Occlusal splints which are commonly used in prosthodontic treatment of temporo-mandibular dysfunction

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Summary

A considerable increase of patients suffering from temporo-mandibular dysfunction has been observed lately. This disease is becoming a social problem. A strong face and head pain, which is one of the symptoms of this disease, calls for effective prosthodontic treatment which eliminates the acute stage of the disease. In the first stage of treatment, i.e. at the stage of acute pain symptoms, an occlusal splint is typically used. It is found to be the most efficient device and is able to decrease or eliminate pain (70-90%), to correct the mobility of the jaw, and it is helpful in differentiating temporo-mandibular dysfunction. The presence of the splint causes the loss of occlusal contact of own teeth (quite frequently parafunctional); by removing the mandible away from the maxilla, it increases the vertical dimension, bringing relief to the joints, causing lower level of muscle tone and optimum bite force distribution. Changed mandible to jaw relation, in case of pain and long term elevator muscles contraction, prevents an appropriate occlusal evaluation in a centric and eccentric occlusion. The splint allows to position the jaw in a centric relation which is very important in prosthodontic treatment. In the article we have discussed: the influence of stabilisation, reposition and NTI splints on the stomatognathic system, their detailed construction and some clinical procedures.

Key words

Occlusal splint, temporo-mandibular dysfunction.

Functional disorders of the stomatognathic system are considered the third dental disorder of a social character, after caries and parodontal diseases, and they affect 12-90% of the human population [1]. The most frequent cause for patients to seek medical attention is pain (93%) in the temporo-mandibular joints (TMJ) and in the masticating muscles and head muscles, either local or radiating into the eye, ear and neck. Other concurrent or isolated symptoms include: limited mandibular mobility, acoustic symptoms in the TMJ (cracks, rustles, snaps) and masticating difficulties. Characteristic for the condition is increased activity and asymmetric activity of the masticatory muscles, which is expressed by asymmetry in free movements of the mandible, also referred to as mandible deviation. Patients are frequently referred to
laryngologists, neurologists or rheumatologists, although often they are efficiently helped by a dental prosthetic practitioner [1.2].

The objective of the article is to discuss the mechanics of the stabilising, repositioning and NTI splints, their design details, indications for use and staging of clinical treatment.

In the first phase of treatment, which usually involves acute pain in the stomatognathic system, occlusal splints are used, which are recognised to be efficient orthopaedic appliance that reduces or eliminates pain (70-90%) after a relatively short time (1-3 months), improve mandibular mobility, and facilitate the differentiation of the dysfunctions. A quick subsidence of pain following the application of the splint points to a muscular cause. In patients with joint related dysfunction the splint allows the practitioner to diagnose an intra-articular disorder, i.e. pathological disc displacement with or without locking and with partial or total repositioning [3.4]. The presence of the splint results in loss of direct occlusal contact between the frequently parafunctional teeth, and by increasing the distance between mandible and maxilla it increases the vertical dimension, relieves the temporo-mandibular joints and reduces the excessive activity of the masseters and frontal fascicles of temporal muscles. The reduced teeth contact area while the splint is used is also one of the mechanisms to reduce excessive muscle tone as the volume of the isometric muscular contractions during mastication is proportional to the teeth contact area. A strict relationship has been established between the masticatory muscles activity and their pain and fatigue.

Experiments have confirmed a reduced activity of the lateral pterygoid muscles, masseters and temporal muscles as early as within three weeks of application of occlusal splints. The use of occlusal splints in the therapy of functional disorders results in gradual elimination of parafunctional reflexes through loss of so called muscle memory and interruption of dysfunctional habits along the entire dental arch, that are transmitted by reflexive regulation mechanism [5]. By providing full support to the dental arches, the splint causes optimum distribution of occlusal forces and creates a new, harmonious vertical and horizontal mandibulo-maxillary relationship. In the event of articular disc or condyle displacement, the splint helps relieve the joints and reposition the disc until it is correctly positioned in the glenoid fossa [6].

In existing pain and long-term muscle contractures that were caused by reflexes, the modified mandibulo-maxillary relation enable proper analysis of centric and eccentric occlusion. The application of the splint allows for positioning the mandible in a centric relation, as a starting point for prosthetic rehabilitation procedures [7].

