

Evaluating Clear Aligners and Conventional Braces in Treating TMJ and Speech Impediment

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ABSTRACT

Orthodontics is the study of treating misaligned occlusion, malpositioned teeth & jaws, and facial growth modification. A variety of orthodontic treatments can prevent these misaligned bite patterns and fix malpositioned teeth & jaws through straightening/moving teeth with the assistance of orthodontic materials. A concept many people do not commonly relate to orthodontics is speech impediment and TMJ (Temporomandibular Joint) issues. Current research shows both braces and clear aligners are very strategic materials that move teeth efficiently, but very few research articles contain information that specifies a better choice for treating speech impediment/TMJ. A systematic review was conducted to evaluate if adult patients with speech impediment and TMJ issues are more likely to have a better outcome in treatment of these symptoms with conventional (e.g. traditional braces) or new orthodontic treatments (e.g. clear aligners). Results show clear aligners work quickly and are less painful for adults; however, conventional braces are proven to be highly effective in treating moderate to severe cases of malocclusions, while clear aligners are best for simple malocclusions. Although this is a popular result, articles continue to state that the comparison is inconclusive and that both materials effectively treat all cases of malocclusions. Be that as it may, it is significant that issues like speech impediment and temporomandibular (TMJ) issues are fixed quickly and efficiently to relieve symptoms before conditions worsen. Other factors like comfortability, compliance, treatment duration, and pricing are often taken into account when deciding which option is most suitable for the patient.

I. Introduction

The past two decades have seen a resonating development in the primary motivating factor of adult patients pursuing orthodontic treatment. There is an increasing demand for dentofacial aesthetics in the adult population as the prevalence of edentulism in adults aged 65 years or older is rapidly declining. However, according to the American Association of Orthodontics, nearly 50% of the world's population has "severe deformities" that can only be treated with orthodontic materials¹. Society's perception of orthodontics has evolved throughout the years; however, one misconception that has remained constant is how orthodontic treatment is "purely cosmetic." While it is a fact that orthodontic treatment can align bone structure and fix teeth deformities, treating these issues have more benefits than people realize.

Orthodontics is the study of aligning teeth, closing gaps between teeth, treating crowded teeth, and correcting occlusions that deviate from the ideal bite (malocclusions). Orthodontic treatment involves diagnosis and studies of tooth positioning, but patients do not only visit orthodontists for straightening teeth. Clinically, patients may present with conditions such as speech impediments, temporomandibular joint (TMJ) pain, receding gums, muscle spasms, headaches, chipped teeth, uneven spacing in the mouth, and teeth abnormalities². Orthodontics can help solve some of these issues in conjunction with inter-disciplinary specialties, such as restorative, prosthodontics, periodontics, endodontics, and oral surgery. The clinical conditions described above can eventually lead to more systemic health issues like headaches, sleep apnea, and mental health issues; therefore, orthodontists must act fast and efficiently with treatment, thus changing this "purely cosmetic" stereotype developed throughout the years.

The majority of orthodontists prefer identifying and treating issues early on. Seven years old is considered the “perfect” age for treatment because this is when primary teeth are still growing, which can make it easier to align, with a higher possibility of preventing health issues in the future¹. The goal is always to have a head start with treatment; however, this cannot always be the case for many adults. Since adult teeth have been in place for many years, adult patients have teeth that are particularly difficult to align, making it more challenging to find the most comfortable and fast-working treatment options. The common orthodontic materials used in treatment include clear aligners, conventional dental braces, headgears, retainers, elastics, sleep apnea appliances, and palatal expanders, among many others. Conventional braces took years to evolve to where they are today. In 1819, Christophe-Francois Delabarre created the first modern braces, a “wire crib,” placed directly over each set of two teeth to keep them in place. He also added elastics to the system in 1843 to improve jaw alignment, which is very similar to today’s modern braces². Since 1843, several breakthroughs have emerged, especially in the 1970s when everything changed. Stainless steel and adhesive were discovered and added to the front of the teeth making braces less painful and damaging to the teeth, and the duration of treatment with braces was also shortened drastically. Several techniques eventually led to hidden or ‘invisible braces.’ Align Technology, the developers of ‘Invisalign,’ sold 1.6 million cases of clear aligners in 2020 as opposed to 1.5 million sales in 2019. Clear aligners have grown in recent years and are being sold worldwide today because patients were reluctant to get traditional braces since clear aligners are more aesthetically pleasing to the eye³.

