

Effectiveness of telemedicine approach as a treatment to reduce severity of temporomandibular disorders

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ABSTRACT

Background: Temporomandibular disorder (TMD) is the most common pain in the maxillofacial area. Overall prevalence of TMD was approximately 31% for adults/elderly and 11% for children/adolescents. TMD is considered a multifactorial disorder. There are various treatments for TMD, one of which is jaw exercises therapy which is the most widely used initial treatment to relieve signs and symptoms. Currently, conventional therapy for TMD patients has been difficult to control patient compliance. Hence, this therapy can be done at home independently through telemedicine as an alternative tool to rehabilitate the patients that can be accessed via smartphone. **Purpose:** To determine the severity of TMD before and after jaw exercises and the effect of telemedicine approach using jaw exercises via smartphone apps on dental students. **Methods:** This study used a quasi-experimental method with a one-group pre-test post-test design using Fonseca anamnestic index (FAI) questionnaire to measure the severity before and after two weeks of jaw exercises on 35 dental students using purposive sampling based on inclusion and exclusion criteria. Wilcoxon signed-rank test was used to analyze the data ($p < 0.05$). **Results:** Before jaw exercises, 21 people (60%) had mild TMD, 14 people (40%) had moderate TMD, and none had severe TMD. After jaw exercises, the severity of 9 people (42.8%) in the mild TMD group has decreased ($p = 0.007$), and the severity of 11 people (78.5%) in the moderate TMD group has decreased ($p = 0.003$). **Conclusion:** There was positive effect that decreased the level of severity of TMD through telemedicine approach after jaw exercises via smartphone apps on dental students.

Keywords: Fonseca anamnestic index; jaw exercises; telemedicine; smartphone apps

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INTRODUCTION

Temporomandibular disorders (TMD) are recognized by the American Academy of Orofacial Pain as a group of musculoskeletal and neuromuscular conditions involving the temporomandibular joint, muscles of mastication, and related tissues.¹ Prevalence of TMD was approximately 31% for adults/elderly and 11% for children/adolescents.² TMD occurs more frequently in women, possibly due to biological, psychological, and/or social factors associated with female gender, increasing the risk of TMD.³ The etiology of TMD is multifactorial. The diagnosis of this disorder can be made by clinical history, physical examination and radiographic studies.^{4,5} Clinical history can use the Fonseca anamnestic index (FAI), which is the most widely used because it is simple, low cost, and effective in describing the presence and severity of symptoms of TMD.⁶

Signs and symptoms of this disorder are usually pain and range of motion that require treatment.⁷

Jaw exercises are one of the treatments for TMD that aims to achieve relaxation in sore jaw muscles and optimize jaw function. This exercise can be done independently and is recommended because it is simple, cost-effective, and allows an easy approach to self-management.⁸ Some of the recommended therapeutic procedures are coordination exercises, strengthening and resistance exercises, and stretching and relaxation exercises that can be done with varying duration, frequency and length of exercise. The duration and frequency of exercise are generally carried out for 3-4 minutes 2-3 times a day. However, the length of exercise, in some studies, was carried out for two to three months with periodic evaluations. In the evaluation carried out every week, it showed changes in the disturbances that occur. That way, even though the exercise is only done

for a short period of time, if the patient does the exercise consistently it can reduce the signs and symptoms of TMD.^{9–12}

Due to the COVID-19 pandemic that makes it difficult for patients to get treatment, telemedicine can be a major tool to self-care at home by the patient without loss of monitoring from the practitioner. Telemedicine is an information-based technology and communication system for cross-distance care services and has been shown to improve the consistency and quality of healthcare, sometimes cheaper than conventional practice.¹³ Information can be sent through various media such as text, audio, images, or video using a device such as a smartphone or desktop computer.^{14,15} Using telemedicine through smartphones is an efficient and effective way of remote consultation as it allows for increased triage, which ultimately provides better care to maxillofacial patients.¹⁶ In addition, Salazar-Fernandez et al.¹³ said that telemedicine allows adequate diagnosis and treatment in most cases of TMD. Because of the above idea, researchers are interested in seeing whether there is an effect of telemedicine approach using jaw exercises via smartphone apps on the severity of TMD in dental students.

