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Review article

Telemedicine in the management of temporomandibular disorders: A literature review

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ABSTRACT

Background: *Temporomandibular disorders are clinical disorders involving the muscles of mastication, temporomandibular joints, and related structures. There are several treatments, such as self-help exercises, that can be done at home using remote care, often called telemedicine, after the patient has been directed to do so by a practitioner and evaluated during regular visits. Along with advancement of the times and technology, as well as with the prevention of COVID-19, telemedicine may currently be the main means of self-care for patients at home without losing the supervision of a doctor.* ***Purpose:*** *The purpose of this study is to determine the effect of using telemedicine in the management of temporomandibular disorders.* ***Methods:*** *A systematic literature review was undertaken using literature search methods in electronic databases: PubMed, ProQuest, and Google Scholar. The keywords were "(Telemedicine OR Teledentistry) AND (Temporomandibular disorder) AND (Effect)." The inclusion criteria for selection of the scientific articles were publication from 2012 to 2022, publication in English, and the full paper being available.* ***Results:*** *Seven articles have been included in this review. Based on the results of this systematic study, using telemedicine is considered able to assist the management of temporomandibular disorders by conducting consultation, follow-up, and treatment remotely via telephone, smartphone application, or internet-based or website-based applications.* ***Conclusion:*** *Telemedicine makes it easier for patients who do not have access to a health center to receive consultations and treatments from home, minimizing time and costs.*

Keywords: *effect; teledentistry; telemedicine; temporomandibular disorders*
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INTRODUCTION

The stomatognathic system is a functional unit of the body that is responsible for chewing, speaking, swallowing, tasting, and breathing. This system consists of bones, temporomandibular joints, ligaments, teeth, and muscles. In addition, a complex neurological control system regulates and coordinates all of these structural components. Disharmony in one of the components above will affect other components, which causes disturbances in masticatory function, one of which is disorders of the temporomandibular joint.[1] A temporomandibular disorder is a jaw joint disorder that is often found in dental practice. Temporomandibular disorders are a group of disorders involving the muscles of mastication, the temporomandibular joints, and structures associated with the stomatognathic system. Patients with these disorders will feel uncomfortable, even though this disorder is rarely accompanied by severe pain.[2,3] Temporomandibular disorders are quite common in Indonesia; the prevalence in adults is around 79.3%. It also affects 5–12% of the adult population worldwide.[3,4]

The etiology of temporomandibular disorders is still unknown, complex, and multifactorial. Several factors that can influence the etiology of temporomandibular disorders are initiation factors, predisposing factors, and perpetuation factors.[5] The diagnosis of temporomandibular disorders can be established by carrying out procedures according to the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) through history taking and physical

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examination. The DC/TMD has also issued a classification of temporomandibular disorders which is divided into two, namely pain-related temporomandibular disorders and intra-articular temporomandibular disorders.[6] Examples of treatment for temporomandibular disorders include self-management, behavior modification, physical therapy, pharmacotherapy, use of occlusal splints, and surgery.[1,7] Some treatments, such as self-help exercises, can be done at home using remote care, or what is often referred to as telemedicine, after the patient has been directed to do so by a practitioner and evaluated during regular visits.[8,9] Along with progress of the times and technology, telemedicine may currently be the main means of self-care for patients at home without losing the supervision of a doctor.[9]

Telemedicine is used as a tool for remote health-related activities, enabling interaction between professionals, exchange of information and knowledge, and remote access to resources that have diagnostic and therapeutic support.[3] Due to prevention of the spread of COVID-19, as written in the circular number HK.02.01/MENKES/303/2020, "Implementation of Health Services Through the Use of Information and Communication Technology in the Context of Preventing the Spread of Covid-19" on April 29, 2020, the Indonesian Ministry of Health suggested health services be carried out virtually with telemedicine.[10] Information related to telemedicine can be sent through various media, such as text, audio, image, and video using a smartphone/computer.[11] In dentistry, telemedicine is known as teledentistry, which allows long-distance communication between doctors and patients by combining digital technology and clinical dentistry. Currently, teledentistry has received increasing attention due to the COVID-19 pandemic in efforts to reduce in-person visits to hospitals. Telemedicine is classified into two parts, namely real-time consultation and the store-and-forward method. Telemedicine also consists of various models, namely, tele-expertise, teleconsultation, telemonitoring, tele-assistance, and telerehabilitation.[12,13]

