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A SYSTEMATIC REVIEW OF MYOFUNCTIONAL APPLIANCE THERAPY AND FIXED APPLIANCE THERAPY ON SPEECH IN ORTHODONTIC PATIENTS

BY

[1]Dr. Akshay S. Mahajan, [2]Dr. Amol A. Verulkar, [3]Dr. Ratnadeep A. Lohakpure, [4]Dr Vivek Shinde, [5]Dr Jayashri Bhangare, [6]Dr Dipak Sahane, Dr poonam Mahajan[7]

[1]BDS, MDS Senior Lecturer at Department of Orthodontics, SMBT Dental College and Hospital, Sangamner, Maharashtra
[2]BDS, MDS, PHD Professor and Head at Department of Orthodontics, VYWS Dental College & Hospital, Amravati
[3]BDS, MDS Reader at Department of Orthodontics, VYWS Dental College & Hospital, Amravati
[4]BDS MDS Reader Dept of orthodontics, SMBT Dental college and hospital sangamner Maharashtra
[5]BDS MDS Senior lecturer, department of orthodontics SMBT Dental college and hospital sangamner Maharashtra
[6]BDS Department of orthodontics SMBT Dental college and hospital sangamner Maharashtra
[7]BDS SMBT Dental college and hospital sangamner

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Abstract

Background

Myofunctional appliance therapy and fixed appliance treatment have become a vital aspect of modern orthodontics, with a large focus on orthodontic research. Orthodontic treatment, whether through myofunctional appliance therapy or fixed appliance therapy, aims to correct malocclusion and improve oral function. However, the impact of these treatments on speech remains unclear.

Methodology

We conducted a comprehensive literature search for published publications across various databases, including PubMed, Medline, the Cochrane Library, and Web of Science, as well as supplementary sources like Google Scholar and ClinicalTrials.gov, covering the period 1983-2022. A total of 5217 research papers were screened using keywords such as "myofunctional appliance and speech," "fixed orthodontic appliance and speech," "speech impairment in orthodontics," "labial versus lingual treatment impact," and "fixed functional appliance and phonetics or articulation."

Result

This review included a total of twelve different investigations, categorized into four randomized controlled trials (RCTs), three controlled clinical trials (CCTs), four prospective cohort studies, and one clinical study. In this investigation, a total of 310 patients studied who were underwent treatment with various myofunctional appliances removable and fixed functional appliances. As well as fixed orthodontic appliances, including both labial and lingual braces were examined. Of these twelve studies, seven were dedicated to examining the effect of myofunctional appliances on speech. These studies meticulously analyzed how these appliances, designed to correct functional and structural anomalies, affected the patients' speech patterns and clarity.

Conclusion

This review emphasizes, the risk for difficulties with speech while using fixed orthodontic appliances like labial and lingual braces, as well as myofunctional appliances like activators and twin blocks. According to the analysis, devices like the Frankel regulator and Bionator have less of a detrimental effect on speech than twin blocks and activators. Particularly, it was found that individuals utilizing twin blocks and activators had more severe speech disturbances; this underscores the necessity of managing these effects with caution in practical practice. In order to reduce speech-related difficulties for patients undergoing orthodontic treatment, this review highlights, the significance of choosing the right orthodontic appliances beneficial to improve patient outcomes.

Keywords: *Myofunctional appliances, Fixed appliances, Labial appliances, Lingual appliances,*

*Corresponding Author: **Dr. Akshay S. Mahajan.**

Orthodontics, Speech, Malocclusion.

Introduction.

A growing number of patients are seeking orthodontic treatment because malocclusion can significantly impact their quality of life. Despite this trend, the discomfort from orthodontic procedures often leads to reduced patient compliance.[1] Orthodontic treatment plays a pivotal role in correcting malocclusion and enhancing overall oral health and aesthetics. Among the various factors considered during the orthodontic intervention, speech is of paramount importance as it directly influences communication and social interactions. Orthodontic appliances, including myofunctional appliances and fixed appliances, are commonly utilized to address malocclusion and associated functional issues. [2]

Myofunctional appliance therapy involves the use of appliances designed to promote proper muscle function, tongue posture, and breathing patterns.[3] These appliances are thought to influence the orofacial musculature, potentially affecting speech production. Conversely, fixed appliance therapy utilizes brackets, wires, and other orthodontic devices to gradually reposition teeth and jaws. The mechanical forces exerted by these appliances may also influence speech articulation and resonance.[4]

