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Research Article

SYSTEMATIC ANALYSIS OF USE OF OCCLUSAL SPLINTS IN TEMPOROMANDIBULAR DISORDER MANAGEMENT

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ABSTRACT

Aims & Objectives: This systematic review evaluates efficacy of occlusal splints in temporomandibular disorder management. **Methods & Materials:** The following databases were searched for analysis of use of occlusal splints in temporomandibular disorder management. MEDLINE (pubmed), Embase, and Google scholar. Reference lists of articles were also searched. **Results:** This systematic review evaluated 16 studies with stabilization splints in which 668 sample sizes were used, 2 studies with anterior repositioning splints in which 30 sample sizes were used, 5 studies with soft splints in which 60 sample sizes were used, 3 studies by invasive methods in which 19 sample sizes were used, 4 studies by multifaceted approach and 7 comparative studies. **Conclusion:** A proper examination and differential diagnosis is necessary to lead to a decision regarding the appropriate role of splint therapy for each problem. The clinicians should be better equipped to successfully implement splint therapy into their armamentarium of treatment options in managing masticatory system disorders.

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INTRODUCTION

Oral appliances are frequently used in patients with Temporomandibular disorders. Oral appliances can be categorized into those that cover all the teeth (complete coverage) and those that cover only some of the teeth. They also can be categorized into those that deliberately attempt to reposition or realign the maxilla-mandibular relationship (repositioners) and those that do not seek to change this relationship (stabilizers or non repositioners). Oral appliances, which used to be simple processed acrylic devices that covered all or most of the teeth in one arch, are now available in a variety of materials and designs.¹ Temporomandibular disorders, which used to be viewed as problems related to some type of occlusal or skeletal disharmony, have undergone a rather substantial paradigm shift. The aim is to review the literature on Oral appliances, with a specific focus on their use in the treatment of Temporomandibular disorders resulting in evidence-based conclusions regarding these issues. In addition to describing the differences in materials used in the fabrication of Oral appliances, the various designs of Oral appliances are analyzed regarding their proposed mechanisms of action and their claimed clinical objectives. Finally, the concept that Oral appliances are effective primarily owing to their potential for acting as elaborate placebos will be considered.¹

MATERIALS AND METHODS

This topic is reviewed systematically as follows

DISCUSSION

Our review yielded moderate quality evidence that stabilization splint therapy has a substantial effect on reducing pain among patients with temporomandibular disorders. Nearly 16 studies had been conducted with stabilization splint therapy with a sample size of 668 for various conditions like disk displacement with reduction, temporomandibular disorder associated muscle pain, and myofascial pain dysfunction syndrome. Various outcome measures like pain during chewing, pain during protrusion, palpatory tenderness, insertion of temporal muscle and anterior portion of temporal muscle, changes in facial pain and headache, score on pain intensity, visual analogue scale, pressure pain threshold and changes in pain in affected joints had been recorded.

Anterior repositioning splints had been used in 2 studies with sample size of 30 in which pain, muscle pain, subjective visual analogue scale had been measured and the final outcome was satisfactory. Anterior repositioning splint is an appliance used on top teeth and has a sloping ramp to encourage the mandible to come forward to recapture the anteriorly displaced disc. The acrylic ramp rests lingual to the lower anteriors with buccal and

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incisal indices of the lower cusp tips. Thus the splint brings the mandible in a protrusive (forward) position.

Table 1 Search strategy

Topic searched	Results
(((((Occlusal splints) OR oral splints)OR Dental splints) OR Bite planes) OR Temporomandibular disorder) AND management	2029
(((((Occlusal splints) OR oral splints) OR Dental splints) OR Bite planes) OR Temporomandibular joint disorder)AND management	2001
(((((Occlusal splints) OR oral splints) OR Dental splints) OR Bite planes) OR Temporomandibular dysfunction) AND management	1335
(((((Occlusal splints) OR oral splints) OR Dental splints) OR Bite planes) OR Temporomandibular joint dysfunction) AND management	1095
(((((Occlusal splints) OR oral splints) OR Dental splints) OR Bite planes) OR pain dysfunction syndrome) AND management	1455
(((((Occlusal splints) OR oral splints) OR Dental splints) OR Bite planes) OR Temporomandibular joint syndrome)AND management	1014
(((((Occlusal splints)OR oral splints) OR Dental splints) OR Bite planes) OR facial arthromyalgia) AND management	619
(((((Occlusal splints) OR oral splints) OR Dental splints) OR Bite planes) OR craniomandibular dysfunction)AND management	659
(((((Occlusal splints)OR oral splints) OR Dental splints) OR Bite planes) OR masticatory myalgia) AND management	624

