According to the results of the questionnaire using the visual analogue scale, patients presented high satisfaction after treatment irrespective of the splint material. Results of a previous study reported the challenge in creating an aesthetic result with fiber-reinforced composite splints because of limited space on the lingual surface of the teeth to be splinted [31]. Due to the lack of information

Table 2 - Mean Periotest values at baseline, immediately after splinting, at 6 and 12 months follow-up

Patient Code	Splint Type	Timepoint	43	42	41	31	32	33	34
P1	FCS	Baseline	1.7	15.1	Max (50)	36	10.0	1.1	2.0
		Immediately	-1.1	1.4	4.1	3.3	-0.3	-2.2	1.6
		6. Month	-	-	-	-	-	-	-
		12. Month	-	-	-	-	-	-	-
P2	WCS	Baseline	5.9	31.1	Max. (50)	Max. (50)	18.9	4.3	10.2
		Immediately	3.4	5.0	7.0	6.8	3.5	0.8	9.3
		6. Month	-	-	-	-	-	-	-
		12. Month	-	-	-	-	-	-	-
P3	WCS	Baseline	2.9	20.5	38.9	Max. (50)	19.4	7.2	3.6
		Immediately	-3.4	1.9	1.5	2.9	2.2	1.3	3.2
		6. Month	-3.5	0.2	1.4	2.1	1.3	0.7	3.0
		12. Month	-3.0	0.6	1.5	2.3	1.0	0.9	2.9
P4	FCS	Baseline	2.8	17.6	35.5	47.5	11.5	-0.6	0.8
		Immediately	-0.3	-0.2	0.0	-0.9	-2.6	-2.7	0.4
		6. Month	-0.3	-0.3	-1.0	-0.9	-2.6	-2.7	0.4
		12. Month	-0.2	-0.1	-1.3	-0.8	-2.7	-1.9	0.5
P5	FCS	Baseline	3.7	20.7	25.9	32.6	30	6.8	3.1
		Immediately	-2.8	0.3	2.1	2.9	3.1	-1.9	2.5
		6. Month	-1.5	1.2	3.0	3.6	4.1	-0.2	2.1
		12. Month	-0.3	1.6	3.4	3.6	3.9	0,1	2,5
P6	FCS	Baseline	25.3	30.7	Max. (50)	Max. (50)	32.7	16.3	4.7
		Immediately	5.8	11.3	18	15.5	6.9	5.9	4.6
		6. Month	-	-	-	-	-	-	-
		12. Month	-	-	-	-	-	-	-
P7	WCS	Baseline	-0.4	5.3	8.4	16.8	40.0	-1.5	-2.2
		Immediately	-2.7	-1.3	-0.1	-1.1	-1.4	-3.4	-2.2
		6. Month	-2.3	-0.8	1.3	6.0	6.3	-2.2	-1.1
		12. Month	-2.0	-0.5	1.2	5.5	5.9	-2.4	-1.0
P8	FCS	Baseline	2.2	14.6	31.3	33.1	9.4	2.3	4.2
		Immediately	2.2	4.4	2.6	1.1	1.0	-2.0	3.8
		6. Month	2.7	4.4	2.1	3.0	1.1	-2.2	2.8
		12. Month	2.9	4.3	2.0	2.8	1.0	-2.0	3.2
P9	WCS	Baseline	3.8	18.0	48.4	30.5	26.0	34.4	7.6
		Immediately	1.4	2.6	4.4	5.2	3.0	0.7	6.9
		6. Month	1.4	2.6	4.4	5.2	3.0	0.7	1.2
		12. Month	2.0	3.0	4.6	5.0	3.5	1.2	2.1
P10	FCS	Baseline	0.2	18.1	44	38.4	10.2	1.1	1.6
		Immediately	-3.3	0.3	-1.4	-1.2	-2.8	-1.3	-1.2
		6. Month	-3.8	-0.7	-1.1	-0.7	-1.2	-1.1	-0.8
		12. Month	-3.2	-0.1	-0.5	-0.6	-1.2	-0.9	-0.8
P11	WCS	Baseline	9.7	6.0	26.9	36.6	11.9	3.1	7.1
		Immediately	-0.9	3.7	3.9	0.0	1.8	-0.9	8.9
		6. Month	-0.9	3.7	3.9	0.0	1.8	-0.9	8.9
		12. Month	0.1	3.2	4.1	0.3	2.2	-0.4	8.0
P12	WCS	Baseline	18.8	15.2	37.8	Max. (50)	23.0	2.5	4.5
		Immediately	0.8	7.8	6.2	4.5	-0.6	-0.5	3.7
		6. Month	0.8	7.8	6.2	4.5	-0.6	-0.5	3.7
		12. Month	0.6	7.2	6.1	4.8	0.1	0.1	4.0
P13	FCS	Baseline	21.8	27.1	28.2	47.3	34.3	17.5	4.5
		Immediately	6.5	8.3	5.7	9.7	9.5	5.7	4.8
		6. Month	-	-	-	-	-	-	-
		12. Month	-	-	-	-	-	-	-
P14	WCS	Baseline	0.8	10	8.9	30.6	10.0	0.2	5.6
		Immediately	-2.3	-0.1	1.0	0.7	0.1	-1.4	6.0
		6. Month	-2.3	-0.3	0.2	0.3	-1.0	-3.4	7.1
		12. Month	-2.2	0.1	0.5	0.3	-1.1	-2.9	6.8