Myofunctional appliance therapy involves the use of specialized devices with the purpose of modifying orofacial muscle function, which improves tongue posture, swallowing patterns, and overall orofacial muscle tone.[5] In contrast, fixed appliance therapy employs braces or other orthodontic appliances to align teeth and correct malocclusion. While both treatment modalities are effective in achieving dental alignment and occlusal function, their impact is on speech production and articulation. [6]

Despite the widespread use of myofunctional and fixed appliance therapies in orthodontic practice, the specific effects of these interventions on speech outcomes remain incompletely understood. Some studies suggest that myofunctional appliances may improve speech parameters by optimizing orofacial muscle function and tongue position. However, there is conflicting research about the influence of fixed equipment on speech, with some studies reporting no significant changes in speech articulation following treatment.

Given the variability in study findings and the importance of speech outcomes in orthodontic patients, there is a need for comprehensive evaluation and synthesis of the existing literature on this topic. In this review, we examine the effect of myofunctional appliance therapy and fixed appliance therapy on speech in orthodontic patients.

The findings of the present study show that myofunctional appliances can lead to temporary alterations in speech due to their size and positioning within the oral cavity. Patients experience difficulties with specific phonemes or experience a general lisp due to the altered position of the tongue or the presence of the appliance in the mouth. However, these speech disturbances tend to be transient as patients adapt to the appliance. With proper myofunctional training and adaptation time, speech typically returns to normal or improves if the therapy corrects muscle-related speech issues.

Methodology

Search Strategy

We performed an extensive literature search in multiple databases, such as Google Scholar, Embase, MEDLINE, PubMed, Scopus, Web of Science, and the Cochrane Library. This study encompassed all articles published between 1983 and 2022. We conducted searches on MEDLINE utilizing a blend of MeSH (Medical Subject Headings) terms and free-text searches covering all fields. These searches were enhanced by incorporating suitable Boolean operators to cover topics related to orthodontic treatment, myofunctional appliance therapy, fixed appliance therapy, and their effects on speech. Specifically, we explored areas such as orthodontics and speech, myofunctional appliances and speech, fixed orthodontic appliances and speech, speech impairment in orthodontic patients, comparison between labial and lingual treatment effects, and the impact of fixed functional appliances on phonetics or articulation.

The selection of articles on the basis of Mesh term and complete search strategy is summarised in the following Figure 1.

Inclusion and Exclusion Criteria

Inclusion criteria:

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- Studies that report on the impact of myofunctional appliance therapy and fixed appliance therapy on speech;
- Studies that were either published in English or translated into English.

Exclusion criteria:

- In vitro or animal studies and questionnaire surveys
- studies providing clinical outcomes on speech impairment
- Studies lacking complete full-text access;

Study Quality Assessment:

The Quality Assessment of Diagnostic Accuracy Studies (QUADAS) technique was utilized to evaluate the included studies' risk of bias. One of three risk levels—low risk, high risk, or unclear risk of bias was utilized for each domain in this tool.

Statistical analysis:

The current investigation employed the recommended strategy for assessing the risk of bias in studies included in Cochrane Reviews, as described by Higgins in 2011. This methodological approach was accurately applied using the software program RevMan 5.4.1. By adhering to these guidelines, the study ensured a rigorous and standardized evaluation of bias across the included studies, thereby enhancing the reliability and validity of the systematic review's findings. This complete assessment framework facilitated a critical appraisal of the methodological quality, enabling the identification of potential sources of bias that could affect the study outcomes.

Table 1 - The Effect of Myofunctional Appliances on Speech.

	AUTHOR	YEAR	STUDY DESIGN	ASSESSMENT METHOD	SAMPLE SIZE	APPLIANCE	SPEECH DIFFICULTY	AFFECTED SOUNDS	DURATION
1	Arponen H et al. [7]	2020	RCT	SOE, SE	52	Headgear Activator Twin block	YES YES	NR NR	13 Months 13 Months
2	Van Lierde KM et al.[10]	2015	CCT	SE, SOE	56	Activator	YES	/s/, /n/, /l/, /t/	12 Months
3	Clark W et al.[13]	2010	Clinical study	SE	NR	Twin block	YES	NR	NR
4	Sari Z et al.[15]	2003	RCT	SE	60	Activator Jasper Jumper	YES NO	NR NR	8.5 Months 8.5 Months
5	Rudzki-Janson I et al.[16]	1998	Prospective cohort	SE	NR	Bionator	NO	NR	NR
6	Sergl HG et al.[17]	1998	CCT	SE	10	Removable appliance	YES	NR	NA
7	Tekieli ME et al.[18]	1983	Prospective cohort	SE, SOE	09	Frankel regulator	NO	NR	2-15 months