Database -Pubmed

Inclusion and exclusion criteria

Parameters	Inclusion criteria	Exclusion criteria
Study design	1. Systematic Review articles. 2. Meta analysis. 3. Randomized control studies. 4. Cohort studies. 5. Case Control studies 6. Splint therapy groups 7. Asymptomatic participants 8. Minimal or no treatment	1. Irrelevant studies 2. Case reports. 3. Case series. 4. Letter to Editor. 5. Professional communications. 6. Systemic reviews. 7. Animal studies
Publication date	From last 10 years to april 30, 2015	Unpublished or ongoing trials, published before 10 years
Language	English	Non-English
Conflict of interest	Free of conflicts of interest	

Selection process

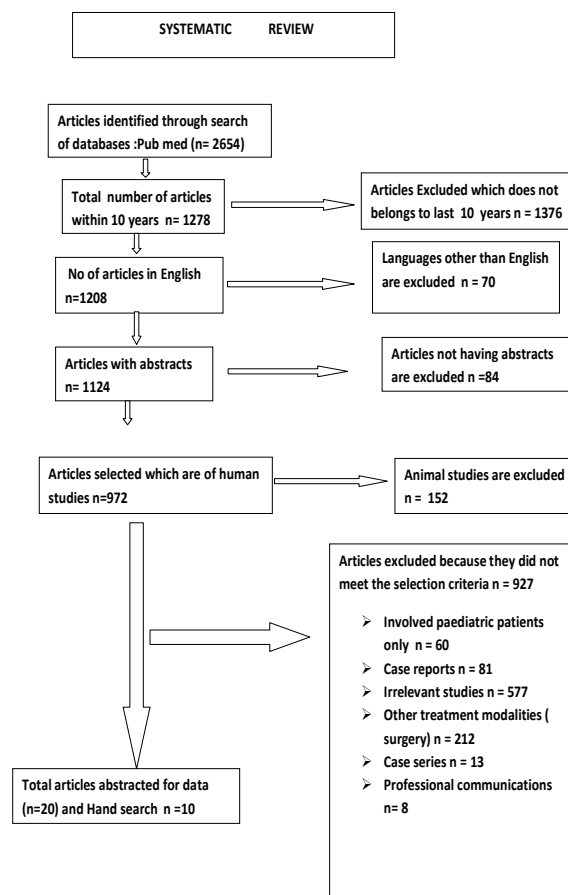
Assessment	Exclusion criteria
Titles	Irrelevant topics
Abstracts	Irrelevant study design (reviews, case reports)
Full text	---

Five studies had been done using soft occlusal splints with a sample size of 60 for conditions like temporomandibular disorder associated pain and disk displacement with reduction which had a better result for temporomandibular disorders. Occlusal splints is chosen for the treatment of dysfunctions in the orofacial region for several reasons. It is relatively simple, reversible, non-invasive and costs less than other treatments. Soft splints have a high degree of patient acceptance. The soft resilient material may help in distributing the heavy load that occurs during parafunctional activity.

Three studies had been conducted on invasive approach with a sample size of 19 for management of temporomandibular disorder associated pain concluding that surgical intervention should be associated with non-invasive methods for successful outcome. Surgical approach includes eminoplasty and eminectomy. In eminoplasty the procedure was performed

without opening the capsule and intra- articular structures. In eminectomy a standard endural incision was used to approach the articular eminence. The superior joint space was opened. The articular eminence and tubercle were removed including the medial portion of the eminence.

Four studies supported multifaceted approach of treatment for temporomandibular disorder like analgesics, home regimens, invasive and non-invasive procedures combined for an effective outcome. Home exercise regimens includes counseling, patient education, auto – massage, stretching exercises and mobilization exercises.



Seven comparative studies were done with a sample size of 446 between various treatment modalities like acupuncture, biofeedback, soft splints, stabilization splints, physiotherapy, rigid appliances, postural relaxation, diaphragmatic breathing, stretching, coordination exercise medication stated that stabilization splint therapy had a substantial effect on reducing pain among patients with temporomandibular disorders. Acupuncture may stimulate the production of endorphins, serotonin, and acetylcholine within central nervous system or it may relieve pain by acting as a noxious stimulus. Physiotherapy regimen includes several exercises that are widely prescribed by clinicians treating temporomandibular disorders because of the self management character of the treatment. These exercises help to relieve musculoskeletal pain and to restore the normal function by reducing inflammation, decreasing and coordinating muscle activity and promoting the repair and regeneration of tissues.