According to the results of research conducted by Salazar-Fernandez et al.,[14] telemedicine allows consultation, diagnosis, and adequate treatment in most cases of temporomandibular disorders, shortening treatment time delays and reducing unnecessary costs for patients suffering from temporomandibular disorders. The results of another study, by Stuermer et al.,[3] state that telemedicine or telehealth is a viable support tool in primary care, which is useful in the management of most cases of temporomandibular disorders. Telemedicine improves patient management and results in positive changes in diagnosis, treatment planning, referral rates, and speed of decision-making.[3,15] Apart from these advantages, clinical examination and treatment via telemedicine have limitations: in some cases, chronic temporomandibular disorders still require face-to-face meetings between dentist and patient for direct treatment according to the patient's condition. Dentist may be technologically challenged, be afraid of making an inaccurate diagnosis. There may be constraints related to infrastructure, such as poor internet access, shortage of hardware, lack of training, lack of technical support and expertise.[14,16,17] In connection with technological developments and the prevention of COVID-19, telemedicine can be used as an alternative health service in the forms of consultation, diagnosis, and treatment of patients with temporomandibular disorders. Based on these problems, this systematic review aims to include the latest references along with the development of science and technology in discussing whether the use of telemedicine affects the management of temporomandibular disorders.

METHODS

This study uses the systematic literature review method by collecting online data sourced from PubMed, ProQuest, and Google Scholar published in the last 10 years because of the progress of time and technology and the development of research that is being carried out more and more. The search was carried out using keywords. After collecting relevant data through the database, the researcher used PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis), an evidence-based minimum set of items aimed at helping scientific authors report a wide array of systematic reviews and meta-analyses, primarily used to assess the benefits and harms of a health care intervention. There are four stages in PRISMA, namely identification, screening, eligibility, and inclusion.[18] At the identification stage, the keywords used were "(Telemedicine OR Teledentistry) AND (Temporomandibular disorder) AND (Effect)." The next stage was screening by filtering articles according to populations, exposures, outcomes (PEOs), and inclusion criteria (Table 1).

Furthermore, the eligibility stage was carried out to examine eligibility, that is, where the article contained a discussion on the effect of using telemedicine in the management of temporomandibular disorders in accordance with PEO, inclusion criteria (Table 2), and was available as a full text accessible in English. Articles were also checked for duplication using the Mendeley application. After that, articles that passed all these stages were assessed for quality based on each study. The randomized controlled trial used Jadad criteria, the cohort used the New Castle-Ottawa criteria, and the cross-sectional study used the Centre of Evidence-Based Medicine criteria.[19–21] The last step was to extract and synthesize data. At this stage, the researcher determined the information that was in accordance with the statement, research objectives, and PEO.

RESULTS

The articles obtained at the identification stage in the databases were 439. In detail, a search on PubMed obtained one article, ProQuest had five articles, and Google Scholar had 433 articles. The search was carried out using filters

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Table 1. Population, exposure, outcome

Population	Temporomandibular disorder patients
Exposure	The use of telemedicine in the management of temporomandibular disorders
Outcome	The effectiveness of telemedicine in the consultation, diagnosis, and rehabilitation that can be done with telemedicine

Table 2. Inclusion and exclusion criteria

	Inclusion	Exclusion
Sources	PubMed, ProQuest, Google Scholar	Other databases
Publication year	2012–2022	<2012
Language	English	Other languages
Publication type	Article/Journal	Other publication types
Population	Temporomandibular disorder patients	Patients without temporomandibular disorders
Exposure	The use of telemedicine in the management of temporomandibular disorders	Conventional management
Outcome	Effectiveness of telemedicine in the consultation, diagnosis, and rehabilitation that can be done with telemedicine	Effectiveness of telemedicine in the consultation, diagnosis, and rehabilitation that can be done with conventional management
Study	Clinical trial (randomized controlled trials, cohort, cross-sectional)	Other study types

