

Content available at: <https://www.ipinnovative.com/open-access-journals>

IP Annals of Prosthodontics and Restorative Dentistry

Journal homepage: <https://www.aprd.in/>**Review Article****Role of hydrostatic occlusal devices in the management of temporomandibular disorders (TMD) – An overview****Ching W Konyak<sup>1,\*</sup>, Prasanth Viswambharan<sup>1</sup>, Harsha Kumar K<sup>1</sup>, Kala S<sup>1</sup>**<sup>1</sup>Dept. of Prosthodontics, Government Dental College, Government Dental College, Kerala, India**ARTICLE INFO***Article history:*

Received 02-08-2023

Accepted 06-09-2023

Available online 10-10-2023

*Keywords:*

Temporomandibular disorders

Hydrostatic splints

Occlusal devices

**ABSTRACT**

Temporomandibular joint (TMJ), an integral component of stomatognathic system, is considered very unique because of the rotation and translation happening inside the same joint and is under the influence of various muscles and ligaments. Pain, clicking and functional impairment give a clue regarding the underlying temporomandibular disorder (TMD). TMD is a multifactorial and complex condition and is very difficult to diagnose and treat. Splints or occlusal devices are most often indicated for the management of TMDs. Rigid occlusal splints act by disengaging occlusion, restoring vertical dimension of occlusion, relaxing muscles and by unloading or repositioning TMJ. Hydrostatic self-adjusting splints help mandible to find its ideal position automatically. Unlike solid splints, hydrostatic splints like 'Aqualizer' eliminates the element of guesswork in treatment because of its inherent ability to relieve pressure on the TMJ.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](#), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: [reprint@ipinnovative.com](mailto:reprint@ipinnovative.com)**1. Introduction**

Management of pain due to TMD is often very challenging. Diagnosis is often the most difficult aspect and hydrostatic splints play an important role in this aspect.<sup>1</sup> Occlusal splints act by disengaging occlusion, restoring vertical dimension of occlusion, relaxing muscles and by unloading or repositioning TMJ. Hydrostatic splints help mandible finds its ideal position automatically and passively. Hydrostatic splints help patient's own muscles to identify the occlusal interferences by the concept of 'full and partial mandibular float'. Discovery of hydrostatic splints is considered as a big breakthrough in the diagnosis and management of TMD. It is useful in the differential diagnosis of facial pain as well. Aqualizer relaxes the muscles and take back the mandible to its hidden preestablished relations. But hydrostatic splints like 'Aqualizer' are often less durable and they can be used for

less than two weeks only.

**2. Discussion**

Articular surface of the temporal bone and the condyle of mandible, both covered by dense articular fibrocartilage forms the temporomandibular joint (TMJ). Surface area of articulation between condyle and temporal bone is relatively wide and it includes articular fossa, articular eminence and preglenoid plane. Temporomandibular joint is considered very unique because the condyle rotates within the fossa and translates along the articular eminence in an anterior direction, making it a 'ginglymodiarthrodial' joint. Translation ensures a much greater incisal opening than it would have been possible with hinge movement alone. President's Conference of American Dental Association on Temporomandibular Disorders (TMD) held in 1983 defined TMD as a group of orofacial disorders characterized by pain in the pre-auricular area, TMJ, or muscles of mastication, limitations and deviations in mandibular range of motion,

\* Corresponding author.

E-mail address: [chingewk@gmail.com](mailto:chingewk@gmail.com) (C. W. Konyak).

TMJ sounds during jaw function.<sup>2</sup>

Temporomandibular disorders are characterised by multiple symptoms like pain, functional impairment, and clicking during movement. Most of the TMJ disorders are self-limiting, especially in adults. According to cross sectional studies, up to 75 percent of adults presents with at least one sign and around 1/3<sup>rd</sup> have at least one symptom. Despite this wide prevalence, adults requiring treatment is only around 5% and even fewer people develop chronic or debilitating symptoms. Even though the etiology of TMD is unclear, many people believe TMD is multifactorial. Occlusal interference, parafunctional habits like bruxism, stress, anxiety or intra articular disc abnormalities can lead to Inflammation or damage of articular capsule and myalgia or muscular spasm.<sup>3</sup>

According to American academy of family physicians, TMD can be due to articular disorders of TMJ or disorders of muscles of mastication. Ankylosis, congenital / developmental disorders like aplasia, hyperplasia of bone, hypoplasia of bone and neoplasia, derangement of articular disc including displacement and/or reduction, fracture of the condyle, inflammatory disorders including synovitis, capsulitis and polyarthritides, osteoarthritis and dislocation of TMJ are the main articular disorders. Local myalgia, myofascial pain, myofibrotic contracture, myositis, myospasm and neoplasia are the major masticatory muscle disorders.<sup>3</sup>

