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# The effectiveness of orthotics in the treatment of temporomandibular joint disorder: A scoping review

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ABSTRACT

*Background:* The temporomandibular joint (TMJ) pathology and masticatory muscle dysfunction, as well as the influence of proprioceptive and dental treatments on the position of cranial bones and the Atlas, are important and interesting subjects in the field of medicine.
*Aim:* Evaluate the existing evidence base regarding the use of foot orthotics in the treatment of temporomandibular disorders (TMDs).
*Methods:* Two studies were conducted to evaluate the efficacy of a new complex approach to the treatment of TMJ pathology and masticatory muscle dysfunction, including myofascial exercises and posture correction insoles. The influence of proprioceptive and dental treatments on the position of cranial bones and the Atlas was also evaluated.
*Results:* From 23 initial registrations, 2 studies fulfilled the inclusion criteria. One article was an RTC and one a case series. The first study showed a significant increase in treatment efficacy compared to the control group. The second study showed that the Atlas was the point of greatest movement in terms of frontal position and that the sphenoid was the point of least movement.
*Conclusions:* These two studies are important for the development of new and effective treatments for TMJ pathology and masticatory muscle dysfunction, as well as for understanding the influence of proprioceptive and dental treatments on the position of cranial bones and the Atlas. It will be interesting to see how these findings will influence future clinical practice and patient care for these conditions.

## 1. Introduction

The temporomandibular joint (TMJ) is a complex structure that plays a crucial role in the functioning of the jaw. Disruptions to the normal functioning of the TMJ can result in a range of painful symptoms, collectively referred to as temporomandibular disorders (TMDs) [1]. The temporomandibular joint (TMJ) is an important structure in the human body, connecting the skull and the mandible [1,2]. The TMJ is a unique joint, as it is responsible for both rotational and translational movements during chewing, speaking, and other daily activities [1,3]. However, it is not uncommon for problems to arise in the TMJ, leading to temporomandibular disorders (TMDs). These disorders can cause a range of symptoms including pain, clicking, and limited jaw mobility, and can have a significant impact on the quality of life of affected individuals [3,4].

The treatment of TMDs can be challenging and often requires a multidisciplinary approach [1,5,6], incorporating dentists, physiotherapists, and other healthcare professionals. One possible treatment for TMDs is the use of orthotic devices [7,8], such as mouthguards or occlusal splints. The aim of these devices is to redistribute forces acting on the TMJ, reducing stress and promoting healing. Another type of orthotic device that has been used in the management of TMDs is the insole or foot orthotic, also known as a foot orthosis or simply a "foot orthotic" [9]. The use of foot orthotics for the treatment of TMDs is based on the principle of restoring balance and stability to the body as a whole, thereby reducing stress and strain on the TMJ. However, the evidence supporting the use of foot orthotics for the treatment of TMDs is limited and inconsistent, and it is unclear whether they are effective in the management of TMDs [10,11].

Orthotics, including foot orthotics and oral appliances, have been utilized in the treatment of TMDs. Foot orthotics are designed to provide support and stability to the feet, and can help to alleviate pain and discomfort caused by conditions such as plantar fasciitis, flat feet, and overpronation. Similarly, oral appliances, including bite splints and jaw repositioning devices, have been proposed as a treatment option for TMDs. The aim of these devices is to realign the jaw and restore normal

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jaw function, thereby reducing pain and discomfort [12,13].

Despite their popularity, there is limited evidence regarding the efficacy of foot orthotics [14,15] and oral appliances in the treatment of TMDs [16,17]. The aim of this scoping review is to evaluate the existing evidence base regarding the use of foot orthotics and oral appliances in the treatment of TMDs. By synthesizing the current literature, this review will provide a comprehensive overview of the current state of knowledge regarding the use of these interventions in the management of TMDs, and highlight areas for future research.

Therefore, which conservative and preventive interventions of insole may be indicated based on the available evidence, to the knowledge of the authors, no review has been conducted to answer this study question and, consequently, there is no comprehensive overview for both clinicians and researchers.

