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REDEFINING OCCLUSAL SPLINTS

Prosthodontics

Dr Meenakshi S* Assistant Professor, Department of prosthodontics, crown and bridge, Jss dental college and hospital, Mysuru, 570015 *Corresponding Author

Dr Priya Mukherjee Post graduate student, Department of prosthodontics, crown and bridge, Jss dental college and hospital, Mysuru, 570015

Dr Aishwarya R Patil Post graduate student, Department of prosthodontics, crown and bridge, Jss dental college and hospital, Mysuru, 570015

Dr Raghavendra swamy KN Professor and Head of the department, Department of prosthodontics, crown and bridge Jss dental college and hospital, Mysuru, 570015

ABSTRACT

Occlusal splint therapy defined as "the art and science of establishing neuromuscular harmony in the masticatory system by creating a mechanical disadvantage for parafunctional forces with removable appliances. It is a device which fits over the occlusal and incisal surface of the teeth in one arch. It may be used for occlusal stabilization, for treatment of temporomandibular disorders, or to prevent wear of the dentition. When considering the use of splints, one should avoid the "one aetiology, one diagnosis and one treatment" approach. A combination of various treatment plans are employed in the management of patients of TMD including counselling, drug therapy, physiotherapy and splint therapyproducing a better cumulative result than any individual options used in isolation. Hence, it is important to recognize the basic science behind temporomandibular joint function and dysfunction, the evaluation of TMJ and the application of splints in rectifying the same- WHEN WHERE AND HOW?

KEYWORDS

Pain, temporomandibular joint disorders, appliances, occlusal splints

1. PREAMBLE

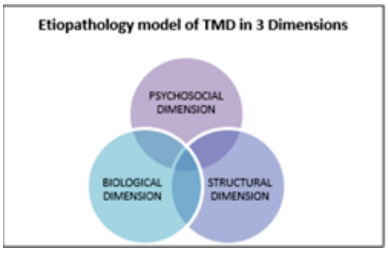
The following document was developed for recognizing the basic science behind temporomandibular joint function and dysfunction, the evaluation of TMJ and the application of splints in rectifying the same. A culmination of various texts, articles and case reports has been used to form an outlay apprising the usage of splints - when, where and how. The following text will enable clinicians to have better approach in occlusal splint therapy for TMJ disorders

2. INTRODUCTION:

Temporomandibular disorders

Temporomandibular disorder (TMD) is defined as alteration inthe alignment and function of the joint and associated muscles which may or may not include occlusal interferences.Thereby depending on the practitioner and the method of diagnosis used, TMD can be classified on the basis of a variety of signs and symptoms such as facial pain , joint discomfort, reduction in opening of mouth, locking of the joint (closed or open), atypical wear of occlusal surfaces, click or pop sounds in the joint area ,etc[1].

Temporomandibular disorder (TMD) is a disease caused by several factors which includes increased or abnormal (especially habitual) function of the muscle, trauma to the joint, influence of various hormones and changes in the articular surfaces. Basically, the disorder develops when there is an imbalance between the position of the mandible and inordinate masticatory forces or central nervous system response.[2]



Etiopathology model of TMD in 3 Dimensions

The masticatory disorders can be classified based on the parts involved namely the [3]

1) muscles
2) temporomandibular joint
3) dentition

Prevalence

90% of the population, mostly 20-40 year-old womenare affected by problems of TMD. But, only a few individuals, out of these, pursuemedical attention.[2]The epidemiological studies have estimated that approximately 50-75 per cent of the populations exhibit some signs of TMDs.[4]

Early in the development in the field of TMDs and orofacial pain neither there was research, nor was there an appreciation of evidence based medicine. Consequently treatments were instituted that were often not effective and sometimes were very aggressive.[3] But nowadays, with the advent of global diagnostic approach and better understanding of the subject, newer treatment options have come up addressing wider range of population with a better prognosis.

