3D-Printed Splints Therapy for Temporomandibular Disorders

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In the field of dentistry, digital technology is developing very quickly. There is an increasing demand for the most efficient use of expensive digital equipment. More and more dental practices are using digital scanners and digital facebows. It is an excellent option to improve 3D splint therapy in temporomandibular disorders. Dental offices and dental laboratories will rapidly adopt 3D-printed orthodontic appliances. The benefits are its accuracy and a light workload. It is precise, long-lasting, less expensive and quicker than the conventional method.

temporomandibular disorders oral splint 3D printing

1. Introduction

Since the first introduction of the Cerec system in the early 1980s, computer-aided design and manufacturing technology (CAD-CAM) has spread widely, not only in the field of adhesive restoration, but also in every field of modern dentistry. Thanks to this innovative technology, it has been possible to conduct chairside restorations fully managed by the clinician, with the advantages of lower costs, more rapid production and the exclusion of the provisional phase [1].

One of the key components of digital dentistry is 3D printing, and it is expected to grow rapidly [2][3]. As a result, dentists need to learn relevant information to help them to incorporate this technology into their everyday practices. Despite the fact that these additive inventions are already widely used, 3D printing is not introduced to most dentists during their undergraduate education [4]. However, the most recent generation of dentists possesses the necessary skills and fundamental knowledge of digital dentistry and can be quickly introduced to the new workflow provided by 3D printing, demonstrating their willingness to invest in this field [5]. The updated digital workflow also improves the patient experience by allowing CAD solutions to visualize anticipated outcomes in new ways [6]. For dental students, the digital process is not a problem. They become familiar with the essential procedures of digital dental treatment during their education, such as digital impression taking, additive manufacturing and intraoral scanning. The potential for digital dentistry to develop is vast among this new generation of dentists. Because the patient could use digital dental tools to follow their entire treatment, the workflow and patient outcomes could be created together. Using social media is crucial [7]. It is currently having a major impact on the healthcare industry and is a great resource for facilitating expert knowledge and experience sharing. Additionally, it appears to be a quicker method than official support networks for obtaining assistance if needed.

2. Etiology of Temporomandibular Disorders

With further improvements in chairside technologies and materials, specifically in 3D printing, an oral splint to treat temporomandibular disorders may at present be created in only one day. Temporomandibular disorders (TMDs) are a collective term for musculoskeletal conditions that could affect the temporomandibular joints (TMJ), masticatory muscles and related structures [8]. According to some estimates, up to 40% of individuals living with TMD symptoms will experience spontaneous recovery of their complaints [9]. Sounds in the TMJ and deviation when opening the jaw are common (about 50% of the population) and considered to be normal, so they do not require any treatment. There are more concerning signs and symptoms, such as reduced mouth opening and occlusal changes (which affect approximately 5% of the population) [9]. TMDs have a considerable prevalence and substantially impact physical and psychosocial factors [10]. The major symptoms of TMDs include pain or tenderness of the jaw; pain in one or both of the temporomandibular joints; aching pain in and around the ear; difficulty or pain while chewing; and aching facial pain or locking of the joint, which makes opening and closing the mouth difficult [9][11].

3. Treatment Options of Temporomandibular Disorders

TMDs also cause considerable socioeconomic costs, which are usually caused by other health problems, such as depression and other psychological issues [12]. The suggested treatments for TMDs vary over an incredible spectrum of modalities. The reason for this is their multifactorial etiology. The clinician has numerous recommendations for treatment methods, from patient education to surgical interventions. There are two main types of treatment modalities: conservative (reversible) (such as biofeedback, oral splints, physiotherapy and patient education) and non-conservative (irreversible) (such as arthroscopy, orthodontic treatment, TMJ surgery and irreversible occlusal treatment). Because of the lack of evidence-based treatment modalities, it is recommended to start with conservative solutions and later to move on to non-conservative solutions. To accurately assess occlusions, the condyle must be guided into the proper position. Before evaluating the occlusion, the condylar position should be examined if there is an occlusal discrepancy between the position of the condyle in the intercuspation position (ICP) and centric relation (CR). Occlusions in ICP and in CR differ for patients with an unstable occlusion. Joint sounds or pain in the temporomandibular joint (TMJ) may be a sign and symptom of this occlusal imbalance between the ICP and CR. To manage TMJ sounds and pain, occlusal correction or orthodontic treatment may be potential options, so determining the patient's precise occlusion is crucial for treatment planning. For this reason, a facebow transfer and an articulator should be used to ascertain the dynamic and static positions of the mandible. To assess mandibular movement, an accurate depiction of the condyle and its axis–orbital plane on the articulator is necessary. The orbital point serves as the hinge axis' anterior reference point, and the condyle's medial pole serves as its posterior reference point in the axis–orbital plane. For transferring this information to the articulator, a facebow transfer is crucial. Although using an articulator and a facebow transfer can be complicated, the axis and orbital point of the condylar hinge must be accurately transferred to the articulator. Furthermore, it is still not clear whether the procedure can be repeated.

At present, virtual facebow transfer and virtual articulator mounting are possible thanks to the development of digital technology. The expertise of the treating healthcare provider may largely influence the selection of a treatment modality [13]. Oral splints or oral appliances are modern methods to manage temporomandibular disorders. Most of the time, using occlusal splints is a non-invasive, reversible way to help dealing with the symptoms of TMDs [14][15].

Splint therapy is the foundation and an essential component of any TMJ treatment plan. For many TMJ conditions, it is the primary therapeutic device. Splints can be used to stabilize the bite, treat temporomandibular disorders or protect the teeth from damage and wear [16]. The protection of the TMJ discs from dysfunctional forces that can cause perforations or permanent displacements is a common goal of occlusal splint treatments. Other treatment goals include improving jaw–muscle function and relieving associated pain by establishing a stable, balanced bite [16][17][18][19].

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