Malocclusion is known as a deviation from the ideal bite, and it is the most common reason for orthodontic treatment. Malocclusion corresponds to dis-alignment in upper and lower teeth when closing the mouth⁴. In other words, a malocclusion may arise if the maxilla (the bone that forms the upper jaw) and mandible (lower jaw) are not correctly aligned. There are three classes of malocclusions that individually create a different shape in the mouth and formulate unique symptoms for the patient. The classification refers to the position of the first molars and the way the upper molars fit together with the lower ones⁵. These malocclusions can give rise to speech impediments and other problems like TMJ issues, muscle weakness, mental difficulties, and even self-esteem issues. Patients with speech impediments can struggle with the emotions of not feeling “normal” or feeling frustrated because they think they “are not good enough” to have clear speech articulation⁶. TMJ and speech impediment manifest themselves clinically in different ways, and these symptoms can be reduced and resolved with varying types of orthodontic treatment. This paper will focus on the treatment of speech impediments and temporomandibular jaw issues with the use of conventional materials versus clear aligners specifically. Different factors will be assessed, including efficiency, comfortability, reliability, and cost for the patient.

II. Methods

This systematic review focused on the following question: Are adult patients with a speech impediment or TMJ issues more likely to have a better outcome in the treatment of these symptoms with conventional (e.g., traditional braces) or new orthodontic treatments (e.g., clear aligners)? The definitions of population, intervention, comparison, and outcome (PICO) were developed based on the focused question as follows:

Population: Adult patients with Speech Impediment/TMJ issues

Intervention: Orthodontic treatment with conventional materials

Comparison: Orthodontic treatment with clear aligners

Outcomes: The primary outcome was treatment effectiveness: Which treatment (conventional materials vs. clear aligners) results in a better outcome of speech impediment or TMJ issues

Search Strategies

An electronic search without time or language restrictions was conducted using Pubmed, Google Scholar, and other published articles. The reference lists of included studies and relevant reviews were also searched for other potential studies. The detailed search strategies were as follows: #1 Headaches AND Braces #2 Braces AND Jaw Pain #3 Clear aligners AND Conventional Orthodontics #4 Orthodontic Comparison #5 Orthodontic treatment #6 Types of orthodontic treatment #7 Types of Speech problems #8 Speech Impediment #9 Issues AND conventional orthodontics #10 Issues AND clear aligners #11 TMJ AND orthodontics #12 TMJ issues AND braces.

III. Discussion

The purpose of this research article was to conduct a systematic review of whether clear aligners or conventional braces are a better form of treatment for adult patients struggling with TMJ issues and speech impediments. Before comparing the two orthodontic materials, this paper will discuss the tooth-related causes, effects, and symptoms of TMJ disorders and speech impediments. Moreover, to grasp a better idea of how TMJ pain and speech impediments are related to the teeth, it is essential to discuss all classes of malocclusions and the main factor causing these problems adults struggle with daily.

All types of malocclusions tend to overwork jaw muscles since the teeth are misaligned and forced into unnatural positions pushing up against each other¹⁰. These pains can eventually lead to aches and soreness in the face, starting from the jaw¹¹. Many patients have limited knowledge of the leading causes of jaw joint problems; however, this is a typical problem patients face daily and are often directly related to malocclusion¹². Generally speaking, malocclusions can appear for various reasons, including thumb and finger sucking as a child, tongue thrust (while swallowing, the tongue gets in touch with any teeth anterior to the molars), sucking or biting of the lips or cheeks, unilateral mastication habit (where a patient chews exclusively on one side), and other known causes¹³.