NR-not reported, NA- not available, RCT- randomized control trial, CCT- clinical control trial, SE-subjective evaluation, SOE- Semi-objective evaluation.

Table 2 - The Effect of Fixed Orthodontic Appliances on Speech.

	AUTHOR	YEAR	STUDY DESIGN	ASSESSMENT METHOD	SAMPLE SIZE	APPLIANCE	SPEECH DIFFICULTY	AFFECTED SOUNDS	DURATION

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1	Wiedel AP etal.[9]	2016	RCT	SE	62	Fixed orthodontic appliance Removable appliance	NO YES	NR NR	3 days 8 weeks
2	Paley JS et al.[8]	2016	Prospective cohort	SE	23	Labial appliance	YES	/s/, /ch/, /dz/, /sh/, /f/, /t/	1 week
3	Rai AK et al[12]	2013	Prospective cohort	SOE, SE	24	Labial appliance Lingual appliance	YES YES	/s/, /d/, /l/ /s/, /d/, /l/	Within 1 month 1 month
4	KhattabTZ et al.[11]	2013	RCT	SOE, SE	34	Labial appliance Lingual appliance	YES YES	/s/ /s/	Within 1 month 3 months
5	Hohoff Aetal.[14]	2003	CCT	SE	12	Lingual appliance	YES	/s/	NA

NR-not reported, NA- not available, RCT- randomized control trial, CCT- clinical control trial, SE-subjective evaluation.

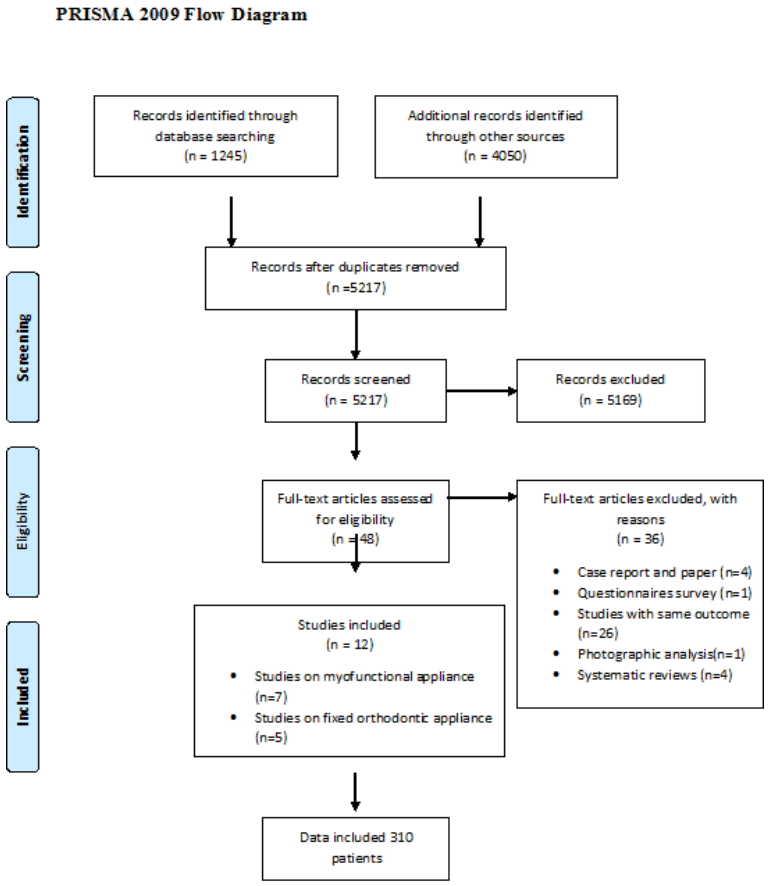

Figure 1. PRISMA flow diagram showing the literature search protocol.

