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Case report

CAD/CAM FIBER-REINFORCED COMPOSITE SPLINT FOR IMMOBILIZATION OF PERIODONTALLY COMPROMISED TEETH

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ABSTRACT

A digital technique for planning and manufacturing a periodontal splint from composite material reinforced with glass fibers is presented. The lingual surface of the permanent mandibular anterior teeth is scanned intraorally.

An accurate periodontal splint of the mandibular anterior teeth with increased mobility is fabricated.

Digital planning and fabrication of an immobilizing splint minimize the human factor that affects the accuracy of the restoration.

Keywords: fiber-reinforced composite, splinting, CAD/CAM technology,

BACKGROUND:

Periodontitis is a chronic multifactorial inflammatory disease associated with dysbiotic plaque biofilms and characterized by progressive destruction of the tooth-supporting apparatus. The major clinical signs and symptoms include the formation of periodontal pockets and loss of periodontal tissue support, alveolar bone loss (horizontal and/or vertical), gingival bleeding, increasing tooth mobility. Advanced periodontal disease is one of the substantial reasons for edentulism and masticatory dysfunction. Complicated treatment approaches are used as à consequence. Thus, the dental care cost for the patient increases, but a negative impact on general health is observed [1].

One of the major symptoms which adversely affect the function, aesthetics and patients' comfort is tooth mobility. Clinical management of teeth with advanced or increasing tooth mobility can be very challenging [2]. Splinting allows redistribution of forces from mobile teeth to the immobile adjacent teeth, thus gaining support and stability. When all factors are considered, and proper maintenance therapy is recommended, then even teeth with advanced attachment and bone loss can be retained functionally for a prolonged period of time [3, 4, 5].

Splinting of loose teeth has been known ever since ancient times. Still, it has always been controversial because of the potential to worsen the oral hygiene of the patient, which can lead to worsening of periodontal disease.

The active development of dental materials in the late 20th century has led to the development of new methods for immobilizing teeth. Composite splints reinforced with fibers based on fiberglass or polyethylene are widely used. These splints are durable, do not cause discomfort and meet the aesthetic requirements of patients. However, when they are used, retention areas often appear, facilitating the growth of microorganisms and leading to impair oral hygiene, which in turn reduces the longevity of the teeth and the splint itself.

Currently, CAD/CAM technologies are widely used in dentistry, allowing accurate and at the same time aesthetic designs, reproduction of all planned parameters, such as shape, the thickness of the fixing layer, distance to the edge of the gum and the cutting edge of the tooth. In addition, the use of CAD/CAM technology minimizes the human factor that affects the accuracy of restorations.

Limited information is available on fiber-reinforced composite (Trilor, Bioloren S.r.I, Italy), except the data provided by the manufacturer. Trilor is described as a 3D fiber reinforced composite (FRC) manufactured for CAD/ CAM applications. The manufacturer reports mechanical properties as follows: traction resistance 380 MPa, flexural resistance 540 Mpa, modulus of elasticity 26 GPa, compression resistance(perpendicular) 530 Mpa.

The manufacturer claims benefits that include: lightweight, durability and resiliency, no firing requirements, high flexural and compressive strength, biocompatibility, and adjustability. Its potential uses include posterior and anterior crowns and bridges, substructure, and telescopic restorations [6]. With these flexural properties and potential applications, 3D FRC has the potential to be a viable material for clinical dentistry.

CASE DESCRIPTION:

A 60-year old female patient was referred to us with a chief complaint of discomfort while biting and increased tooth mobility of lower incisors. The patient was diagnosed as a periodontitis case, stage III, grade B according to the new classification of periodontal diseases and conditions (2017). She had more than 5 mm clinical attachment loss in the most affected anterior region; more than 33% bone loss

(mainly horizontal, as well as vertical in the molars) (Fig. 1), class II furcation involvement. The teeth of the mandibular anterior segment had II degree mobility (Fig. 2).

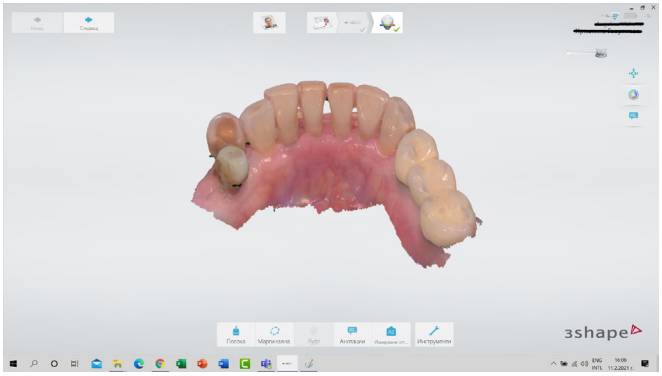
Fig. 1. Radiography of the mandibular frontal teeth.