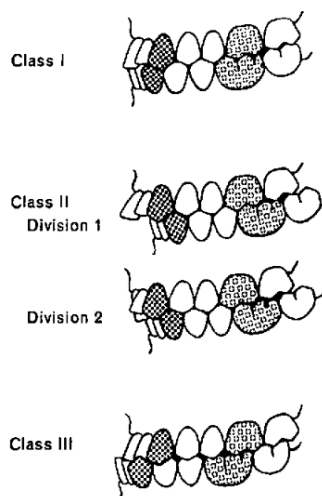


Figure 1: Obtained from British Journal of Orthodontics, 1974

Class I malocclusion is a normal relationship between the upper teeth, lower teeth, jaws, and the determination of a balanced bite. Class I can be caused by a child excessively using a baby bottle or even thumb-sucking. This class of malocclusion does not affect a patient's bite as much as classes II and III. Class II is where the lower first molar is posterior to the upper first molar. The upper front teeth and jaw project further forward than the lower teeth and jaw, causing an overbite. This class causes patients to have a receding chin and lower lip appearance. Class II can

be caused by insufficient growth of the lower jaw, an overgrowth of the upper jaw, or a combination of both. Some class II problems are inherited from past generations and also can appear due to finger sucking as a child¹⁴. Furthermore, Class II division I is where the upper front teeth are projected more forward than the bottom teeth. Class II division II is when the upper front teeth appear almost as if they are digging into the bottom set of teeth. Class III is where the lower first molar is anterior to the upper first molars. The lower teeth project further forward compared to the upper teeth and jaw, leaving a patient with a prominent chin and causing an underbite. Class III problems are due to an overgrowth in the lower jaw, undergrowth of the upper jaw, or a combination of both. Similar to class II, class III problems can be inherited from past generations. Malocclusions have the potential to create multiple orthodontic problems such as: overcrowding, spacing, crossbites, diastemas, open bites (when the upper and lower set of teeth slant outwards and do not touch when it is closed), overjets (where the teeth on the upper jaw rest at an outward angle extending farther from the lower jaw), or overbites (when the upper teeth project more forward than the bottom teeth)¹⁵. These malocclusions are responsible for causing teeth-related problems like TMJ pain and speech impediments, which is why orthodontic intervention should be considered.

The temporomandibular joint, or TMJ, is the joint connecting the lower jaw and the skull¹⁶. The movement in this joint allows a person to open and close their mouth and chew from side to side¹⁷. If a patient hears clicking, ringing, or buzzing in the ears, has pain in the jaw joint, exhibits grinding (more typically at night), and has difficulty opening or closing the mouth (mandible mobility), this could all be a sign that teeth are not meeting each other appropriately¹⁸. Additionally, locking of the joint, aching pain in/around the ear, and tenderness in the jaw are also symptoms of TMJ pain/disorder. In a study by Almăsan et al, 64 patients were evaluated to find the most frequent symptoms in patients with malocclusions relating to TMJ issues. In subjects with Class I malocclusion, joint noises were most common at 83.33%, 16.66% had muscular pain, and 16.66% had TMJ pain. Class II malocclusion subjects presented with 71.42% joint noises, 14.28% had reduced mandible mobility (restriction in opening mouth wide), 14.28% had muscular pain, and 14.28% had TMJ pain. In Class III malocclusion subjects, 90.90% had joint noises, 45.45% had muscular pain, 27.27% of reduced mandible mobility, and 27.27% presented TMJ pain. According to Almăsan et al, TMJ pain was concluded to be highest in class III malocclusion patients¹⁹. However, a separate study by Grazia Fichera et al, found class II to be the leading cause of TMJ pain. It found that 48% of patients with TMJ issues have Class II malocclusion, 16% have Class I, and 28% have Class III²⁰. If TMJ disorders are left untreated, there is a potential to contribute to a patient's discomfort and tension. According to Cleveland Clinic, TMJ pain can lead to a path of anxiety, depression, sleep apnea, aching headaches, and many others. Reducing the severity of any of these symptoms caused by TMJ varies depending on the level of malocclusion. However, treatments for class I/II and moderate class III malocclusions range from clear aligners to conventional braces and orthognathic surgery for severe misaligned class III malocclusions. Other methods of non-orthodontic treatment are the fabrication of night guards for TMJ issues, or even acupuncture has been found to help.