Role of Splints

The management of patients with temporomandibular disorder is controversial and attracts suggestions from widely differing viewpoints. When considering the use of splints, one should avoid the "one aetiology, one diagnosis and one treatment" approach. A combination of various treatment plans may often be employed in the management of patients suffering from symptoms of TMD including counselling, drug therapy, physiotherapy and splint therapy, often producing a better cumulative result than any individual options used in isolation.[5]After identifying the origin of the joint disorder, splint treatment, which is reversible as well as non-invasive, helps in both provisional diagnosis and in providing comfort to the patient until definitive treatment is achieved. Occlusal splint therapy may be defined as "the art and science of establishing neuromuscular harmony in the masticatory system by creating a mechanical disadvantage for parafunctional forces with removable appliances."[6] A precisely made splint helps in a achieving a mutually protected type of occlusion.[7]

1. WHAT ARE SPLINTS/ OCCLUSALAPPLIANCES??

Splints are type of removable prosthesis fabricated by either hard or soft material covering the tooth surfacesin one arch, which occludes accurately with the teeth of opposite arch. It is known by different names like occlusal splint, night guard, interocclusal appliance and orthopaedic appliance.

The basic uses of an appliance are as follows,

1) It temporarily introduces a steady occlusion which alleviates the muscle pain by modifying the neural and muscular reflex activity ,
2) Its alters occlusion to achieve stable condylar positions.

3) In situations of abnormal forces causing breakdown or tooth wear, it shields the hard and soft tissues.[3]

Types of occlusal splints

1) Permissive occlusal splints
- They have a smooth surface on one side that allows muscles to slide back to their orthopaedic stable position without interference
- The smooth surface can be in the upper or lower arch as long as it frees the mandible to slide in centric relation.

2) Directive occlusal splints
- It is used to direct the lower arch into specific occlusal relationship that in turn directs the condyles in a predetermined position.
- They are not used generally, but reserved for specific conditions involving intracapsular TMDs.[1]

Mostly used occlusal appliances are (Okeson)
- Stabilization appliance (also known as muscle relaxation appliance)
- Anterior positioning appliance (orthopaedic repositioning appliance)
- Anterior bite plane, the pivoting appliance, soft or resilient appliance.[3]

4. HOW DO SPLINTS WORK?

Splints serve as multipurpose adjunctive tool in the following ways:-
- It provides relaxation of spasmodic muscles
- It preserves the hard and soft tissues from the deleterious effects of bruxism,
- It establishes normal periodontal ligament proprioception.
- It helps in relocate the condyles in centric relation (CR).[6]

5. APPLICATIONS OF ORAL SPLINTS:[9]

A. Temporomandibular disorders:
- Myofascial pain
- Disc displacement disorders
- Arthritides of the temporomandibular joints

B. Other pain disorders
- Headaches/migraine

C. Motor and sleep disorders
- Sleep bruxism
- Sleep apnea
- Parkinson's disease
- Oral tardive dyskinesia

D. Occlusal rehabilitation
- Orthodontics
- Periodontics
- Prosthodontics
- Phantom bite

E. Others (Prevention of tissue trauma, habits)
- Diurnal bruxism
- Sports
- Cheek or fingernail biting
- Electroconvulsive therapy
- Lip commissure burn
- Esophageal reflux
- Sinusitis

6. CASE REPORT

CASE REPORT -1

A 21 year old male patient reported to the department of oral medicine and radiology with the chief complaint of pain in the right and left side of the face in front of the ear and reduced mouth opening since 15 days. The pain was gradual in onset and radiated to the temple region which got relieved on taking medication such as ibuprofen and paracetamol. Pain aggravated on opening and closing the mouth during activities like eating or yawning.

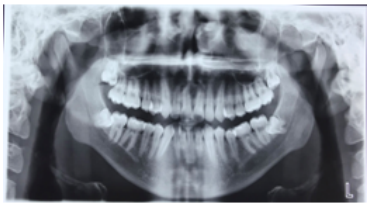
Clinical findings:-

Extra-orally, no gross asymmetry of face was noted. The mouth opening was reduced to a considerable amount of 17mm. The patient exhibited no deviation or deflection while mouth opening. The TMJ was auscultated and it elicited clicking sound on opening and closing of mouth. On palpation, the temporal muscle and TMJ both showed signs of tenderness and pain on opening and closing of mouth.

On intra-oral examination patient's oral hygiene was noted to be satisfactory with absence of any decay. Mandibular anterior crowding was present. The patient was then advised for an Orthopantomogram to aid in the final diagnosis. On complete clinical and radiographic analysis, a provisional diagnosis of internal derangement of the right and left TMJ was given.