Characteristics Of Included Studies							
Author	Sample size		Age in yrs, mean(SD*)		Condition	Treatment modality	Assessment of results and outcome
	Test control	Test control	Test control	Test control			
Lundh and colleagues, 1985 ⁴ (Sweden)	23	23	NR	NR	Disk displacement with reduction	Stabilization splint	Palpatory tenderness laterally over the joint , palpatory tenderness of lateral pterygoid muscle, temporal muscle , superficial masseter muscle
Lundh and colleagues, 1988 ⁴ (Sweden)	21	22	NR	NR	Temporomandibular disorder (TMD)associated muscle pain, disk displacement with reduction	Stabilization splint	Pain during chewing, protrusion, palpatory tenderness of lateral pterygoid muscle , insertion of temporal muscle, anterior portion of temporal muscle, superficial masseter muscle
Johansson and colleagues, 1991 ⁴ (Sweden)	15	15	NR	NR	TMD with facial pain and headache	Stabilization splint	Changes in facial pain and headache, score on pain intensity visual analogue scale (VAS)
List and colleagues 1992 ⁴ (Sweden)	30	20	39	48	Painful temporomandibular joint (TMJ) disk displacement without reduction	Stabilization splint	Activities of daily living scale, pain intensity VAS, frequency of pain, pressure pain threshold
Lundh and colleagues, 1992 ⁴ (Sweden)	25	26	NR	NR	TMD –associated muscle pain	Stabilization splint	Changes in pain at maximal mouth opening , changes in pain at protrusion, changes in pain in affected joints on movements toward other side, changes in palpatory tenderness of masseter muscle.
Turk and colleagues 1993 ⁴ (united states)	30	20	35.9	33.1	TMD muscle pain	Stabilization splint	Pain severity scale, muscle palpation pain index, pain in the muscle sites examined bilaterally, origin and insertion of the masseter, temporalis and internal pterygoid muscles and one palpation site for the external pterygoid
Dao and colleagues 1994 ⁴ (Canada)	20	19	29.3	31.8	TMD muscle pain in general population	Stabilization splint	Pain intensity VAS, pain unpleasantness VAS, quality of life index
Wright and colleagues 1995 ⁴ (united states)	10	10	34	31	TMD muscle pain	Soft splint	Pleasure aglometer score
Al Quran and kamal 2006 ⁴ (Jordan)	38	38	31.8	36	Myogenous and TMD	Stabilization splint	Pain severity VAS
Fisher and colleagues 2008 ⁴ (Germany)	10	10	51.4	43.5	Complex regional pain syndrome type I, TMD	Stabilization splint	10 pain numerical rating pain scale , SF -36 health survey, temporomandibular muscle index
Tecco and colleagues 2010 ⁴ (Italy)	20	10	NR	NR	TMD – associated disk displacement with reduction	Anterior repositioning splint	Pain , muscle pain , subjective relief VAS
Carlson <i>et al</i> 2001 ¹⁵	44	-	-	-	Temporomandibular disorder	G1 – oral appliance G2 – postural relaxation, diaphragmatic breathing, proprioceptive re-education	G2 was more effective than G1
Dworkin <i>et al</i> 2002 ¹⁵	117	-	-	-	Temporomandibular disorder	G1- stretching, coordination exercise, medication, oral appliance; G2- stretching, postural relaxation, diaphragmatic breathing, cognitive – behavioral treatment	Short term: G2 more effective. Long term : G1 =G2
Truelove <i>et al</i> 2006 ¹⁵	200	-	-	-	Temporomandibular disorder	G1- relaxation, passive stretching G2 – G1 + rigid oral appliance G3 - G1 + softoral appliance	Similar and effective G1=G2=G3

Author /year	Sample size	condition	Treatment modality/Intervention and control/ comparison groups	Frequency and duration	Assessment of results and outcome
List <i>et al</i> 1992/93 ²⁰ sweden	N = 55, sex: 46 females, 9 males,	Temporomandibular disorder	Accupuncturevsocclusal splint therapy vs control	6 – 8 week duration; accu: 6- 8 treatments of 30 min duration; splints -: worn at night for 7 – 8 weeks; control : wait list	Pain threshold in kg/cm ² /s clinical dysfunction score(CDS): included oral opening, function, palpation of TMJ and masticatory muscles and pain with movement Significant differences between the 2 treatment groups and control groups n for pain (p<.05), CDS (p<.01), pain intensity (p<.01). Acupuncture and occlusal splint therapy have a significant effect on pain threshold , CDS, pain intensity with TMD
Dahlstrom and colleague 1982/84 ²⁰ sweden	N =30 sex: 30 female	Temporomandibular disorder	Biofeedvsocclusal splints	6 weeks duration Biofeedback: 30 min , 6 x, splints worn at night for 6 wk	CDS (1= none, 5 = very severe) oral opening No significant difference Two treatments were equally effective in short term