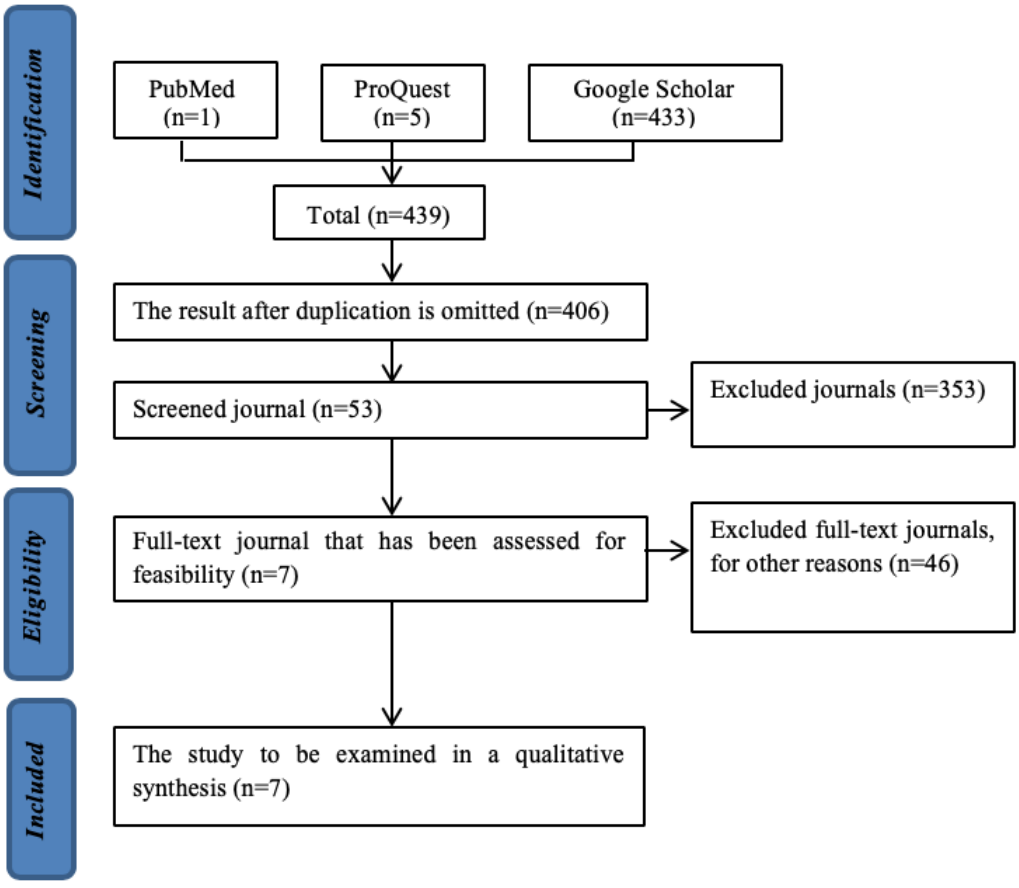

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis flowchart.

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Table 3. Data extraction characteristics and analysis