MATERIALS AND METHODS

This study used a quasi-experimental method with a one group pre-test post-test. Thirty-five dental students of North Sumatra University were selected using purposive sampling with inclusion criteria, which is students aged 18–23 years who had complete teeth up to M2, and had TMD which can be known through filling out the FAI questionnaire. This questionnaire was proposed by Fonseca in 1994, and is commonly used to classify TMD severity because it is good in obtaining relevant data and covers multi-dimensions and provides a full true picture of TMD. It was used for its simplicity and clearness of the questions.¹⁷ It is composed of 10 questions, includes checking for the presence of pain in the temporomandibular joint, head, and back, while chewing, para-functional habits, movement limitations, joint clicking, a perception of malocclusion and sensation of emotional stress. For each question there are three answer choices, no (Score 0), sometimes (Score 5), and yes (Score 10). Categories are determined by the sum of the scores of all question items and allow the following classification, absence of signs and symptoms of TMD (0-15 points), mild TMD (20-45 points), moderate TMD (50-65 points) and severe TMD (70-100 points) (Figure 1). They were summed up and the total score was out of a 100 maximum. The exclusion criteria included history of trauma in the maxillofacial and TMD treatment, using prosthetics and orthodontics. This study had permission from the Research Ethics Committee of Universitas Sumatera Utara (Number 1218/KEP/USU/2021).

There are three types of jaw exercises performed, d coordination exercises, strengthening and resistance

exercises, and stretching and relaxation exercises (Figure 2). Coordination exercises were performed with the patient instructed to open the jaw in a straight line in front of a mirror. The open motion of the subject must be in a straight line according to the midline of the teeth and use a straight object such as a ruler as a comparison. Strengthening and resistance exercises are performed by placing the thumb under the center of the patient's chin. The patient is instructed to open the jaw slowly by lowering the jaw, while applying steady light pressure to the underside of the chin with the thumb. Stretching and relaxation exercises were performed by hold the tongue on the palate for eight seconds while opening and closing the jaw slowly. Each exercise is performed for 10 repetitions, of which one repetition is performed for eight seconds. The exercises will be carried out for two weeks, three times a day. The exercises will be carried out via a telemedicine application on a smartphone. In addition to jaw exercises, the telemedicine application also contains an initial screening in the form of an FAI questionnaire, as well as an evaluation of care after doing jaw exercises. The FAI questionnaire will be filled out when the patient completes two 2 weeks of jaw exercises to see the effect before and after exercise via telemedicine on the severity of TMD experienced by the patient.

Initially, patients who had been selected according to the inclusion criteria were invited to meet via Zoom to be given instructions on how to use the application as well as an independent examination of signs and symptoms to answer the FAI questionnaire. After that, the patient was instructed to download the telemedicine application by writing "TMD Exercises" on their smartphone. Once downloaded, the patient was confirmed to have a stable internet network to be able to access the telemedicine application, and register on the application by filling in personal identification such as name, gender, age, and telephone number. One patient filled it in, the application instructed them to enter the code sent to their phone number to log in. On the home page, the application instructed them to fill out the FAI questionnaire according to the results of the previous examination. After that, the answers that have been saved were sent to the operator to be reviewed. If appropriate, the operator provided feedback in the form of instructions to perform jaw exercises for two weeks. Patients who got feedback could access jaw exercise tutorial videos and the application directed them to record their jaw exercises. Once recorded, the application asks the patient to upload the recording and send it to the operator as proof that the patient has performed the jaw exercises properly and according to the instructions. The application automatically provides jaw training notifications according to a predetermined time at 8 am, 2 pm, and 8 pm. Patients who miss jaw exercises will be contacted periodically by the operator by telephone. After two weeks of doing jaw exercises, the application will direct them to fill out the FAI questionnaire again. After filling out the questionnaire, the operator will provide education such as reducing bad habits that can increase TMD. To determine the effect of jaw exercise therapy