Fig. 2. Initial situation

The treatment plan consisted of nonsurgical periodontal treatment – complete scaling and root planning and stabilization of the lower anterior with a splint fabricated from CAD/CAM glass fiber-reinforced composite disks (Trilor, Bioloren S.r.I.). Surgical treatment of infrabony defects was planned as a second stage treatment procedure after complete resolution of the gingival inflammation.

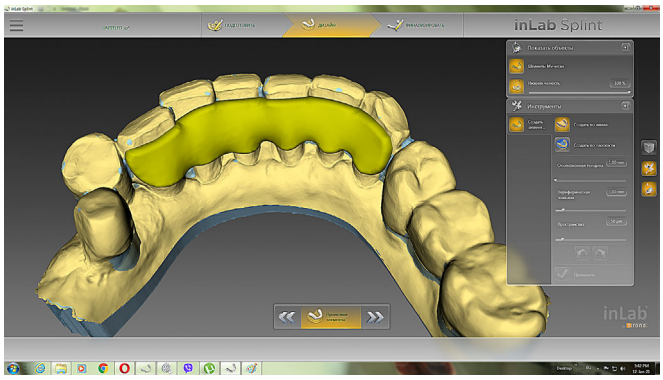
After periodontal debridement, the patient was scanned with an intraoral scanner (Trios, 3Shape) (Fig. 3).

Fig. 3. Intraoral scan of mandibular teeth



The splint was designed to stabilize mandibular frontal teeth lingually from the lower right to the lower left canine. The thickness of the splint had a cross sectional width of 0.5 mm, and the apical outline of the splint had an offset of 2 mm from the gingival margins (Fig. 4).

Fig. 4. CAD of the splint.



After milling, the splint was covered with GC Optiglaze (Fig.5).

Fig. 5. The splint covered with GC Optiglaze.

Optiglaze is a nano-filled, light-cured, protective coating for direct and indirect restorations made of composite resin. It provides an esthetic and glossy surface to composite restorations, artificial teeth, removable dentures, provisional crowns and custom acrylic trays. It can also be used instead of mechanical polishing in areas difficult to polish, such as occlusal grooves or interproximal areas of indirect composite restorations [7].

The intaglio surface of the splint was sandblasted with Al_2O_3 (aluminium oxide) particles with a size of 50 μm at a pressure of 2 bar from a distance of 1.5 cm. The splint was cemented using rubber dam isolation with resin cement (RelyX Ultimate Adhesive Resin Cement; 3M ESPE) (Fig. 6).

Fig. 6. Cementation of the splint

Fig. 7. Intraoral view of the cemented splint

The patient was instructed to maintain good oral hygiene and pay special attention to the interproximal surfaces. Follow-up visits were scheduled every 6 months (Fig. 7).

DISCUSSION:

According to previous studies on cast metal resin-bonded fixed dental prosthesis (RBFDP), the use of rigid restoration for splinting is not recommended [8]. Due to to the rigidity of the metal alloy that transfers the entire shear and torsional stress generated by the mobile teeth to the adhesive interface, a high debonding rate of RBFDPs in periodontal patients has been detected. The highest level of interfacial adhesive stress is caused by the high elasticity modulus of the metal structures. The most favorable stress transfer within the tooth/restoration complex is observed when flexible composite materials are applied [9].

The main risk factor for the unfavorable prognosis of periodontal disease is tooth mobility, and for that purpose, stabilization with the means of splinting has been recommended for such cases in order to improve patients' comfort during mastication.

The final result from the treatment corresponds to the results of other authors presenting a successful outcome.

CONCLUSION:

This article presents a digital approach for planning and fabrication of periodontal splint using CAD/CAM technology from composite material reinforced with glass fibers (Trilor; Bioloren S.r.l.) for machine milling.

The manufacturer claims benefits that include: lightweight, durable and resilient, no firing requirements, high flexural and compressive strength, biocompatibility, and adjustability.

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