Just like TMJ issues, speech impediments like lisps and mispronunciations are often caused by malocclusions; issues like overjets (class II/division I), open bites (class III), underbites (class III), or crossbites (class I). In order to speak clearly, the cheeks, jaw, tongue, and teeth must work together to produce articulated speech. The teeth must come together in alignment to allow an air-tight seal for the tongue to move correctly to the roof of the mouth. When there is an anterior tooth opening, the tongue creates the seal, resulting in speech impediments when conversing²¹. On the other hand, if there is not enough room for the tongue, like in crossbites or underbites, speech is also heavily affected. If a patient cannot produce clear and recognizable words, this can also affect performance and functioning in the educational and work environment, making it difficult for adults to maintain a basic lifestyle. Typically, lisping occurs with an overbite. Additionally, lisping and mispronunciation can be caused by wide gaps in between the teeth, which make it challenging to produce sounds with the letters “F,” “V,” “Z,” and “Ch”²². These sounds are difficult to produce with an improper alignment, especially consonant sounds like “T” or “S,” which call for tongue-to-tooth contact. Clear aligners, conventional braces, extractions, elastics, and headgears are often ways to treat these classes of malocclusions, and orthognathic surgery is often not needed for resolving moderate speech impediments such as lisping and mispronunciation. Orthodontic treatment is not the only cure since there are many options for all

speech challenges, such as seeking a speech pathologist/therapist to practice articulation. If a patient has misaligned teeth, speech therapists may help in addition to orthodontic intervention to align those teeth properly.

Although the common orthodontic treatments involve mechanical appliances such as braces, clear aligners, headgears, and retainers, spreading the biting force throughout all the teeth would help maintain the long-term health of teeth, gums, and jaw joints starting from an early age.²³ Orthodontic intervention is not just for children and adolescents; adult patients could also benefit from treatment. The article by Ke et al. evaluated eight papers, two of which were randomized controlled trial studies and six were cohort studies. The result of the studies concluded that both clear aligners and traditional braces were able to improve malocclusions; however, clear aligners might not be as effective as braces in achieving drastic improvement. Clear aligners will struggle to produce adequate occlusal contacts and may only be used for simple malocclusions (like the moderate class I and II)²⁴. Still, clear aligners have an advantage in the segmented movement of teeth and shortened treatment duration. Braces were also found more effective in controlling teeth torque and retention, which is good for improving severe malocclusion cases. A second study by Kassam et al. found removable aligners to be effective in crowding issues but had limitations in achieving favorable outcomes, being more likely to relapse post-treatment. Invisalign can provide successful alignment but again poses difficulties in achieving occlusal contacts, buccolingual inclination, and vertical movement of teeth²⁵. Conventional braces make precise wire adjustments within 0.5 mm to intrude or extrude teeth as necessary, making them highly efficient in different cases. Although these two articles conclude that clear aligners should be used in simple malocclusions,²⁶ studies conducted by Koukou et al. concluded that clear aligners effectively treat all class malocclusions²⁷. While traditional braces can treat more severe malocclusions because of their strength, control, and precisely adjustable wiring, one article claims that clear aligners have been frequently applied in these situations in orthodontic clinic practices. However, their effect on oral health-related quality of life compared with fixed appliance treatment remains inconclusive²⁸. Currently, the studies on how effective each treatment option is, remain unknown due to the mixed results taken away from each article. With the knowledge that both options can correctly treat simple malocclusions, clear aligners and traditional braces will be a good option for effectively treating speech impediments such as lisping and mispronunciation. With TMJ pain caused by non-severe class I, II, and III malocclusions, clear aligners and traditional braces will work efficiently; however, orthognathic surgery may be needed with class III to realign the jaw depending on the severity of the case. Therefore, clinicians should consider the orthodontic appliance's characteristics when making treatment decisions.