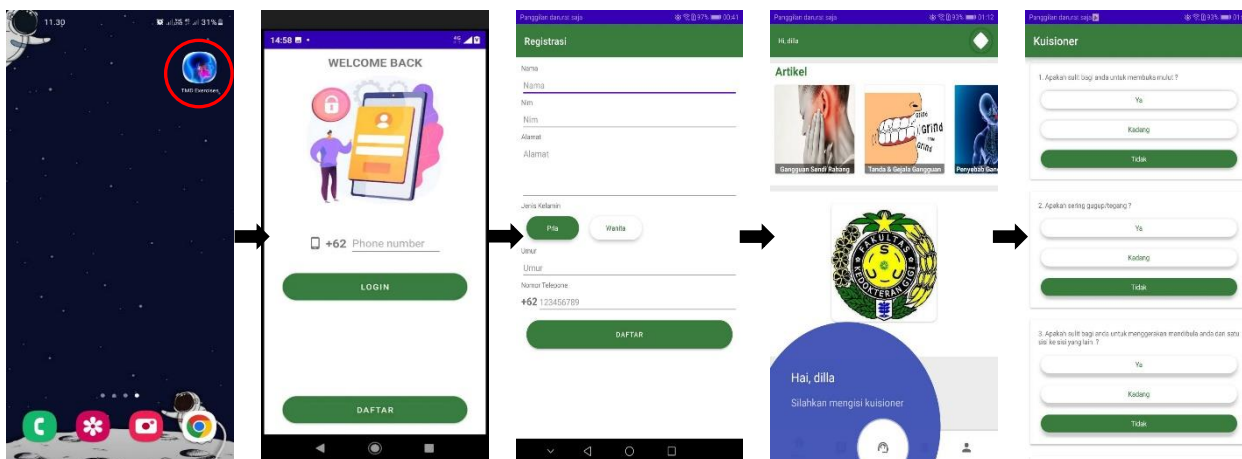


Figure 1. TMD exercises by telemedicine using a smartphone apps.

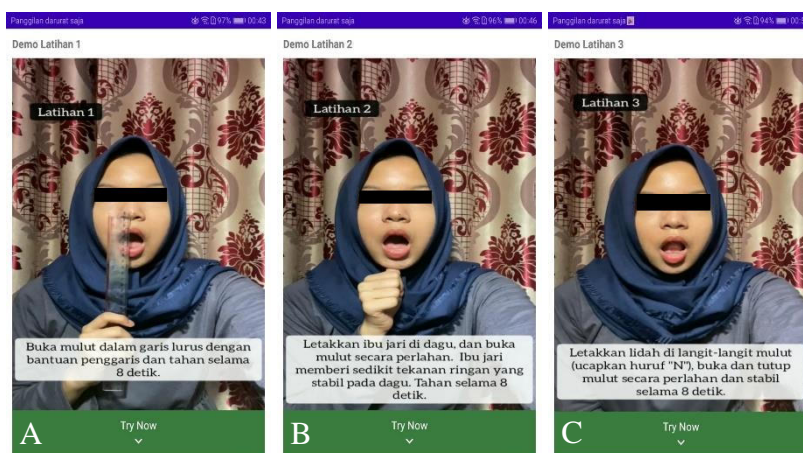


Figure 2. Three types of jaw exercises: coordination exercises (A); strengthening and resistance exercises (B); stretching and relaxation exercises.

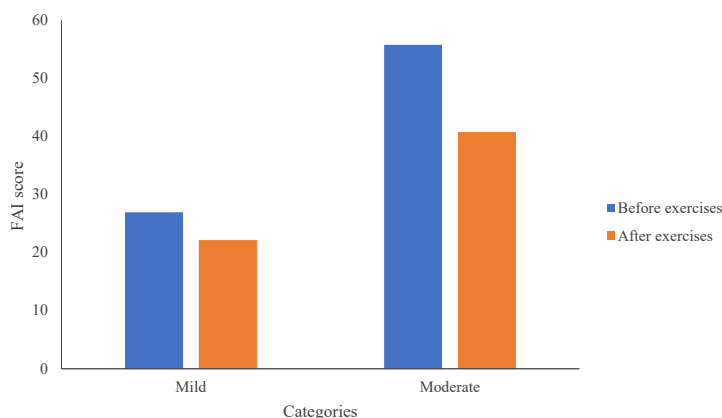


Figure 3. Effect of telemedicine approach before and after jaw exercises therapy.