The use of occlusal splints at an early stage of functional disorders helps eliminate or reduce pain (70-90% cases), relieve the temporo-mandibular joints, reduce the excessive activity and restore symmetric muscular tonus. The occlusal splints used in the treatment of stomatognathic functional disorders may be divided into splints with accurately modelled occlusal surface and flat-surfaced splints, where only the functional cuspids of lateral teeth (buccal surfaces of lower teeth or palatal surfaces of upper teeth) and the cutting edges of front teeth are in contact during central occlusion, while the lateral and protrusive movements are done on the canines. Such splint design secures a reduction of the excessive activity of masseters on the working side and of temporal muscles on the balancing side.
Fig. 1. Michigan stabilising splint.

A more detailed approach divides splints into reflexive, stabilising and repositioning. They differ in terms of material and shape of the occlusal surface as well as manner of use and extent, although it is not the case that one type of splint is used to treat only one specific type of disorder. Some cover the entire dental arch, others only part of it, other yet act at specific points of two opposing teeth. They are used in the maxilla or the mandible [1.2.3.6.7]. Given the current state of knowledge and possibilities of diagnosing patients with identified functional disorders, it is absolutely necessary to address and eliminate the symptoms of the disease. Failure to undertake an early stage treatment and prosthetic reconstruction of the dental arches in those patients will cause the stomatognathic disorder to persist, which must be considered malpractice. The remaining part of the paper will describe the occlusal splints which are most frequently used in functional disorder therapy.

- Michigan Splint

A stabilising Michigan splint is a relaxant occlusal device, fixing the mandible in central position. (Fig.1). It provides all the above mentioned positive effects to the stomatognathic system. An indication for this type of splint are muscle related painful and painless stomatognathic disorders, functional disorders of cervical spine, tonus related headache, parafunctional habits and differential diagnosis of diseases with similar symptoms localised within the stomatognathic system, like collagen vasculopathies, multiple sclerosis, systemic lupus erythematosus. In addition, the Michigan splint is used in dysfunctions involving inflammations of the articular capsule or synovial membrane, during planned treatment of arthroscopy patients or following open joint surgery and in the cases of slight displacement of the disc without locking, when the click on mandible adduction occurs relatively early [2.3, 6, 7.8].

Fig. 2. Precisely defined occlusal contact points between the splint and occlusal cuspids of the opposite arch.

Fig. 3. Habitual occlusion in a female patient.

The splint covers the entire dental arch. Its labial edge extends to the previously drawn line of greatest convexity of the crowns of own teeth, and it covers the gum on the palatal side with a strip 1.5 cm wide. The Michigan splint is made of transparent acrylic plastic, hot polymerised in the can. Despite its flat occlusal surface, the contacts with the opposing arch are strictly defined (Fig.2). In centric occlusion it should contact the occlusal cuspids of the side teeth and the incisive edges of the front teeth. The occlusal cuspids may not be in contact only in the case of severe displacement of individual teeth. In eccentric occlusion the splint should only be in contact with opposing canines. This is important as this kind of occlusal mandible movement has a beneficial effect on the electric activities of masseters and anterior fascicles of temporal muscles. In centric occlusion it is recommended to achieve so called “freedom at centre”, i.e. in contact with the splint the mandible should have the freedom to slide within an occlusal field of 0.5-0.8 mm sagittally and transversely.
Splint thickness should be considered on a case basis, with an average of around 2 mm. Since muscle stretching is one of the mechanisms causing the hypertonus to decrease, the splint may not be too thin. Besides, whenever reverse clicks occur, the vertical dimension of the splint should secure such arrangement of the articular disc-articular head system as to eliminate the click during mandible adduction [3]. Patient preparation involves the explanation of the mechanics of the appliance, stating the expected duration of application, sequence of procedures, and in the clinical part – liquidation of major occlusal obstacles. Working models (with the extent of the splint marked on the buccal surface of the teeth) are fixed to the articulator based on a spatial orientation established using the face-bow. The splint is modelled from pink wax, in accordance with the design principles discussed before, and made of hot polymerised acrylic [5]. During the same appointment when the ready splint is issued, the practitioner checks the correct location of the splint, correct occlusal contacts with the teeth of the opposite arch in centric and eccentric occlusion and the “freedom at centre”. Patients should be informed on how to insert and pull out the splint and on the recommended time of wear, i.e. 2-4 hours during the day (especially the time of intensive parafunction) and during night rest.

- Repositioning splint

This splint covers the entire dental arch, fixing the mandible in protrusion in relation to habitual occlusion. It is made of hot polymerised acrylic (Fig.3 and 4). It is recommended in functional disorders involving articular disc displacement without locking and in inflammatory conditions of the retrodiscal tissues (chronic microtrauma). The repositioning splint fixes a specific location of the mandible in relation to the maxilla, which allows the disc to return to the correct position, i.e. on mandibular condyle.