Author	Sample size	Conditions	Treatment modalities / Interventions	Assessment of results and Outcome
Dao 1994 ²⁵	N=63	Temporomandibular disorder	Stabilization splint Group A : SS to be worn day and night except at meal time Group B: Active control Group C :passive control	Pain intensity, pain unpleasantness and quality of life was measured
Magnusson 1999 ²⁵	N= 26	Temporomandibular disorder	Stabilization splint Group A : inter occlusal appliance n = 14 Group B : Jaw exercises n = 12	Patient rated pain and discomfort according to 6- graded behaviour rating scale.
Okeson 1983 ²⁵	N= 24	Temporomandibular disorder	Stabilization splint Group A : occlusal splint n = 12 Group B : relaxation therapy n = 12	Pain on palpation, inter incisal distance in mm
Johansson 1991 ²⁵	N = 45	Temporomandibular disorder	Stabilization splint Group A : SS - maxillary full coverage acrylic resin splint n=15 Group B: Acupuncture n=15 Group C : control n=15	Change in subjective dysfunction score (SDS) , Helkimo clinical dysfunction score (CDS)
Raphael 2001 ²⁵	N = 68	Myofascial pain dysfunction syndrome	Stabilization splint Group A : Maxillary , flat -plane , hard acrylic splint covering hard palate n = 35 Group B : palatal splint	Psychological measures, functional outcomes, expectations for improvement
Rubinoff 1987 ²⁵	N = 50	Temporomandibular disorder	Stabilization splint Group A : SS- designed to cover all maxillary teeth, n= 15 Group B : non- occluding palatal Appliance n=11	Pain diary, pain on palpation, success rating
Winocur 2002 ²⁵	N= 40	Temporomandibular disorder	Stabilization splint Group A : Full coverage , Hard acrylic appliance n=15 Group B: Hypnorelaxation n=15 Group C : Minimal treatment n=10	Pain, mouth opening, muscle sensitivity to palpation , chronic pain severity

Author	Sample size	Conditions	Treatment modality	outcomes
Gary D.Klasser <i>et al</i> 2009 ¹	—	Patients with Temporomandibular disorders.	Occlusal splint therapy	Authors have concluded that Occlusal splints are used for a shorter life span and failure to relieve symptoms if used permanently
Murphy <i>et al</i> 2011 ²	—	Patients with Temporomandibular disorders	Analysis among non-invasive, minimally invasive and fully invasive	Authors have concluded that tissue characterization is essential to identifying design objectives and validating progress
J.M. Zakrzewska 2013 ³	—	Chronic facial pain with unilateral or bilateral and continuous or episodic	Non – invasive methods	Authors have concluded that pharmacological and behavioral management is essential for pain management
Jeniffer J. Buescher 2007 ⁵	—	Patients with Temporomandibular disorders	Non – invasive methods	Author has concluded that oral splints should be considered with other treatment modalities of analgesics and antidepressants
Marta Mierniket <i>al</i> 2012 ⁷	—	Patients with Temporomandibular disorders specially with myofascial pain	Massage therapy	Authors have concluded that massage or manual therapy play a great role along with occlusal splints
Babatunde O Akinbami 2011 ⁹	—	Patients with Temporomandibular dislocations	Invasive methods has been analysed	Authors have concluded that conservative approach is essential. More complex and invasive method of treatment may not offer the best option and treatment
OrhanGüven 2009 ¹⁰	N= 19	Patients with chronic recurrent Temporomandibular dislocations	Invasive methods i.e ., eminoplasty and eminectomy	Author has concluded that Thorough examination and evaluation of each case is essential. Also added that the treatment protocol is under debate still.
Bruno D' AureaFurquim 2015 ¹¹	—	Patients with Temporomandibular disorders and chronic pain	—	Authors have concluded that TMD symptoms are a complex individual response with unique complaints. Hence multidisciplinary therapy should be encouraged.
Kathleen Herb <i>et al</i> 2006 ¹²	—	Patients with Temporomandibular joint pain and dysfunction	Examination of terminology and regional anatomy. Review of pathophysiology of Temporomandibular disorder.	Authors have concluded that comprehensive conservative plan along with surgical options are needed.
Sipilae <i>al</i> 2011 ¹³	N = 6227	Patients with Temporomandibular disorders	Muscle and joint on standardized palpation	Masticatory muscle pain and temporomandibular joint pain was associated with back, neck and shoulder pain.
Eng –ching Yap 2007 ¹⁴	—	Patients with myofascial pain	Multifaceted approach	Author has concluded that Early diagnosis and rehabilitation may help to relieve symptoms.
A. Michelottiet <i>al</i> 2005 ¹⁶	—	Patients with non specific Temporomandibular disorders	Physiotherapy versus other reversible therapies	Authors have concluded that home exercise regimes is weak because of very limited RCT available in literature. Hence further studies should be conducted.