Table 1. Results of statistical test using Wilcoxon signed rank test

Jaw exercises	Mild severity level			Moderate severity level		
	n	$x \pm SD$	p	n	$x \pm SD$	p
Before	21	26.9 ± 5.1	0.007*	14	55.7 ± 7.3	0.003*
After	21	22.1 ± 6.8		14	40.7 ± 16.5	

*Significant (p<0.05)

by telemedicine approach using smartphone apps on the severity of TMD, a statistical test was performed using the Wilcoxon signed rank test ($p < 0.05$) to find out the average between two related samples.

The telemedicine application has been validated by two prosthodontic doctors, both from video tutorials to evaluating the success of treatments that are adapted to conventional methods that are often carried out in practice. Telemedicine-TMD Exercises have been registered to Intellectual Property Right (IPR) from the Ministry of Law and Human Rights of Indonesia (Number 000341260).

RESULTS

The results of the questionnaire before jaw exercise therapy showed 21 people (60%) had mild TMD, 14 people (40%) had moderate TMD and none had severe TMD. The questionnaire result showed after jaw exercises therapy at mild severity, 9 (42.8%) people out of 21 experienced a decrease in the total score. Meanwhile, at the moderate level based on the results of the FAI questionnaire after jaw exercise therapy, 11 people (78.5%) out of 14 experienced a decrease in the total score (Figure 3). The results of statistical tests using the Wilcoxon signed rank test obtained significant results ($p < 0.05$), at mild severity level $p = 0.007$, and the moderate severity level $p = 0.003$ (Table 1).

DISCUSSION

This study showed significant results, which indicates there is an effect. This can be caused by patients who are dental students being familiar with the symptoms, signs and impacts of TMD. Nomura et al.¹⁸ saw many dental students who unknowingly had a TMD. When aware of having a disorder, steps of prevention and treatment become easier to do because individuals knew the effects that will occur if the disorder is ignored.^{18,19}

One of the initial treatments for TMD is jaw exercise therapy. In the Delphi study, Lindfors et al.²⁰ showed that there is an international agreement among therapists for TMD that jaw exercise therapy is an effective treatment and is recommended for patients with TMD and pain. In addition, patients also feel safe and protected because they have the tools (jaw exercises) to deal with the problem on their own if the symptoms reappear. The patients also appeared to be more confident, stronger and in control when using jaw exercises. This process can be defined as empowerment and can play an important role in pain treatment and rehabilitation.²⁰ Jaw exercise therapy carried out in this study consisted of three types: (1) Coordination exercises aimed to improve muscle coordination, relax tense muscles, overcome limitations in jaw movement, and restore normal muscle length and function by stimulating blood circulation to the temporomandibular joint muscles. (2) Strengthening and resistance training aimed to overcome

muscle spasms, limited movement, muscle weakness, and muscle in-coordination. This exercise involves contracting the mandibular muscles against resistance during jaw opening movements. This exercise increases reflex inhibition and relaxation of the corresponding antagonist muscles. (3) Stretching and relaxation exercises aimed to improve the range of motion of the jaw and eliminate or reduce joint sounds.^{5,11}

This study carried out jaw exercise therapy independently at home (Home Physical Therapy) using telemedicine because it has been proven to be effective. Telemedicine is a cross-distance care service so that patients can perform independent jaw exercise therapy anywhere but still under the supervision of expert practitioners. Some research said that telemedicine enables adequate diagnosis and treatment in the majority of cases of TMD, shortens treatment time delays and reduces unnecessary costs to patients with TMD. Treatment through telemedicine as a support application can be used as a means to send questionnaires, jaw exercise videos, reminders for exercises and to evaluate so that it can meet the goals of TMD treatment, self-management and self-efficacy.^{13,21} Therefore, jaw exercise therapy is recommended to be carried out through telemedicine compared to conventional. Besides that, telemedicine has proven to improve consistency and quality of healthcare and is less expensive than conventional practice.¹³