This study aimed to highlight and begin to fill this gap using a scoping review design. The synthesis of clinical data could add significant information for the overall management of healthy and unhealthy adults and could stimulate further research in this field.

As recommended by the Joanna Briggs Institute (JBI) [18], the scoping review approach can be used to map and clarify key concepts, identify gaps in the research knowledge base, and report on the types of evidence that address and inform practice in the field. These aims correspond to the objectives of this project. For this reason, other types of review, such as systematic reviews, umbrella reviews or rapid reviews, were not considered methodologically effective.

**This scoping review aimed to**.

1 Evaluate the existing evidence base regarding the use of foot orthotics in the treatment of temporomandibular disorders (TMDs).
2 Synthesize the current literature to provide a comprehensive overview of the current state of knowledge regarding the use of these interventions in the management of TMDs.

## 2. Methods

The present scoping review was conducted following the JBI methodology [18]for scoping reviews. The Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) [19] Checklist for reporting was used.

### 2.1. Research team

To support robust and clinically relevant results, the author conducted the research, drawing his expertise in evidence synthesis, quantitative and qualitative research methodology, sports and musculoskeletal rehabilitation.

### 2.2. Review question

We formulated the following research question: “What is the existing evidence base regarding the use of foot orthotics in the treatment of temporomandibular disorders (TMDs)?".

### 2.3. Eligibility criteria

Studies were eligible for inclusion if they met the following Population, Concept, and Context (PCC) criteria.

*Population.* Subjects of any age who experienced temporomandibular joint (TMJ) disorders were included.

*Concept.* Any intervention (preventive, conservative, pharmacological), except surgical, was considered.

*Context.* This review considered studies conducted in any context. Types of evidence sources. This scoping review included any study design or type of publication. No time, geographic, setting or language restrictions applied.

### 2.4. Exclusion criteria

Studies that did not meet the specific PCC criteria were excluded.

### 2.5. Search strategy

An initial limited search of MEDLINE was performed through the PubMed interface to identify articles on the topic and then the index terms used to describe the articles were used to develop a comprehensive search strategy for MEDLINE. The search strategy, which included all identified keywords and index terms, was adapted for use in Cochrane Central, Scopus, PEDro. Searches were conducted on December 20, 2022 with no date limitation.

### 2.6. Study selection

Once the search strategy has been completed, search results were collated and imported to EndNote V. X9 (Clarivate Analytics). Duplicates were removed using the EndNote deduplicator before the file containing a set of unique records is made available to reviewers for further processing. The selection process consisted of two levels of screening using Rayyan QCRI online software12: (1) a title and abstract screening and (2) a full-text selection. For both levels, two authors independently screened the articles with conflicts resolved by a third author.

The entire selection process and reasons for the exclusion were recorded and reported according to the latest published version of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA 2020) [19] flow diagram.

### 2.7. Data extraction and data synthesis

Data extraction was conducted using an ad-hoc data extraction form which was developed a priori, based on the JBI data extraction tool. Key information (authors, country, year of publication, study design, patients characteristics, PFD, type of intervention and related procedures) on the selected articles were collected. Descriptive analyses were performed, and the results were presented in one ways:

Numerically. Studies identified and included were reported as frequency and percentage, and the description of the search decision process was mapped. In addition, extracted data were summarized in tabular and diagrammatic form according to the main characteristics.

## 3. Results

As presented in the PRISMA 2020-flow diagram (Fig. 1), from 23 records identified by the initial literature searches, 21 were excluded and 2 articles were included.

### 3.1. Characteristics of included studies

Table .3 summarises the main characteristics of the studies. They are a randomised controlled trial, and one that is a case series. However, most of the subjects were women and the intervention consisted of wearing orthotics. To date, there are no active study protocols. The subjects of the studies and the studies themselves were recruited in Spain and Russia (see Table 2).