on the chewing comfort associated with tooth mobility or thickness of splint material and aesthetics, the results of this study could not be compared with others. However, it can be stated that both splint types were tolerated similarly. Follow up of these patients and future studies need to verify whether splinting is an aid for improving periodontal parameters as opposed to no splinting at all. Yet, the results indicated favourable function with the use of splints reported by the patients.

CONCLUSION

Based on the interim results of this clinical study, the following could be concluded:

• Periodontal splints could overcome impaired chewing comfort due to the tooth mobility as a result of severe periodontal disease.

• FCS tends to show increased mechanical limitations compared to WCS.

• After periodontal treatment, diagnostic mobility measurement could be suggested before splinting since the possible effect of mobility degree ≥40 may impair clinical success of splints.

Table 1 - Demographics of the patients received periodontal splints (FCS: Fiber reinforced-composite splint; WCS: Wire-composite splint)

	FCS (n = 7)	WCS (n = 7)
Age (Years, median; min-max)	44 (32 - 62)	48.50 (27 - 59)
Gender (Male/Female)	3 / 4	3 / 4
Smoker (Yes/No)	3 / 4	3 / 4

Table 3 - Periotest values (Mean and standard deviations) for FCS and WCS groups. Periotest0: Baseline periotest value; PeriotestA: Immediately after splinting; Periotest6: After 6 months; Periotest12: After 12 months

Splint Type	Periotest0	PeriotestA	Periotest6	Periotest12
FCS	22.24 (15.86)	2.63 (4.99)	0.20 (2.31)	0.40 (2.17)
WCS	19.78 (16.29)	1.52 (2.84)	1.30 (2.85)	1.48 (2.66)

Table 4b - Distribution of repaired and removed splints and the correspondingperiotest values

Patient code	Splint Type	Tooth number	Periotest value
Repaired Splints			
P1	FCS	41	Max. (50)
P2	WCS	41, 31	Max. (50), Max. (50)
P4	FCS	31	47.5
P6	FCS	41, 31	Max. (50), Max. (50)
P7	WCS	32	40
P13	FCS	31	47.3
Totally Removed Splints			
P1	FCS	41	Max. (50)
P2	WCS	41, 31	Max. (50), Max. (50)
P6	FCS	41, 31	Max. (50), Max. (50)
P13	FCS	31	47.3

Table 4a - Distribution of teeth presenting periotest values ≥ 40 in the corresponding patients

Patient code	Splint Type	Tooth number	Periotest value
P1	FCS	41	Max. (50)
P2	WCS	41, 31	Max. (50), Max. (50)
P3	WCS	31	Max (50)
P4	FCS	31	47.5
P6	FCS	41, 31	Max. (50), Max. (50)
P7	WCS	32	40
P9	WCS	41	48.4
P10	FCS	41	44
P12	WCS	31	Max. (50)
P13	FCS	31	47.3

Table 5 - Distribution of answers to the questions (Q1-Q6) based on Visual Analogue Scale (0-10) to the self-administered questionnaire

	Splint Type	Q1	Q2	Q3	Q4	Q5	Q6
P1	FCS	9	8	8	10	10	10
P2	WCS	10	10	8	10	10	10
P3	WCS	8	9	8	9	10	9
P4	FCS	9	8	8	9	9	9
P5	FCS	8	8	8	10	8	10
P6	FCS	8	10	5	10	10	10
P7	WCS	8	9	7	10	8	9
P8	FCS	8	8	5	10	8	8
P9	WCS	9	9	5	7	6	6
P10	FCS	10	10	10	10	10	10
P11	WCS	9	9	8	10	9	9
P12	WCS	10	9	8	8	10	9
P13	FCS	8	8	6	8	8	8
P14	WCS	7	7	8	10	9	9
Total		**121**	**122**	**102**	**131**	**125**	**126**

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