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A. Michelotti et al 2005 ¹⁶	—	Patients with non specificTemporomandibular disorders	Physiotherapy versus other reversible therapies	Authors have concluded that Following osteopathic principles, it is important to consider the functional interrelation among the head, the neck, the TMJ, and the body as a whole in the management of TMD.
Antonino Marco Cuccia et al 2011 ¹⁷	—	Patients with temporomandibular disorders	—	Authors have supported the use of physical therapy for TMD patients but more evidence based research is needed.
Edward F Wright et al ¹⁹	—	Patients with temporomandibular disorders	Orthotic, stress management and medicative	Authors have concluded that proper examination and differential diagnosis is necessary to lead to a decision regarding appropriate role of splint therapy
Sangeethayadavet al 2011 ²¹	—	Patients with temporomandibular disorders	Occlusal splints	Authors have concluded that oral splints can be used in early stages
Sharmiladeviet al 2014 ²²	—	Patients with internal derangement of TMJ	Early : non – invasive Later : invasive	Authors have concluded that selective application of occlusal splints designs lead to successful outcome of results
Dewitt C et al ²³	—	Patients with temporomandibular disorders	Occlusal splints	Authors have concluded that The conventional soft occlusal splint therapy is a much safer and effective mode of a conservative line of therapy in comparison to long-term pharmacotherapy in patients with myofascial pain dysfunction syndrome
VenkateshNaikmasur et al 2015 ²⁶	N = 40 Group A = 20 Group B = 20	Patients with myofascial pain dysfunction syndrome	Group A --- muscle relaxants and analgesics Group B --- soft occlusal splint therapy	Authors have concluded that oral appliances are still regarded as useful adjuncts for treating certain kinds of TMD patients, but the emphasis is entirely on their conservative application.
Harpreetkumar et al ²⁷	—	Patients with temporomandibular disorders	Occlusal splints	Authors have concluded that NTI-tss bite stop may be successfully used for the management of TMDs and bruxism.
HenrikeStapelmann et al 2008 ²⁸	—	Patients with temporomandibular disorders	Anterior bite stop	

Based on studies by K. Niemela, M.Korpela, A.Raustia, P.Ylostalo, K.Sipila. (Efficacy of stabilization splint treatment on temporomandibular disorders)Occlusal splint therapy is an effective means of diagnosing and managing specific masticatory system disorders. Despite the unanswered questions on the physiologic mechanisms that explain the effectiveness of intraoral orthotics on reducing symptoms of temporomandibular disorders, there is still a plethora of documentation that intraoral orthotics, when appropriately used in the management plan, which can contribute to the relief of temporomandibular disorder symptoms. But the efficacy of the stabilization splint treatment on temporomandibular disorder in long time follow up remains to be confirmed.²⁹

The clinician is encouraged to evaluate completely each particular patient in an effort to develop a differential diagnosis that leads to an effective management plan, which, in turn, addresses the cause(s) as best as possible before commencing any intraoral orthotic therapy for a temporomandibular disorder, the clinician should be confident that the patient will benefit from the therapeutic approach to be employed or, at least, that the resultant effect, or lack thereof, on the symptoms will provide additional diagnostic information. The clinician also needs to take into account that approximately 40% of patients suffering from temporomandibular disorder demonstrate a favorable response to intraoral orthotic therapy just from a placebo effect. As with any treatment, a good patient – dentist relationship concomitant with patient education can allay patient concerns and anxieties, which, in and of themselves, can contribute to a positive and favorable response to intraoral orthotic therapy.³⁰

CONCLUSION

Occlusal splint therapy has been used for many years for the diagnosis and treatment of various disorders of the masticatory system. Many designs are described in the literature. The different types of splint are used to treat different conditions. A proper examination and differential diagnosis is necessary to lead to a decision regarding the appropriate role of splint therapy for each problem. To recapture partial or complete anterior disc displacement anterior repositioning splints can be used. Permissive splints can be used in muscle and disc incoordinations. Stabilization splints are useful for immediate posterior disillusion by anterior teeth and condylar guidance. The clinicians should be better equipped to successfully implement splint therapy into their armamentarium of treatment options in managing masticatory system disorders.

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