### 3.2. Participants

Table 1 summarises the data on subjects of different age groups who with temporomandibular disorders used orthotics as a supplementary treatment. In Rothbart BA’s 2013 [8] article, they radiographically assessed whether the frontal plane position of the cranial bones and the atlas could be altered by using dental orthotics, prescriptive orthotics or both simultaneously, while in Fadeyev R et al., ’s 2018 [7] study

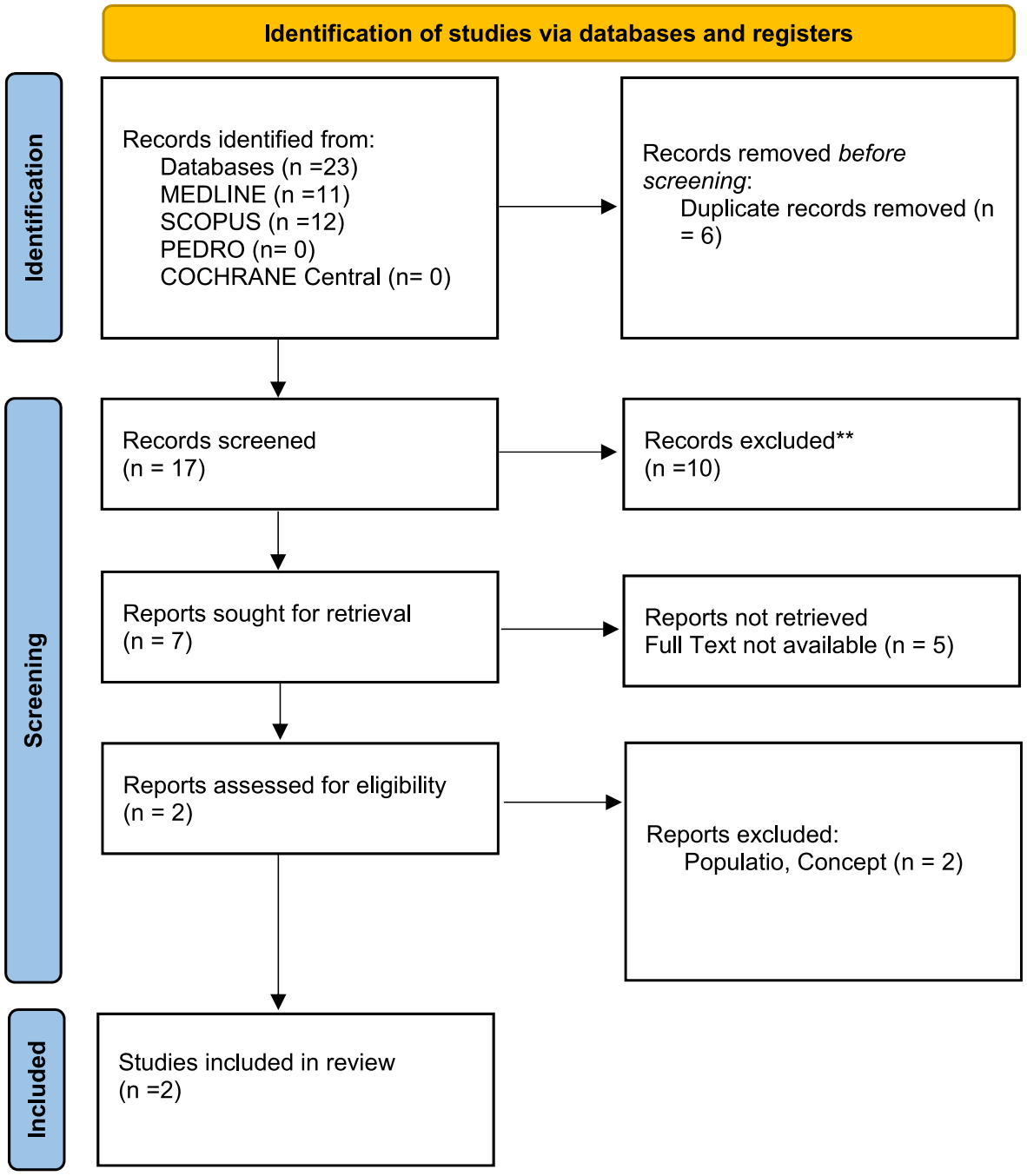


**Fig. 1.** Preferred reporting items for systematic reviews and meta-analyses 2020 (PRISMA) flow-diagram.

**Table 1**
Main characteristics of included studies.

| N° | AUTHOR | TITLE | YEAR | COUNTRY | STUDY DESIGN | SOURCE OF EVIDENCE | LEVEL OF PERFORMANCE |
|---|---|---|---|---|---|---|---|
| 1 | Rothbart BA° [8] | Prescriptive proprioceptive insoles and dental orthotics change the frontal plane position of the atlas (C1), mastoid, malar, temporal, and sphenoid bones: a preliminary study | 2013 | Spain | Case Series | Traditional | Not reported |
| 2 | Fadeyev R° et al. [7] | Results of complex rehabilitation patients with temporomandibular joint disease and parafunction of masticatory muscles | 2018 | Russia | Trial | Traditional | Not reported |

° Authors Name.

whether myogynastic exercises and posture correction orthotics could, in the complex rehabilitation of patients with TMJ pathology and masticatory muscle parafunction, improve function and pain.

## 4. Discussion

In this scoping review, we have mapped and summarized the

**Table 2**
Types of interventions.

| N° | AUTHOR | YEAR | INTERVENTION | | | | |
|---|---|---|---|---|---|---|---|
| | | | PREVENTIVE | CONSERVATIVE | SURGICAL | PHARMACOLOGICAL | MORE DETAILES |
| 1 | Rothbart BA° [8] | 2013 | | This study examines the effect of dental orthotics and prescriptive insoles on the frontal plane position of cranial bones and the atlas in four patients with temporomandibular joint dysfunction and preclinical clubfoot deformity. The results show that changes in the frontal plane position can occur when using proprioceptive insoles and/or dental orthotics, with improvement towards orthogonal seen in two patients when using both, but negative results seen with the use of generic proprioceptive insoles alone or in combination with dental orthotics | | – | This study analyzed changes in frontal plane position of cranial bones and atlas using dental orthotics and proprioceptive insoles. Radiographs were taken of four patients and planar line measurements were made on specific landmarks on the atlas, mastoid, malar, temporal, and sphenoid bones. Results showed that changes in frontal plane position occurred when using the orthotics and insoles, and that these changes varied between patients. |