Glossary of Prosthodontic Terms (GPT 9) identifies occlusal Splint or occlusal device as any removable artificial occlusal surface affecting the relationship of the mandible to the maxillae used for diagnosis or therapy; uses of this device may include, but are not limited to, occlusal stabilization for treatment of temporomandibular disorders, diagnostic overlay prior to extensive intervention, radiation therapy, occlusal positioning, and prevention of wear of the dentition or damage to brittle restorative materials such as dental porcelain.<sup>4</sup>

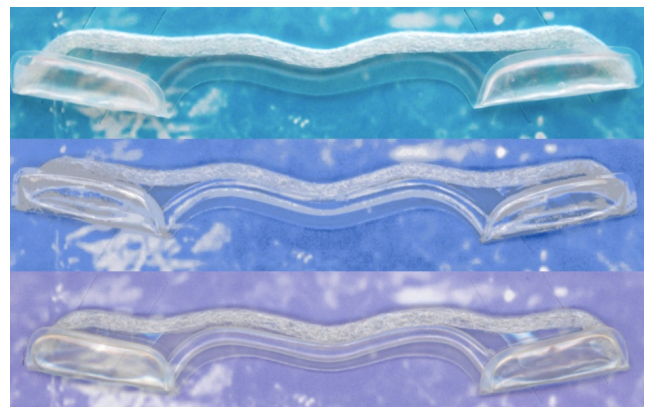
Occlusal appliances are so versatile that they may be used in countless number of ways for different purposes like occlusal stabilization, prevention of wear of teeth or for treating different types of TMDs. According to Jeffrey P. Okerson, occlusal appliance can be a muscle relaxation appliance/ stabilization appliance used to reduce muscle activity, anterior repositioning appliance / repositioning appliance, anterior bite plane, pivoting appliance or a resilient appliance. Peter E. Dawson categorises them as permissive splints / muscle deprogrammer, directive splints / non-permissive splints and pseudo permissive splints like soft splints and hydrostatic splints.<sup>5</sup> Anterior deprogrammers are useful in decreasing muscle activity in clenchers. Anterior repositioning splints are very useful in TMJ overload and disc displacements. Full coverage splints sometimes can increase the muscle activity over time and complicate breathing pattern.<sup>1</sup>



**Fig. 1:** Fluid chambers placed between occlusal surface of posterior teeth



**Fig. 2:** Self adjusting occlusal balance facilitated by aqualizer



**Fig. 3:** Low, medium and high aqualizers.

Occlusal splints when indicated in TMD; disengage occlusion, restore the vertical dimension of occlusion, relax muscles and unload or reposition TMJ.<sup>5</sup> Permissive splints act by allowing the teeth to glide unhindered over the biting or contact surface thus altering the occlusion so that the teeth do not interfere with complete seating of the condyles. Hence, these splints are also called as muscle deprogrammers.<sup>6</sup> Two classic designs of permissive splints include 'Flat Plane Stabilization Appliance (Michigan splint)' and 'Anterior Bite Plane'. Michigan splints apart from providing joint stabilization; protect the teeth, redistribute the occlusal forces, relax the elevator muscles and decrease bruxism. Anterior bite planes advocate the treatment of TMDs based on their ability to disengage the posterior teeth, thus eliminating the influences of the posterior occlusion on the masticatory system.<sup>5</sup>

Non permissive splints prevent free movements of the mandible by incorporating slopes or indentations on the occluding surface. These are also called 'directive splints' because these appliances guide the mandible in a specific relationship to the maxilla. They act by positioning or aligning the condylar-disk assemblies to a more stable position. Directive splints includes anterior repositioning appliance and mandibular repositioning appliance.<sup>6</sup> These splints are helpful in two clinical situations; severe trauma with retro-discal effusion and painful disk displacements that do not improve by itself.<sup>7</sup> Anterior repositioning splints help to treat reciprocal clicking, they stabilize the condyle-disk relationship and reduce retro-discal tissue compression by moving the condyle away from the fully seated joint position. Posterior bite plane helps to achieve a horizontal maxillomandibular relationship, major vertical dimension changes and mandibular repositioning and is usually indicated in cases of severe loss of vertical dimension of occlusion (VDO).<sup>7</sup>

Distraction splint (Pivot Appliance) treat internal disc derangements and intracapsular inflammation by allowing occlusal contact only with the most posterior teeth thus upon clenching the splint, the condyle is pulled downward, which removes the traumatic load and allows the disc to regain its normal position. As the mandible rotates around the splint, it reduces pressure within the TMJ by unloading the joints. It can also be used as a unilateral pivot appliance with only unilateral occlusal contact, when the mouth is closed, the pivot loads the TMJ on the opposite side and slightly unloads the TMJ on the same side.<sup>7</sup>