For symptomatic relief, pharmaco-therapy, hot packs and soft diet, was advised for a period of 1 week after which he was advised for a follow up at the Department or oral surgery and Department of prosthodontics respectively.

After a thorough, multidisciplinary discussion a treatment plan best suited for the patient was advised. After one week of palliative therapy mouth opening was improved, which allowed impression making and face bow transfer for fabrication of hard splint. The department of oral surgery performed bilateral arthrocentesis and patient was advised to use the hard splint after the surgery for a period of 2 months. The palliative treatment was continued after the surgery for three days. Follow up was done at 1, 3 and 6 weeks. Patient was comparatively healthy at the end of two months.



RADIOGRAPHIC ANALYSIS (OPG) 1

CASE REPORT- 2

A 19 year old female patient reported to the OPD with difficulty in opening and closing the mouth and pain on the right side since 2 months. Pain was gradual in onset and was experienced mainly during the daytime. Past history revealed orthodontic treatment which was done 3 years ago.

Clinical findings:-

Extra-orally, no gross asymmetry of face was noted. The mouth opening was reduced to a considerable amount. The functional examination of TMJ revealed tenderness on the right side and deflection while opening to right side. The structural examination of TMJ showed no swelling. On palpation, right temporalis and masseter muscle were tender.

Intraorally, patient had a fair oral hygiene with initial dental caries with respect to a few teeth and erupting third molar in the right lower back region.

Radiograph was taken to rule out joint discrepancies. A tentative diagnosis of Occluso-muscle disorder triggered by deflective occlusal interferences was diagnosed.

A treatment plan with Stabilization splint was advised for the patient along with pharmacotherapy. The patient was instructed to wear the splint for a minimum period of 12 hours. Follow up was done at 1, 3 and 6 week. Gradual pain relief was noted.

RADIOGRAPHIC ANALYSIS (OPG) 2

7. DISCUSSION:

Fundamentals of TMJ
- TMJ, a ginglymoarthroidal joint displays the distinctive simultaneous movement of its constituent parts i.e. rotation and translation during mandibular function.
- ROTATION- for first 25 mm of mouth opening - action of the suprahyoid muscles.
- TRANSLATION/GLIDING – more than 25 mm of mouth opening -action of the lateral pterygoid muscle.

- Elevators of mandible- temporalis, masseter, and medial pterygoid muscles.

The joint space is divided into superior and inferior compartments by the articular disk which is less than 1 mm thick. The movement of the disk occurs with the condyle due to its medial and lateral attachment.

Any obstruction, for example, a tumour, spasm of the muscle, fracture, ankyloses etc. that restricts the normal gliding of one condyle will not affect the gliding of unaffected condyle. Hence, this will lead to deviation of the chin toward the affected side. If the condition affects both the condyles, it causes restricted mouth opening (less than 25mm)

Examination of TMJ

The clinical examination of TMD usually precedes a screening history consisting of various short questions, just to make the clinician aware of any TMDs present in the patient.

The following type of questions can be asked to identify functional disturbances.

- Difficulty and/or pain in opening of the mouth-for instance, yawing?
- Jaw getting stuck or locked?
- Discomfort or pain during chewing or talking?
- Noises in the joint?
- Jaws feel stiff, tight or tired?
- Discomfort in or around forehead, ears, or cheeks
- Past history of head and neck trauma?
- Any bite alterations?
- Any recent treatment for inexplicable pain in the face or joint?3

Along with the above assessment, a brief examination for facial conformity should also be done. Any deflectionfrom the normal will indicate added need for investigation.

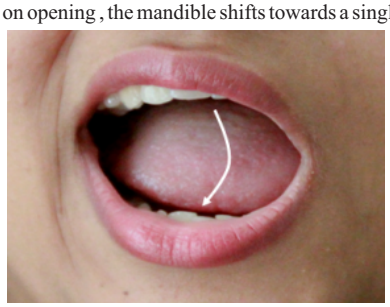
Initial manifestations of joint discomfort include the following:
Clicking and crepitus

Hypersensitivity in the area of condyle and muscles of mastication

Joint function disruption (e.g.: excessive mobility, movement limitation, deflection)

Deviation – jaw shows an alteration in the opening path but comes back to the centered position

Deflection – on opening , the mandible shifts towards a single side



First step in clinical examination is as follows:-[11]

AUSCULTATION

During functional movements of the mandible, clicking and crepitus may be identified. The investigation is done by asking the patient to do opening and closing movements of the jaw and if the sounds are noted, the patient is asked to repeat the same movements but with protrusion of the mandible.