Telemedicine via smartphone apps in this study is designed as a simulation video containing instructions for jaw exercise therapy, and a recording feature that is equipped with a timer along with its repetitions as a means for patients to perform jaw exercise therapy. The recording results will be sent to and stored by the operator so that the patient can be monitored and can be given direction if the exercise therapy is not appropriate. Also, they have an automatic reminder three times a day which is installed automatically immediately after the application is downloaded. Telemedicine approach via smartphone apps can be done anywhere so that it can improve patient compliance in doing jaw exercises. In addition, it also has supporting features, namely education in the form of articles and FAI questionnaires as a means of measuring the severity of TMD before and after two weeks of jaw exercise therapy. Patients who feel they still have symptoms and signs of TMD can continue therapy through the application with the frequency and duration according to their settings.

Jaw exercise therapy will be effective if the patient routinely undergoes the instructions and procedures given. According to Kartika et al.,¹⁰ jaw exercise therapy should be done for 2-3 minutes with a frequency of 2-3 times a day, and in most cases, it takes about 2-3 months to get satisfactory benefits, both subjectively and objectively.¹⁰ However, research by Sakuma et al.¹² found that clinical symptoms such as maximum mouth opening distance, pain on movement, pain on mastication, and impact on daily activities in the second week were significantly increased.¹² The following is in accordance with this study, where therapy was carried out for a duration of three minutes

three times a day and for two weeks which showed a decrease in severity before and after jaw exercise therapy, that respondents no longer felt symptoms of TMD such as sound and pain in temporomandibular joint, and fatigue when chewing.

Likewise, in this study, as many as 15 people (42.9%) did not show any changes before and after jaw exercise therapy. This can be caused by the patient being uncooperative and not aware of the need for treatment for the TMD they are experiencing so they often miss the automatic jaw exercise therapy alarm on their smartphone. In addition, there are also external factors such as daily activities that make patients skip jaw exercise therapy.

To conclude, there was significant positive effect of telemedicine approach using jaw exercises via smartphone apps on dental students. The weakness of this study is that the severity of TMD cannot be checked directly considering the COVID-19 pandemic situation, the honesty of patients when filling out questionnaires cannot be measured, and the length of exercise carried out will show more satisfactory results if carried out in a longer period.