| 2 | Fadeyev R° et al. [7] | 2018 | | The objective of the study was to determine the effective and appropriate use of myogymnastic exercises and orthopedic methods for posture correction in the rehabilitation of patients with temporomandibular joint (TMJ) pathology and masticatory muscle parafunction. The study treated 63 patients (43 with TMJ disease and 51 with masticatory muscle parafunction) using a combination of splint therapy, medicamentation treatment, an individual plan of myogymnastic exercises for chewing muscles, and individual insoles for posture correction. The results showed that the total treatment effectiveness was 12.49 % higher than traditional methods, as seen in improved periodontal vessel dopplerography, chewing muscle tonus, and mouth opening amplitude | | | A study was conducted on 63 patients (11 male and 52 female) with an average age of 31 years, 43 of whom had TMJ disease and 51 had masticatory muscle dysfunction. Patients were divided into two groups, with treatment in the main group consisting of splint therapy, medication (Mydocalm), and physical therapy, while the control group only received splint therapy and medication (Miodocalm). The data was analyzed using various statistical tests and significant differences were observed between the two groups. |

**Table 3**
Summary of main characteristics of included studies.

| Variable | No of Studies |
|---|---|
| **Year of Pubblication** | |
| 2013 | 1 |
| 2018 | 1 |
| **Study design** | |
| primary research | |
| RCT | 1 |
| Case Series | 2 |
| **Interventions** | |
| Interventions | 2 |
| **Sex** | |
| female | 11 |
| Male | 52 |
| **Use of five-toed socks** | 2 |

literature considering interventions using orthotics for the treatment of temporomandibular disorders. These two studies [7,8] present interesting and important results for the treatment of temporomandibular joint (TMJ) pathology and masticatory muscle dysfunction as well as the influence of proprioceptive and dental treatments on the position of cranial bones and the Atlas.