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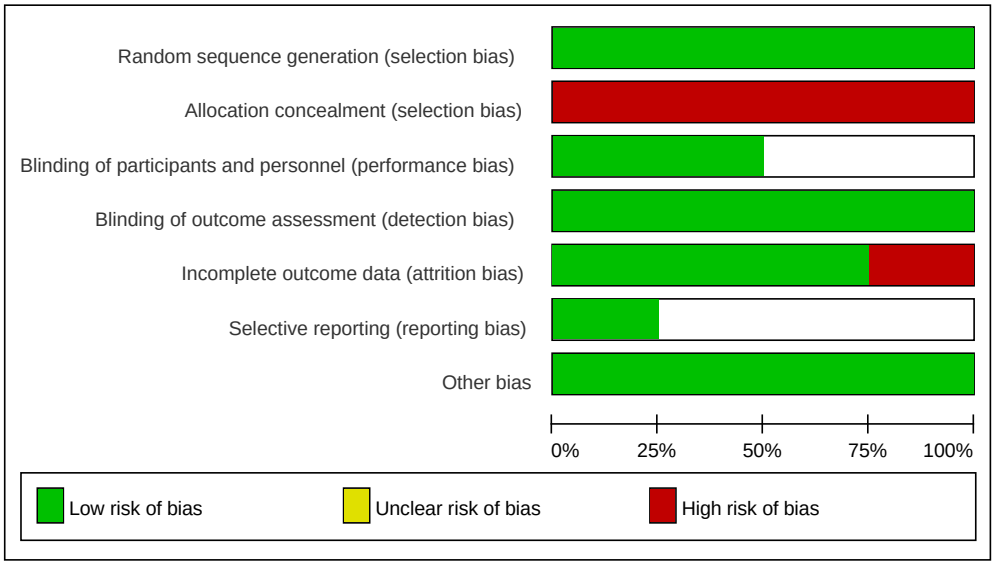

Figure 2: Risk of bias graph: Review authors' judgments about each risk of bias item presented as percentages across all included studies.

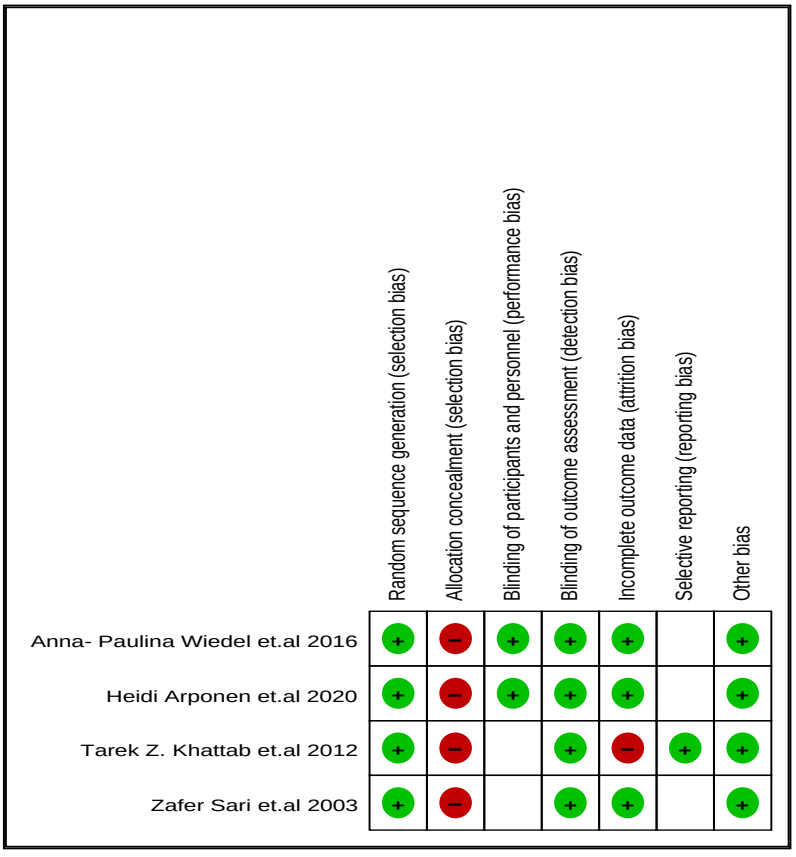

Figure 3: Risk of bias summary: Review authors' judgments about each risk of bias item for each included study.