Pseudo permissive splints include soft splints and hydrostatic splints which can exacerbate bruxism, possibly due to premature posterior contacts associated with the very fact that these splints cannot be balanced.<sup>6</sup> Soft rubber splint which is a resilient appliance acts by achieving even and simultaneous contact with opposing teeth to relieve pain, discomfort, myalgia, bruxism, and clenching.<sup>7</sup> Hydrostatic splints depend on the concept that the mandible finds its

ideal position automatically as the appliance is not directing where the jaw should be.<sup>5</sup>

Lerman was credited with one of the earliest fluid splints, 'Aqualizer'. Originally it was comprised of water filled plastic chambers on both sides which were attached to a palatal appliance made in acrylic. It was designed in such a way that posterior teeth would occlude on these two fluid filled chambers. Design was modified later, eliminated the use of acrylic appliance and the splint gained its retention from under the upper lip while fluid filled chambers were positioned between posterior teeth of maxilla and mandible (Figure 1). Aqualizer is one of the most important breakthroughs in the management of temporomandibular pain.<sup>2</sup> Aqualizer offers a minimally invasive approach in the management of TMD, occlusal disharmony and myalgia. Hydro-dynamic fluid system in Aqualizer helps the musculature to self-adjust facilitating occlusal balance, stability and balance between neuromuscular and skeletal components of stomatognathic system and cranium (Figure 2). Though cost effective and despite being a prefabricated emergency/temporary splint, 'Aqualizer' is a diagnostic tool as well. It aids in reaching a differential diagnosis for TMD and occlusal issues, effectively discriminating joint pain from muscle pain and pain related to occlusion. It is useful for differential diagnosis of facial pain as well. Aqualizer is very useful in getting physiological balance before making impressions for dental appliances. If the fluid splint is able to relieve the pain, appropriate occlusal treatment can be planned. Clinician can have an early assessment of the improvement in symptoms before going for definite and expensive treatments like custom appliances.<sup>1</sup> Hydrostatic splits help patient's own muscles to identify the occlusal interferences by the concept of 'full and partial mandibular float'. Initially there is 'full float' because there will be fluid between maxillary and mandibular teeth which will help to neutralize occlusal prematurity helping the symptoms to subside. Occlusal correction is necessary for permanent pain relief. Fluid will be lost gradually and at the areas of interference only a thin film of fluid will remain which will help in identifying the areas to be relieved.<sup>8</sup> The procedure is very systematic and not 'blind' dealing TMD with solid splints.<sup>9</sup>

Aqualizer of suitable size can be selected and patient will wear it for a minimum of 20 minutes. Pain relief is a clear indication that the pain can be of muscle origin or TMJ origin or both. If there is no relief, pain may be due to some other cause. By keeping Aqualizer in position, anterior occlusal bite can be registered using polyvinyl siloxane (PVS). Once it is set, remove the Aqualizer and complete the posterior occlusal bite registration using PVS while the patient is biting on the already recorded anterior bite registration. Remove the bite registration as one piece and the casts can be mounted in an articulator. Appropriate occlusal device can then be fabricated<sup>1</sup>. Initial management

of TMD with Aqualizer prior to the intervention using hard acrylic splints shows quicker relief from symptoms than in patients who never received any fluid splint.<sup>10</sup>

Aqualizer is available in three different vertical heights, low medium and high. Fluid quantity will be more in high splints. Selection of vertical height depends on the available freeway space; low split is indicated in patients with minimal freeway space. Depending on arch size, 'Aqualizer' is available in ultra and mini forms (Figure 3). Mini form is indicated for kids and in patients with small arch size.<sup>2</sup>

Aqualizer helps the muscles to automatically reposition the jaws which aids in relieving TMD. Under the influence of 'Aqualizer', body autocorrects occlusal distortions and optimises functional harmony by cushioning the jaw. Aqualizer follows the principle of Pascal's law and applies uniform pressure everywhere regardless of where the pressure is applied because it is a hydrodynamic fluid system. This feature will reduce pressure on the TMJ reducing the possibility of pain. Unlike solid splints, Aqualizer eliminates the element of guesswork in the treatment because of its inherent ability to relieve pressure on the TMJ. Fluid splints are even indicated in patients with chronic neck pain and migraine. 'Aqualizer', literally has no side effect.<sup>2</sup> Hydrostatic splints relax the muscles and take back the mandible to hidden preestablished relations.<sup>11</sup> But hydrostatic splints like 'Aqualizer' are often less durable and they can be used for less than 2 weeks.<sup>12</sup> Occlusal appliances can also be used as therapeutic devices in selected cases.<sup>13</sup> Condylar position inside the glenoid fossa is very critical in myofascial pain dysfunction syndrome and hence occlusal evaluation is critical in its management.<sup>14</sup> Possibility of selective grinding too should be explored.<sup>15</sup>