PALPATION

To evaluate and assess, if the joint is tender or to check for the co-ordination and simultaneous movement of the joint, the following two methods are advocated:-

1. The patient is asked to open and close the mouth while the clinician places his/her forefinger over the condylar area and glenoid fossa region.
2. The palpation of the posterior surface is done by inserting the little finger inside the patients' ear.[11] (TABLE 1)

In case of pain, as elicited by Rocabado pain map[12], the patient is referred for pharmacotherapy and surgical intervention directly. In such cases, splints are of little usage.

A. FUNCTIONALANALYSIS [11]

- **MAXIMUM INTER INCISAL DISTANCE:** Boleys gauge is used by the clinician to measure the distance between the incisal edges of the maxillary and mandibular central incisors.
- **RULE OF THUMB** – diagnosis of incipient TMD can be made if two of the following three signs are present:

a. Perioral neuromuscular abnormalities
b. Crepitus (clicking, popping and grating)
c. Tenderness of the Lateral Pterygoid Muscle

Dental Examination:-

1. Pulpitis
2. Tooth mobility
3. Tooth wear (attrition, abfraction)
4. Occlusal examination – centric relation contacts, intercuspal position and eccentric occlusal contacts

B. RADIOGRAPHIC ANALYSIS[11,13]

1. TMJ imaging
2. Plain radiography
3. Transcranial radiography
4. Tranpharyngeal radiography
5. Transmaxillary radiography
6. Panaromic radiography
7. Computed tomography
8. SPECT (single proton emission tomograpghy)
9. TMJ Arthrography
10. Magnetic resonance imaging
11. Ultrasonography
12. Radionucleotide imaging (scintigraphy)

The complexity of TMD makes it difficult for the clinician to form a definitive treatment plan. Thus, making a reversible and non-invasive splint therapy as the best first line of treatment. If malocclusion is the causeof TMD, a splint therapy can help in achieving a stable occlusion, making it a diagnostic adjunction to managing TMDs. (TABLE 2)

In one of studies by Wright et al 1995, it was stated that the soft splints are usually preferred because of ease of fabrication, reversible nature and cost effectiveness.[25]On the contrary, Litner et al (2004) mentioned the successful outcome with hard splints in patients with TMD disorders.[26]Perttengill et al (1998) claimed the usefulness of both the soft and hard splint in alleviating pain related to TMJ.[27]Henceforth, this review was done to draw a relationship between the disorder and type of splint to be used.

8. CONCLUSION:

Temporomandibular disorder is a combined terminology which includes all the complications related to the TMJs and surrounding muscles.. A variety of treatment options are recommended, often more than one to be done at the same time but the conservative therapy should be the first line of treatment for treating TMDs than surgical intervention. Occlusal Splint therapy is considered most appropriate and a very important adjunct to pharmacologic therapy. And therefore, accurate diagnosis, correct treatment plan with proper fabrication of the appropriate occlusal device should be the prime aim of the prosthodontist to serve the patients best interest.

Conflicts of interest: None
Source of funding : Nil

TABLE 1: PALPATION OF TMJ RELATED MUSCLES[1]

1.	Lateral pterygoid	• The index finger is placed posterior to the maxillary tuberosity, just above the level of occlusion, with the palmer surface placed towards the medial surface of the pterygoid hamulus. • Early TMJ symptoms, unilateral tenderness commonly occurs. If hypersensitivity or pain is present on both sides, the condition is more protracted • Tenderness in the superior head of the LPM is an important diagnostic clue because it may indicate abnormal functional loading of the joint	1. 
2.	Temporalis Muscle	• Palpated bilaterally and extraorally. • anterior, medial and posterior portions of the muscle are examined separately. • Palpation is carried out while the muscle is contracted isometrically. • temporal tendinous attachment on the coronoid process, in the posterolateral region of the upper vestibule is palpated.	2.  3  4 
3.	Masseter	• On both the sides, the clinician places his/her fingers ahead of TMJ on the zygomatic arch at the upper and lower attachment of muscles. • Once deep masseter is palpated then the fingers are dropped to the inferior attachment on the inferior attachment of ramus • During maximum isometric contractions the width of the superficial masseter and its direction of pull can be registered around the gonial angle. This muscle attachment should be examined for pain on pressure. Occasional trigger spots may occur which can be quite painful	5  6 
4.	Sternocleidomastoid (becomes symptomatic with TMDS)	• On both the sides, posterior to the external acoustic meatus, where the muscles ends on the mastoid fossa. • Clinician palpates the complete muscle descending to the starting point at clavicular bone	7 