The first study [8]evaluated the efficacy of a new complex approach for the treatment of TMJ pathology and masticatory muscle dysfunction which included myo-gymnastics exercises and postural correction insoles. The results showed a significant increase in treatment efficacy compared to the control group. However, further studies with a larger number of participants and a longer follow-up are needed to confirm these results and fully evaluate the treatment efficacy.

The second study [7] evaluated the influence of proprioceptive and dental treatments on the position of cranial bones and the Atlas, showing that the atlas was the point of greatest movement in terms of frontal position and that the sphenoid was the point of least movement. This study highlights the importance of maintaining a holistic view when using proprioceptive insoles, as the elimination of a specific symptom may destabilize cranial bones and cause further problems.

Overall, these two studies are important for the development of new, effective treatments for TMJ pathology and masticatory muscle dysfunction as well as understanding the influence of proprioceptive and dental treatments on the position of cranial bones and the Atlas. It will be interesting to see how these findings will impact future clinical practice and patient care for these conditions.

These two studies present interesting and important results for the treatment of temporomandibular joint (TMJ) pathology and masticatory muscle dysfunction, as well as the influence of proprioceptive and dental treatments on the position of cranial bones and the Atlas. However, it is important to note that these studies are limited in number and of low quality, and therefore further research with larger sample sizes and longer follow-up is needed to fully validate these findings. The results of these studies provide a starting point for further investigation into the treatment of TMJ pathology and masticatory muscle dysfunction, as well as the impact of proprioceptive and dental treatments on cranial bones and the Atlas.

### *4.1. Research implications and suggestions for clinical practice*

The results of these studies have important implications for the treatment of temporomandibular joint (TMJ) pathology and masticatory muscle dysfunction, as well as the influence of proprioceptive and dental treatments on cranial bone and Atlas position. Therefore, after an individual assessment, a specific intervention plan must be defined. The overall management must be specific and tailored to the individual. In order to provide better guidance for clinical practice and to fill current gaps, there should be more and high-quality research. It is important to emphasise that these suggestions are not recommendations or tests.

Scoping reviews are not conducted to develop reliable clinical guidelines and recommendations but may provide implications for practice in terms of guidance from a clinical perspective.

### 4.2. Strengths and limitations

#### 4.2.1. Answering evidence gap

To the best of our knowledge, this is the first study to map and summarise the literature to identify interventions using orthotics as an integrative treatment for temporomandibular dysfunction. We used a discovery review design. We answered a relevant research question by identifying the volume and distribution of the trial base. We also mapped key concepts and research priorities within the literature.

*4.2.1.1. Clinical practice.* Although it is for different reviews, we have not assessed the methodological quality of the individual studies and no conclusions can be drawn on the intervention effects of wearing insoles in temporomandibular disorders, we provided an ovserview, the most complete, it should be emphasized that this is a tool that can be used by any person and that its content is not further defined. Consequently, the results of the previous existing studies cannot be verified independently.

## 5. Conclusions

In conclusion, these two studies present interesting and important results for the treatment of temporomandibular joint (TMJ) pathology and masticatory muscle dysfunction, as well as the influence of proprioceptive and dental treatments on the position of the cranial bones and the Atlas. However, it should be noted that the number of studies in this area is limited and the quality of these studies is not high, therefore further research is needed to confirm these findings and fully evaluate the effectiveness of these treatments. Nevertheless, these studies provide valuable insights into the development of new and effective treatments for TMJ pathology and masticatory muscle dysfunction, as well as the influence of proprioceptive and dental treatments on cranial bone position and the Atlas. This information is important for clinicians to consider when developing treatment plans for patients with these conditions, and will be exciting to see how these findings will impact future clinical practice and patient care.

## Author contributions

RT proposed the revision project and identified the framework. RT and RT proposed the methodology. RT identified the research strategy. RT extracted and analyzed the data. RT and RT supervised the methodology. All authors conducted the revision and developed the first and subsequent drafts of the manuscript.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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