### 3. Conclusion

All hard splints like the flat plane splint, the anterior deprogrammer design appliance, anterior repositioning splints etc involve laboratory procedure which requires time. Most often mouth opening in TMD patients will be restricted making impression procedure very difficult. In such patients hydrostatic splints like Aqualizer helps to relieve inflammation and pain by relaxing the muscles. Hydrostatic splints are very useful in diagnostic purpose as well because they help the mandible to 'float'. While using hydrostatic splints, dentists need not deal with the occlusal interference 'blindly' like when they use rigid splints. But the durability of hydrostatic splints is questionable.

### 4. Conflict of Interest

There are no conflicts of interest in this article.

### 5. Source of Funding

None.

## References


1. Marangos D. The Aqualizer: Diagnostic Aid and Treatment Modality. *Oral Health*. 2012;p. 38-41. Available from: <https://www.oralhealthgroup.com/features/the-aqualizer-diagnostic-aid-and-treatment-modality/>.
2. Srivastava R, Jyoti B, Devi P. Oral splint for temporomandibular joint disorders with revolutionary fluid system. *Dent Res J (Isfahan)*. 2013;10(3):307-13.
3. Buescher JJ. Temporomandibular joint disorders. *Am Fam Physician*. 2007;76(10):1477-82.
4. The Glossary of Prosthodontic Terms: Ninth Edition. *J Prosthet Dent*. 2017;117(5S):1-105. doi:10.1016/j.prosdent.2016.12.001.
5. Alqutaibi AY, Aboalrejal AN. Types of Occlusal Splint in Management of Temporomandibular Disorders (TMD). *J Arthritis*. 2015;4(4):1-4. doi:10.4172/2167-7921.1000176.
6. Ramalingam S, Priyan GS. Occlusal splint therapy in TMD pain management: A review. *J Glob Oral Heal*. 2009;5(2):102-6. doi:10.25259/JGOH\_2\_2022.
7. Albagieh H, Alomran I, Binakresh A, Alhatarisha N, Almeteb M, Khalaf Y, et al. Occlusal splints-types and effectiveness in temporomandibular disorder management. *Saudi Dent J*. 2023;35(1):70-9. doi:10.1016/j.sdentj.2022.12.013.
8. Lerman MD. The hydrostatic splint: new muscle-directed TMJ-PDS treatment technique. *CDS Rev*. 1987;80(4):31-4.
9. Lerman MD. The Muscle Engram: The Reflex that Limits Conventional Occlusal Treatment. *J Craniomandib Pract*. 2011;29(4):297-303.
10. Buchbender M, Keplinger L, Kesting MR, Adler W, Schmitt CM. A clinical trial: Aqualizer™ therapy and its effects on myopathies or temporomandibular dysfunctions. Part I: Objective parameters. *Cranio*. 2021;p. 1-9. doi:10.1080/08869634.2021.1885887.
11. Lerman MD. A revised view of the dynamics, physiology and treatment of occlusion : A new paradigm. *J Craniomandib Pract*. 2004;22(1):50-63.
12. Greer DW, Neeley M. New concept in splint design and the treatment of tension headache, cervicgia and facial pain. *Contemp Esthet Restor Pract*. 2005;6(11):880-9.
13. Klasser GD, Greene CS. Oral appliances in the management of temporomandibular disorders. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2009;107(2):212-23. doi:10.1016/j.tripleo.2008.10.007.
14. Weinberg LA. Role of condylar position in TMJ dysfunction-pain syndrome. *J Prosthet Dent*. 1979;41(6):636-43.
15. Posselt ULF. The temporomandibular joint syndrome and occlusion. *J Prosthet Dent*. 1979;25(4):432-8.

## Author biography

**Ching W Konyak**, Post Graduate Student

**Prasanth Viswambharan**, Professor  <https://orcid.org/0000-0003-2422-6816>

**Harsha Kumar K**, Vice Principal and HOD & Professor  <https://orcid.org/0000-0003-4417-5032>

**Kala S**, Associate Professor  <https://orcid.org/0009-0000-4991-2658>

**Cite this article:** Konyak CW, Viswambharan P, Harsha Kumar K, Kala S. Role of hydrostatic occlusal devices in the management of temporomandibular disorders (TMD) – An overview. *IP Ann Prosthodont Restor Dent* 2023;9(3):131-134.