Fig. 4. Repositioning splint to fix the mandible in a protrusive position.
Fig. 5. Polycarbonate matrix of an NTI splint

The selection of protrusive position should be based on a test, fixing the mandible in such a position where there are no clicks during adduction and abduction. Therapeutic occlusion is established in the patient’s mouth on a template on the occlusal surface. At the same time, the protrusive position of the mandible secures a physiological arrangement of the articular head-disc complex. The task of a repositioning splint is to secure permanent position of the head on the intra-articular disc and to reduce pain in the temporo-mandibular joint and muscles.

The protrusive position should be the smallest forward movement of the mandible from the habitual occlusal position (1-3 mm), where no acoustic symptoms are found during mandible adduction and abduction, i.e. the head constantly resting on the disc.

Patients should use repositioning splints 24 hour a day. Wear time depends on the degree of reduction or recession of symptoms (pain, clicks). In an attempt to establish the wear time in patients with disc displacement without locking caused by reduced occlusal height we found that 8 weeks is sufficient to consider the therapeutic occlusion correct and to commence final prosthetic treatment to fix correct mandible position [12].
A repositioning splint may be made for both maxillary and mandibular teeth, and selection depends on patient’s individual needs, i.e. location of missing teeth or aesthetic considerations. If the patient refuses to use the upper splint during the day, another lower splint may be made, which covers the lateral teeth and is more convenient for mastication and more aesthetically pleasing, and is worn in turns with the upper splint. A repositioning splint may be made of acrylic or polyester plates (Erkodur), by hot pressing in an Erkopress device, and the occlusal surface should be modelled with fast curing acrylic, to provide additional rigidity to the splint [6]. Literature appreciates acrylic splints more than ErcoDur splints.

• NTI Splint

The abbreviation stands for Nociceptive Trigeminal Inhibition. It is a polycarbonate matrix covering the upper incisors, sealed with a purpose designed fast curing material Snap (Fig.5 and 6). The NTI operating principle is based – as in the case of a deprogrammer – on a defensive reflex triggered during parafunctional movements, based on reflexive regulation mechanisms which secure immediate reduction of the occlusal forces. The defensive response is activated by the nociceptors in the parodontium, mostly located around the maxillary and mandibular medial incisors. Indications for the application of an NTI splint include tonal and migraine headaches and muscular/articular pain caused by intensive occlusal and non-occlusal parafunctions. Counterindications for this type of splint include loosening of teeth in the front dental arch section and general diseases like epilepsy.

Fig. 6. Material used for splint sealing - Snap.
Fig. 7. NTI splint in the oral cavity.

The application of an NTI splint does not require impressions for working models, as a standard matrix is sealed individually in situ with a fast curing material. The splint is positioned on upper central incisors so that the lower incisor medial line crosses the middle of the bump (discluding element) (Fig.7). The height of the bump should be so adjusted as to secure disclusion of the canines and teeth in the lateral section of the arch, with minimum elevation of occlusal height, while the bump surface remains in contact with lower incisors in a protrusive and retrusive position of the mandible. The fast curing material is applied up to 2/3 of the matrix height and mounted on upper incisors in a previously tested position, so as to secure splint sealing and stabilisation. After the polymer has cured (about 5 minutes) the stability of the splint on upper incisors and the ease of splint removal must be checked. Patients should use the splint for several hours during the day and during night rest. Eating with the NTI splint is not recommended.

In summary, the use of occlusal splints in staged treatment of patients with functional stomatognathic disorders is efficient and justifiable. An optimum occlusal splint should be non-invasive, comfortable to use and aesthetically pleasing [12]. It is difficult to meet those requirements with one splint. If the disease affects both joints and muscles, treatment may involve a combination of splints. The type of splint used should be based on the diagnosis, and it should be acceptable to the patient in terms of their occupation and aesthetic expectations.
Practitioners embarking on the application of splints to treat patients with functional disorders should be aware that the treatment is difficult and requires knowledge of muscle and joint physiology and biomechanics. Splint based therapy is typically the beginning of prosthetic rehabilitation and should be applied in conjunction with physical therapy, pharmacotherapy and psychotherapy. When acute pathological symptoms have subsided and the new occlusal settings have been adapted (whenever they change), final therapy may be commenced.

Literature