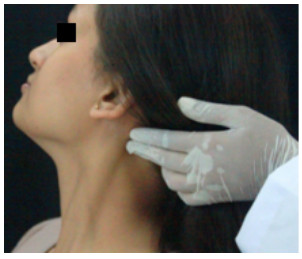
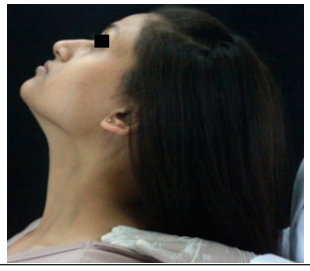
			8 
5.	Posterior cervical muscles(becomes symptomatic with TMDS) I. Splenius capitus I. Trapezius (Common source of headache pain)	Behind the insertion of the SCM muscle is a depression where palpation is started and is further moved inferiorly until the muscle blends into other neck muscles Superior aspect is felt from the posterior of SCM infero laterally till the shoulder area	9  10 

TABLE 2: SPLINT USAGE: WHEN, WHERE AND HOW?

	Disorders	Clinical Features	Type Of Splint	Thickness	Duration Of Wear	Reacall/follow Up (improvement Of Symptoms)
1	Masticator Muscle Spasm	-Pain w.r.t ears, jaws, headache -Aggravated by mandibular movements like chewing and yawning[14]	-HARD splint  -Stabilization splint -also called as Michigan splint, fox splint, Centric relation appliance[5] 	-Given according to present free way space of the patient; such that maximum occlusal contact is achieved.	-Minimum of 12 hours(designed for maxillary arch[15]or arch with less number of teeth present[1]	- 1, 7,15,30,90,150 and 180 days interval follow up.[15] - On improvement of symptoms of pain; patients were advised to gradually reduce wear upto minimum 8 hours a days.[15]
2	Disc displacement with Reduction	-Long history of clicking -Catching sensation -May or may not be painful[3]	-Full coverage splint constructed on the lower arch (for guiding the mandible downward and forward in protruded position)[3]	- Based on free way space, curve of spee and incisal guidance	24 hours a day for 3 months[3]	3, 6 and 12 months follow up.
3	Disc displacement without Reduction	-Reduced mandibular opening -On attempting wide opening of mouth; often deflects to one side[3]	-Stabilization splint[8]	- Based on free way space	Night time wear	1, 3 and 6 weeks
4	Bruxism	- Excessive tooth destruction(attrited or fractured) -discomfort in the joint and surrounding muscles -Headache -Active signs such as cheek ridging and tongue scalloping	-HARD splint -Interceptor splint also called as Localized occlusal Interference splint[3] - Anterior Deprogramming splint (for severe clenchers)[1]  -Soft occlusal splint (daytime clenchers)[3]	- 1-2 mm thickness in 2nd molar region. (upper stabilization splint)[16]	Primarily night time wear or when patients are aware of parafunctioning (driving)[3] -maxilla/mandible	2,4 and 6 weeks after insertion.

5	Migraine	- Repeated attacks of throbbing headache with photophobia, vomiting, preceding visual upset and sensory upset -mostly involving one side and lasting several hours or days.	- Soft occlusal splint[17]  -Upper or lower bite raising appliance[18] -Stabilizer occlusal splint on maxilla[19] -Anterior deprogrammer	- Based on free way space, curve of spee and incisal guidance.	-Every night during sleep[17,18] -During the time of attack	6 weeks and 3 months follow up.[17,18]
6	Sleep Apnea	• Excessive daytime sleepiness. • Loud snoring. • episodes of stopped breathing during sleep causing gasping or choking. • Awakening with a dry mouth or sore throat. • Morning headache.[20]	Mandibular advancement device (MAD) constructed on the lower arch.[21] 	As much as to protrude the mandible and tongue so as to gain space posteriorly preventing the collapse of the airway.	Worn during sleep hours.	1,3 and 6 weeks follow up.

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