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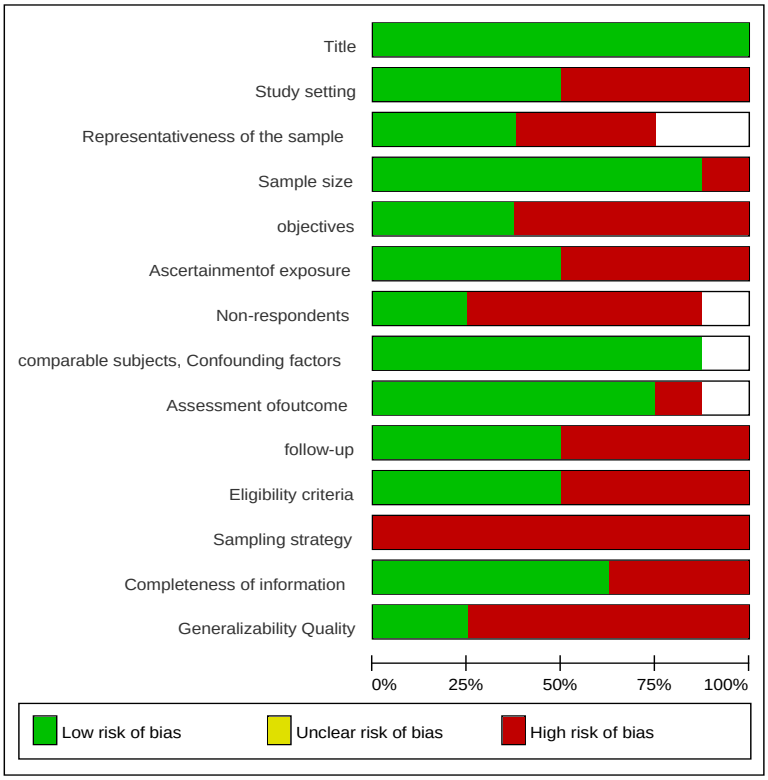

Figure 4: Risk of bias graph: Review authors' judgments about each risk of bias item presented as percentages across all included studies.

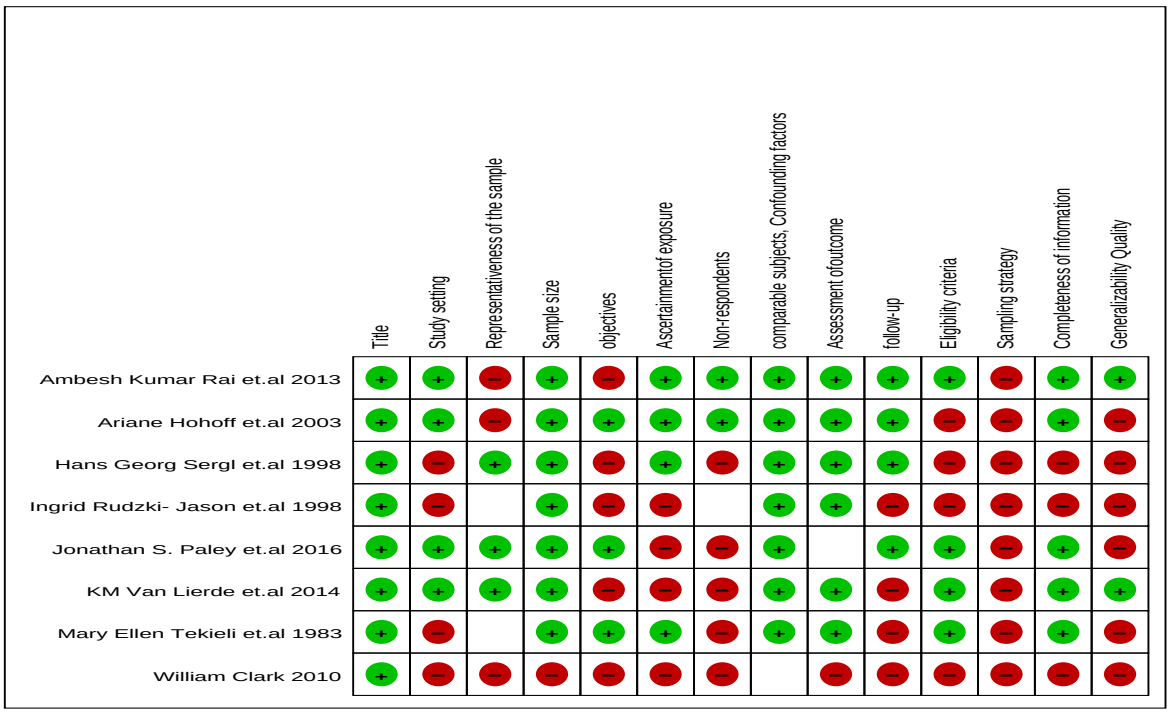

Figure 5: Risk of bias summary: Review authors' judgments about each risk of bias item for each included study.