Although efficiency is an essential factor, clinicians should take other external factors into account such as time of treatment, compliance, comfort, and pricing of both materials and should be heavily considered when choosing the best option for the patient. Depending on the malocclusion severity, the treatment time will vary. For the most common class of malocclusion, class I, it takes around 24 months on average to complete the treatment with traditional braces. Some patients require less than 12 months, and some take up to three years²⁹. On the other hand, clear aligners take up to six months to complete treatment for a general class I case³⁰. Also, considering the patient's age, the older they are, the longer it might take for both appliances to start shaping the mouth after years in place. Clear aligners have a reduced treatment time, making them more enticing to the patients. Moreover, many studies have shown clear aligners rely more on patients to ensure they are taking proper care of their aligners. They must wear the aligners as specified by the orthodontist. They must be cleaned by brushing and running them under warm water. After every meal or drink, it is recommended to brush the teeth so there is no risk of stains on the teeth³¹. For some patients, removing these appliances before every meal might be frustrating or annoying; however, if they do not comply with the regulations, treatment may not work as effective. Braces may be less strict in maintenance. It is essential to brush and floss after each meal and not to have sticky foods that can stain or get stuck to the metal wiring/brackets. Therefore, there is less compliance for traditional braces patients must follow, making it more enticing to get this option. Orthodontists do not have to rely on the patient as much compared to clear aligner treatment. Although, braces require frequent check-ins with the orthodontist to tighten wires and ensure the wiring is stable. Furthermore, the comfort of clear aligners is one of the main selling points. When treating patients with malocclusions, it is common for patients to feel pain, but in terms of which option can reduce that discomfort, patients appeared to feel less pain with clear

aligners than those treated with fixed appliances in the first week of treatment³². After the first week, differences in pain levels were not noted because of the adaptability of patients. With clear aligners, there are also fewer effects on speech during the treatment, no food restrictions, and it is more aesthetically pleasing to the majority of patients. With the Covid-19 pandemic, clear aligners reduced the health risk since the patients did not have to come in for wiring adjustments with traditional braces³³. Braces are also less expensive than clear aligners. Clear aligners range from \$3,500 to \$9,000, while traditional braces cost between \$2,500 to \$6,000 entirely³⁴. It is certain clear aligners are more costly compared with conventional braces.

Both options are effective depending on the severity of each malocclusion, and it is inconclusive which material is more efficient. Conventional braces are highly recommended for non-surgical cases because of the precise wiring, retention, and teeth torque it allows. Clear aligners require a lot more reliance and compliance, requiring additional effort to maintain clean teeth. However, clear aligners usually have a shorter treatment span, are more comfortable, and lower the pain in the first week of treatment. They are also more aesthetically pleasing since they are not visible and cause no differences in articulation. Both treatment modalities can be beneficial in treating TMJ issues and speech impediments, but existing evidence does not prove conclusive to say one is better than the other. It is important to evaluate each specific case and develop a treatment plan that will most benefit the patient.

IV. Conclusion

This research article posed the question: Are adult patients with speech impediments or TMJ issues more likely to have a better outcome in the treatment of these symptoms with conventional (e.g., traditional braces) or new orthodontic treatments (e.g., clear aligners)? Crossbites typically cause teeth-related speech impediments like lisping and mispronunciation, uneven gaps in the teeth, overjets, and open bites, which count as class I, class II/division I, and class III malocclusions. Temporomandibular joint issues can arise from all classes of malocclusion; however, they are most consistent in class III patients, according to multiple articles. Moreover, the majority of research articles recommended conventional braces for more severe cases of class I/II and moderate class III patients. Due to their adjustable archwire and brackets/metal wiring durability, they are found more trustworthy. Few research articles recommend clear aligners for severe/moderate cases; instead, they suggest clear aligners for simple malocclusions like moderate class I and II. Clear aligners have evolved drastically throughout the years and have become more effective in treating patients with all types of malocclusions. Still, a definite answer as to whether or not conventional braces are more efficient than clear aligners in treating patients with TMJ and speech impediments is inconclusive due to the mixed opinions within the research articles. This article discussed external factors such as time of treatment, compliance, comfort, and pricing of both materials, which also heavily weigh on a patient's decision between the usage of the two orthodontic materials. Therefore, when an adult with TMJ and/or speech impediments comes into an orthodontist's office, they should heavily consider all factors of their options, including talking to their orthodontist about the specific case they have in treating for efficiency. Future studies such as clinical trials should be conducted to support the evidence found for this systematic review. The direction of future clinical trials should be geared towards taking multiple patients with TMJ and speech impediment and treating them with clear aligners and conventional braces to see which treatment is better suited for the patient.

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