Writer and year	Title	Study	Sample	Country	Management	Conclusion
Lam J. et al. (2020)[22]	Internet-Based Multimodal Pain Program with Telephone Support for Adults with Chronic Temporomandibular Disorder: Randomized Controlled Pilot Trial	Randomized controlled trial (control group: patients with occlusal splint treatment)	43 (Aged between 17 and 75 years)	Lund, Sweden	Therapy is carried out through internet- or web-based programs that can be followed by adult patients with chronic temporomandibular disorder.	Effectively improved jaw function with jaw exercises
Exposto F.G. et al. (2021)[23]	Remote Physical Examination for Temporomandibular Disorders	Randomized controlled trial (control group: standard physical examination)	16 (Mean age 31 years)	Aarhus, Denmark	Use of Zoom application for video calls between clinicians and patients to evaluate symptoms and perform remote examinations	Feasible and provides a high level of accuracy in diagnostics
Wahlund K. et al. (2021)[24]	Internet-Based Treatment for Adolescents with Symptomatic Temporomandibular Joint Disc Displacement with Reduction	Randomized controlled trial (control group: jaw exercise treatment only)	83 (Aged 12–19 years)	Sweden	Jaw exercise application, which combines jaw exercises and counseling in adolescents with symptomatic temporomandibular joint disc displacement with reduction, is used in adolescent patients.	Effective in presenting information and treatment with jaw exercises
Ibraheim A. et al. (2021)[16]	The Role of Teledentistry in Oral Surgery During the COVID-19 Pandemics	Retrospective Cohort	21 (18–84)	London, England	Patient follow-up was carried out through telephone survey.	Effective in monitoring stable patients
Stuermer V.M. et al. (2021)[3]	Synchronous Teleconsultation in the Management of Temporomandibular Disorder	Retrospective Cohort	56 (Average age 43.7 years)	Porto Alegre, Brazil	Tele-consultation was feasible as a health care support tool that helps in Handling cases of temporomandibular disorders in health centers	Helped to manage the majority of temporomandibular disorder, streamlining care, and having the potential to avoid unnecessary referrals to special care
Torul D. et al. (2021)[12]	Is Tele-Dentistry an Effective Approach for Patient Follow-up in Maxillofacial Surgery	Cross-sectional	4 (Between 18 and 71 years)	India	Video calls to test the feasibility and accuracy of virtual diagnostics	Feasible and diagnostically accurate
Wallace C.K. et al. (2021)[25]	Role of Teledentistry in Paediatric Dentistry	Cross-sectional	5	New Castle, United Kingdom	Signs and symptoms of temporomandibular disorders can be established through remote examination via video consultation.	Diagnostic and rehabilitatively effective

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according to each database. The articles obtained were transferred to the citation manager, namely Mendeley, to be reviewed for duplication. There were 33 duplicate articles out of a total of 439 articles, so there was a remaining 406. Screening continued with the reading of abstracts one by one and the discarding of articles that did not meet the inclusion and exclusion criteria based on PEO. The screening of article abstracts found 353 articles that were not appropriate, leaving 53 articles. The full texts of all articles that passed the screening stage were searched for, then read and sorted again (Figure 1).

There were 46 articles that did not meet the eligibility criteria, leaving seven articles. In the next step, the articles were examined to discern their eligibility, that is, where the article contained a discussion on the use of telemedicine in the management of temporomandibular disorders that met the inclusion criteria and was available in accessible full-text form in English. After that, the remaining journals were deemed to comply with the inclusion and exclusion criteria based on PEO. Articles that were worthy of further research were reviewed one by one. Their quality was assessed using several scales and criteria depending on the type of research design in the article. There were three randomized controlled trial articles, two cohort articles, and two cross-sectional articles. All the articles were of high quality. The remaining articles were also extracted, and their data were synthesized in the form of their author's name, year of study, research title, number of samples, country, form of management, and conclusions from the management of the temporomandibular disorder (Table 3).

DISCUSSION

The results of data extraction in Table 2 showing the seven articles discuss the effect of using telemedicine in the management of temporomandibular disorders. Data about the effect of using telemedicine have been obtained in the form of management and conclusions. The data obtained from the seven articles have similarities in the forms of technology used, namely teleconsultation. In these seven articles, there are three with different forms of management, namely telerehabilitation, and two articles with telemonitoring.