Results:

Study description:

After the screening process, an additional 5,169 articles were excluded due to missing key parameters, incomplete data, or irrelevance to the current study. A total of 103 full articles were reviewed for further analysis. After a rigorous screening and data analysis, our systematic review comprised 12 studies (Fig. 1). These investigations were published between 1983 until 2020. Our analysis includes four randomized controlled trials, three clinical control trials, one clinical study, and four prospective cohort studies (see Tables 1 and 2).

Quality assessment:

The Cochrane Collaboration approach was used to assess the risk of bias in randomized controlled trials (RCTs), and

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analyses were carried out with RevMan software. The two reviewers were very reliable, with a considerable kappa value ($k > 0.89$).

Study characteristics:

In this review, the present study examined speech difficulties that arise from using myofunctional appliances, including both removable and fixed functional types, as well as fixed orthodontic appliances, encompassing labial and lingual variations.

This research included a range of study designs, which encompassed RCTs, CCTs, observational studies, and prospective research.

Clinical outcomes related to speech impairment, such as affected sounds, were assessed. The total sample size across all included studies comprised 310 patients, who were treated with various types of myofunctional appliances and fixed orthodontic appliances. Specifically, seven studies evaluated the influence of myofunctional appliances on speech, whereas five looked at the impact of fixed orthodontic appliances on speech outcomes.

Arponen H et al.[7] conducted an RCT with 52 participants, finding that headgear activators and twin blocks caused speech difficulties for 13 months. Van Lierde KM et al.[10] in a CCT with 56 participants, reported that activators caused speech difficulties affecting /s/, /n/, /l/, and /t/ for 12 months. Clark W et al.[13] observed speech difficulties with twin blocks, though specifics on affected sounds and duration were not reported.

Sari Z et al.[15] in an RCT with 60 participants, found that activators caused speech difficulties for 8.5 months, but Jasper Jumpers did not. Rudzki-Janson I et al.[16] reported no speech difficulties with Bionators in a prospective cohort study. Sergl HG et al.[17] found that removable appliances caused speech difficulties in a CCT with 10 participants, but the duration was not specified. Tekieli ME et al. [18] noted no speech difficulties with Frankel regulators in a prospective cohort study with 9 participants, with durations ranging from 2 to 15 months. (Table-1)

Wiedel AP et al.[9] conducted an RCT with 62 participants, finding that fixed appliances did not cause speech difficulties, whereas removable appliances did, lasting up to eight weeks. Paley JS et al.[8] in a prospective cohort study with 23 participants, reported that labial appliances caused speech difficulties affecting sounds like /s/, /ch/, /dz/, /sh/, /f/, and /t/ for one week.

Rai AK et al.[12] conducted a prospective cohort study with 24 participants, noting that labial and lingual appliances caused speech difficulties, particularly affecting /s/, /d/, and /l/, within one month and lasting for another month. Similarly, Khattab TZ et al.[11] in an RCT with 34 participants, found that labial and lingual appliances caused speech difficulties, especially with the /s/ sound, lasting up to three months.

Finally, Hohoff A et al.[14] conducted a CCT with 12 participants, reporting that lingual appliances caused speech difficulties affecting the /s/ sound, although the duration was not specified. Overall, removable, labial, and lingual appliances generally caused more significant and longer-lasting speech difficulties compared to fixed appliances. (Table-2)

Discussion:

Orthodontic treatments, including myofunctional appliance therapy and fixed appliance therapy, are widely used to correct malocclusions and improve dental alignment. These treatments can also affect speech, which is a complex process involving coordinated movements of the lips, tongue, palate, and vocal cords. In orthodontic treatments, myofunctional appliances are often removable devices designed to correct muscle function and guide the development of facial and oral structures. These appliances typically target younger patients during growth spurts, purpose of promoting proper muscle development. Because these appliances can influence tongue posture and oral muscle tone, they can have an impact on speech. Whereas; Fixed appliance therapy, involving braces or similar orthodontic devices, primarily targets dental misalignments and bite issues. [19]

The goal of this systematic review was to assess the impact of myofunctional and fixed appliance therapy on speech in orthodontic patients. Myofunctional appliance therapy includes a range of both removable and fixed functional appliances, including activators, twin blocks, Jasper jumpers, Bionators, and others. This study reviewed presented varying observations regarding the effect of these appliances on speech.