REFERENCES

1. Ferreira CLP, da Silva MAMR, de Felício CM. Signs and symptoms of temporomandibular disorders in women and men. *CoDAS*. 2016; 28(1): 17–21.
2. Valesan LF, Da-Cas CD, Réus JC, Denardin ACS, Garanhani RR, Bonotto D, Januzzi E, de Souza BDM. Prevalence of temporomandibular joint disorders: a systematic review and meta-analysis. *Clin Oral Investig*. 2021; 25(2): 441–53.
3. Akhter R. Epidemiology of temporomandibular disorder in the general population: a systematic review. *Adv Dent Oral Heal*. 2019; 10(3): 1–13.
4. de Leeuw R, Klasser G. *Orofacial pain: Guidelines for assessment, diagnosis, and management*. 6th ed. Quintessence Publishing; 2018. p. 143–72.
5. Okeson JP. *Management of temporomandibular disorders and occlusion*. 8th ed. St. Louis: Elsevier; 2020. p. 2, 5–19, 108–9, 132, 174–5, 206–8, 262–71, 277–82.
6. Alyessary AS, Yap AU, Almousawi A. The Arabic Fonseca Anamnestic Index: Psychometric properties and use for screening temporomandibular disorders in prospective orthodontic patients. *Cranio*. 2020; : 1–8.
7. De Rossi SS, Greenberg MS, Liu F, Steinkeler A. Temporomandibular disorders: evaluation and management. *Med Clin North Am*. 2014; 98(6): 1353–84.
8. Lindfors E, Magnusson T, Ernberg M. Patients' experiences of therapeutic jaw exercises in the treatment of masticatory myofascial pain-A postal questionnaire study. *J Oral Rehabil*. 2019; 46(9): 800–6.
9. Shimada A, Ishigaki S, Matsuka Y, Komiyama O, Torisu T, Oono Y, Sato H, Naganawa T, Mine A, Yamazaki Y, Okura K, Sakuma Y, Sasaki K. Effects of exercise therapy on painful temporomandibular disorders. *J Oral Rehabil*. 2019; 46(5): 475–81.
10. Kartika L, Himawan LS. Penatalaksanaan kasus gangguan sendi temporomandibula dengan latihan rahang (Laporan kasus). *Indones J Dent*. 2007; 14(1): 12–7.
11. Moraes A da R, Sanches ML, Ribeiro EC, Guimarães AS. Therapeutic exercises for the control of temporomandibular disorders. *Dental Press J Orthod*. 2013; 18(5): 134–9.
12. Sakuma S, Yamaguchi Y, Taguchi N, Ogi N, Kurita K, Ito Y. Pilot study of the short-term effects of range-of-motion exercise for the temporomandibular joint in patients with temporomandibular joint disc displacement without reduction. *J Phys Ther Sci*. 2017; 29(2): 274–7.
13. Salazar-Fernandez CI, Herce J, Garcia-Palma A, Delgado J, Martín JF, Soto T. Telemedicine as an effective tool for the management of temporomandibular joint disorders. *J Oral Maxillofac Surg*. 2012; 70(2): 295–301.
14. Jampani ND, Nutalapati R, Dontula BSK, Boyapati R. Applications of teledentistry: A literature review and update. *J Int Soc Prev Community Dent*. 2011; 1(2): 37–44.
15. Kadir MA. Role of telemedicine in healthcare during COVID-19 pandemic in developing countries. *Telehealth Med Today*. 2020; : 1–5.
16. Aziz SR, Ziccardi VB. Telemedicine using smartphones for oral and maxillofacial surgery consultation, communication, and treatment planning. *J Oral Maxillofac Surg*. 2009; 67(11): 2505–9.
17. Al Moaleem MM, Okshah AS, Al-Shahrani AA, Alshadidi AAF, Shaabi FI, Mobark AH, Mattoo KA. Prevalence and severity of temporomandibular disorders among undergraduate medical students in Association with Khat Chewing. *J Contemp Dent Pract*. 2017; 18(1): 23–8.
18. Nomura K, Vitti M, Oliveira AS de, Chaves TC, Semprini M, Siéssere S, Hallak JEC, Regalo SCH. Use of the Fonseca's questionnaire to assess the prevalence and severity of temporomandibular disorders in Brazilian dental undergraduates. *Braz Dent J*. 2007; 18(2): 163–7.
19. Özdoğan S, Ata H, Selçuk H, Can HB, Sermenli N, Turan FN. Temporomandibular joint disorder determined by Fonseca anamnestic index and associated factors in 18- to 27-year-old university students. *Cranio*. 2020; 38(5): 327–32.
20. Lindfors E, Arima T, Baad-Hansen L, Bakke M, De Laat A, Giannakopoulos NN, Glaros A, Guimarães AS, Johansson A, Le Bell Y, Lobbezoo F, Michelotti A, Müller F, Ohrbach R, Wänman A, Magnusson T, Ernberg M. Jaw Exercises in the treatment of temporomandibular disorders-An international modified Delphi study. *J oral facial pain headache*. 2019; 33(4): 389–398.
21. van der Meer HA, de Pijper L, van Bruxvoort T, Visscher CM, Nijhuis-van der Sanden MWG, Engelbert RHH, Speksnijder CM. Using e-Health in the physical therapeutic care process for patients with temporomandibular disorders: a qualitative study on the perspective of physical therapists and patients. *Disabil Rehabil*. 2022; 44(4): 617–24.