Temporomandibular disorders are a group of disorders involving the muscles of mastication, the temporomandibular joints, and structures associated with the stomatognathic system. These disorders are often found in dental practice; therefore, dentists need to carry out examinations to establish a diagnosis and provide appropriate treatment. Some of these treatments can be done remotely using teledentistry. Teledentistry is a part of telemedicine that is engaged in dentistry and allows long-distance communication between dentists and patients using digital technology. The implementation of teledentistry can take the form of hospital-based systems and smartphone applications both in real time and in the store-and-forward method.[26,27]

Among smartphone applications, WhatsApp is a popular application that allows for information sharing between patients and doctors.[28,29] The use of the WhatsApp application to conduct video calls was used in the research of Torul et al.[12] to test the feasibility and accuracy of virtual diagnostics. In this study, the results of examination and follow-up in patients with temporomandibular disorders were very well received by patients and clinicians, so they support alternative management.[12] Results were similar in the study of Ibraheim et al.,[16] where patient follow-up was carried out by telephone survey. In this study, telephone follow-up was found to be effective in postoperative review. In patients with relatively stable temporomandibular disorders, a telephone review may be considered to assist in the management of the disease.[16]

Temporomandibular disorders have also been successfully diagnosed through remote examination as in the study of Exposto et al.[23] This study uses the Zoom application to conduct video calls between clinicians and patients in order to evaluate symptoms and perform remote examinations by instructing patients to feel their temporomandibular muscles and joints according to DC/TMD guidelines for the assessment of joint sounds, muscle pain, and joints. After that, the patient informs the clinician about the results of the examination, which will later be re-evaluated during a face-to-face meeting. In this study, remote testing was judged to be feasible in performing an accurate assessment and physical examination for patients who may not have access to an orofacial pain specialist or health care professional specializing in temporomandibular disorder.[23]

History and examination of temporomandibular disorders can also be done using teledentistry. In the study of Wallace et al.,[25] signs and symptoms of temporomandibular disorders are established through remote examination via video consultation. In addition to consultation and examination, providing advice on temporomandibular disorders, stress management, avoiding parafunctional habits, and physiotherapy are done remotely.[25] Another study, conducted by Stuermer et al.,[3] also found that teleconsultation was feasible as a health care support tool that helps in handling cases of temporomandibular disorders in health centers. In this study, remote consultation improves patient management with a good level of diagnostic accuracy to enable treatment planning. Teleconsultation is a useful tool in the management of temporomandibular disorders in health centers in that it can be an alternative type of consultation between patients and dentists.[3]

Internet-based or web-based forms of treatment can also be used in telemedicine to reduce pain.[30] In the study of Lam et al.,[22] therapy is carried out through internet- or web-based programs followed by adult patients. There are video instructions for jaw exercises, explanations of the level of pain frequency, and an overview of treatment progress that can be accessed by the patient but is still supervised by the dentist. It was found that the use of this internet-based program can help adult patients with chronic

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temporomandibular disorder pain. The patients felt an increase in jaw function after the program, which was in the form of jaw exercises.[22]

The use of jaw exercise applications is also used in adolescent patients in the research of Wahlund et al.,[24] which combines jaw exercises and counseling in adolescents. Adolescent patients are instructed, through means of an instructional film, that jaw exercises should be performed at least three times daily until the first evaluation, at two months. Meanwhile, the counseling provided was in the form of information related to the anatomy of the temporomandibular joint, the function/dysfunction of the temporomandibular joint, as well as suggestions for what to do. It was found that the two programs carried out through the internet were feasible to use and that this program was an effective treatment for symptoms of temporomandibular disorders.[24]

In conclusion, telemedicine has influenced the management of temporomandibular disorders, including helping to establish a diagnosis remotely, conducting reviews by telephone, and performing treatments such as jaw exercises that are instructed via video and can be followed by patients at home. In addition, there are similarities in the advantages of telemedicine as a management for temporomandibular disorders, namely minimizing time, easier access for patients who are far from health centers, reducing contagion, and minimizing costs.[3,12,16,22–25] This systematic review has limitations, such as the limited number of studies that assess and discuss the effect of the use of telemedicine in the management of temporomandibular disorders. The use of databases in this study was also limited by partial access. The selection of limited studies also affected the results of the articles obtained.

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