Arponen H et al.[7] highlighted that speech difficulty was more pronounced with twin block appliances compared to headgear activator appliances, primarily due to soft tissue irritation. Similarly, **Sergl HG et al.**[17] observed severe speech impairments with activators that had large resin bases and extensive interocclusal openings. Conversely, the Jasper jumper appliance was found to have minimum impact on speech, allowing for comfortable wear and maintaining tongue space, as reported by **Sari Z et al.**[15]

Fixed orthodontic appliances, both labial and lingual, were also assessed for their effect on speech. Labial appliances were noted to cause a slight impact on speech, particularly affecting consonants such as /s/, /t/, /f/, and /l/. Speech disturbances caused by labial appliances were reported to resolve within weeks to a month after insertion. However, lingual appliances showed more significant speech deterioration immediately after insertion, with some difficulties persisting for over three months, especially regarding the distortion of /s/ sounds.[18]

Several studies reported speech difficulties with fixed orthodontic appliances, particularly labial and lingual appliances. **Paley JS et al.**[8] conducted a prospective cohort study with 23 participants and found significant speech difficulties with labial appliances, affecting the pronunciation of various sounds such as /s/, /ch/, /dz/, /sh/, /f/, and /t/. The

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speech difficulties emerged within the first week of appliance installation.

The assessment of speech issues in orthodontic patients requires a comprehensive approach that incorporates multiple evaluation methods. This includes objective measurements using digital sonography, semi-objective analysis by speech therapists, and subjective feedback from the patients themselves. Combining these methods provides a comprehensive understanding of the impact of orthodontic appliances on speech.[19]

The present systematic review summarizes clinical evidence from existing studies assessing the effects of myofunctional appliance therapy and fixed appliance therapy on speech among orthodontic patients. This study suggests that myofunctional appliances have a more pronounced effect on speech compared to fixed orthodontic appliances. This difference could be attributed to the functional nature of myofunctional appliances, which may alter tongue positioning and oral airflow more significantly during speech production. In contrast, fixed appliances primarily focus on dental alignment and may exert less influence on speech articulation.

Limitations:

Several limitations are noted across the study, including variations in sample size, assessment methods, and duration of follow-up. Additionally, some studies lacked detailed reporting of speech difficulties and affected sounds. Future research should employ standardized assessment protocols and larger sample sizes to provide more robust evidence regarding the effects of orthodontic appliances on speech. Moreover, longitudinal studies tracking speech changes throughout treatment would elucidate the persistence and resolution of speech difficulties over time.

Conclusion:

This systematic review highlights, the potential speech difficulties associated with different types of orthodontic appliances, including myofunctional appliances and fixed orthodontic appliances. Our analysis revealed that both removable and fixed functional appliances, such as activators and twin blocks, can lead to speech impairments, with disorders of /s/, /n/, /l/, and /t/ occurring more frequently. Specifically, patients undergoing activator therapy exhibited more severe speech difficulties compared to those treated with Bionator and Frankel regulator appliances.

Furthermore, patients with lingual brackets experienced higher degrees of speech difficulty compared to those with labial brackets. The affected sounds were predominantly vowels such as /i/ and consonants including /s/, /t/, and /d/. Although most speech issues improved within weeks, distortions in the /s/ sound caused by lingual appliances were found to persist for over three months.

These findings underscore the importance of considering the potential impact on speech when selecting orthodontic appliances. Clinicians should be aware of the specific speech-related challenges associated with different appliances and provide appropriate guidance and support to patients undergoing orthodontic treatment. Further research is needed to explore strategies for mitigating speech difficulties and improving patient outcomes in orthodontic therapy.

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*Corresponding Author: **Dr. Akshay S. Mahajan.**