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Effectiveness of Non-Invasive Physiotherapy in Optimising Mucus Drainage and Sinus Ventilation in Sinusitis: A Literature Review

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ABSTRACT

Introduction: Sinusitis is an inflammatory condition of the paranasal sinuses that can cause pain, pressure, and swelling. From the many symptoms that can arise due to sinusitis, physiotherapy can reduce dependence on pharmacological interventions and minimise long-term side effects. The purpose of this study was to determine the effectiveness of non-invasive physiotherapy in optimising mucus drainage and sinus ventilation in sinusitis patients. **Methods:** conducted was a literature review. The author conducted a comprehensive exploration on various academic databases that can be accessed online, including Google Scholar, PubMed, PEDRO, and Scopus. The keywords used in the search were "Physiotherapy, Intervention, Manual Therapy, Modalities Therapy, Sinusitis". The article selection process used PRISMA flow. **Results:** The results showed significant differences in various clinical parameters with a p-value range between $p < 0.001$ to $p = 0.039$, where ultrasound therapy and LLLT provided more rapid improvement, while breathing exercises and manual techniques had long-term effects for impaired mucus drainage and ventilation. **Conclusion:** Physiotherapy Interventions that can be given in cases of sinusitis, namely therapies such as ultrasound modalities, shortwave diathermy, Low-Level Laser Therapy, manual sinus drainage, self sinus massage, Jade Stone Mobilisation and yoga postures have proven effective in reducing symptoms of chronic sinusitis, including pain, sinus obstruction, and inflammation

Keywords*: Manual Therapy, Non-invasive Interventions, Physiotherapy, Sinusitis, Sinus Drainage*

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INTRODUCTION

Sinusitis is an inflammatory condition of the paranasal sinuses that can cause pain, pressure and swelling. It can be acute or chronic, with varying causes and symptoms. Acute sinusitis is a common condition that is often caused by a viral infection, although bacteria and fungi can also be to blame. Symptoms usually include nasal congestion, purulent discharge from the nose, facial pain, headache, fever, and general malaise. Most people with acute sinusitis recover spontaneously within 7 to 10 days without antibiotic treatment, although 25% still experience symptoms after 14 days (Wilson & Wilson, 2021). Chronic sinusitis is sinus inflammation that lasts more than 12 weeks. Unlike acute sinusitis, chronic sinusitis is not always caused by a bacterial infection and does not always improve with standard treatments such as antibiotics. This condition can be caused by infection, nasal polyps, or inflammation of the sinus lining (Kwon & O'Rourke, 2023).

The prevalence of sinusitis in Indonesia is unknown, but worldwide the prevalence of chronic rhinosinusitis (RSK) ranges from 5-12%. Epidemiological data shows that chronic sinusitis has a geographically variable prevalence, with rates in North American and European countries ranging from 4.5% to 12% (Shi et al., 2015). As one of the most common upper respiratory system

disorders, sinusitis has pathophysiological and clinical complexities that require a comprehensive approach in physiotherapy interventions. Inflamed sinus cavities will result in impaired mucus drainage, obstruction, and various symptoms that affect the patient's quality of life. So physiotherapy is important in sinusitis because it can help remove mucus congestion and reduce inflammation through drainage techniques and manual therapy. In addition, physiotherapy teaches proper breathing techniques, improves blood flow, and helps prevent sinusitis recurrence holistically. Various therapeutic strategies aim to reduce inflammation, restore mucus drainage, and improve respiratory function (Fouda et al., 2023a).

Of the many symptoms that can arise from sinusitis, physiotherapy can reduce dependence on pharmacological interventions and minimise long-term side effects. Therefore, this study aims to determine physiotherapy techniques that can reduce and overcome symptoms that can result from sinusitis such as impaired mucus drainage and ventilation.

METHODS

This study uses a literature review approach by systematically searching the relevant scientific literature. This method refers to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines as used in previous studies (Tsung et al., 2024). Literature exploration was conducted using the academic databases Google Scholar, PubMed, Pedro, and Scopus, with the keywords "Physiotherapy, Intervention, Manual Therapy, Modality Therapy, Sinusitis". The search criteria followed a Boolean logic strategy ("AND" and "OR") to increase the relevance of the results.

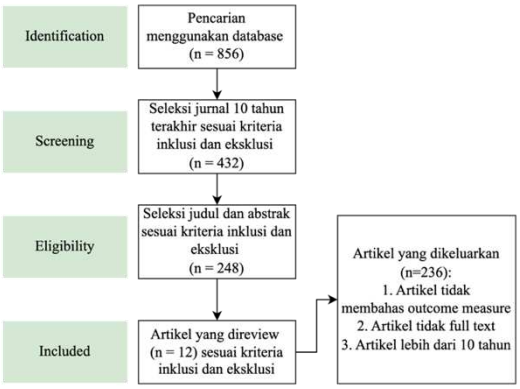

Figure 1. Prima Flowchart

The article selection process follows the PRISMA flow in stages (Figure 1). The identification stage is carried out by searching using predetermined keywords. Next, at the screening stage, articles are filtered based on the publication limit of the last 10 years (2015-2025). At the eligibility stage, selection was made based on the relevance of the title and abstract. Finally, articles that did not meet the criteria of text completeness and outcome measure relevance were eliminated, leaving 12 articles for analysis. Inclusion criteria included full text articles, randomised controlled trial, quasi-experimental, cohort, cross-sectional, or systematic review research designs, and Scimago Q1-Q3 indexed. Meanwhile, articles without full text, unsuitable design, or published more than 10 years ago were excluded from the analysis. Selected articles were analysed using the narrative synthesis method (Rai et al., 2020) to identify effective physiotherapy intervention patterns in the management of sinusitis in a comprehensive and systematic manner.

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RESULTS

Various physiotherapy interventions such as therapeutic ultrasound, manual drainage techniques, jade therapy, low-level laser therapy (LLLT), shortwave diathermy (SWD), nasal septal mobilisation, yoga breathing exercises, and aerobic exercise with nasal breathing show effectiveness in improving quality of life, reducing pain, and improving symptoms of chronic sinusitis such as impaired mucus drainage. The results showed significant differences in various clinical parameters with a p-value range between $p < 0.001$ to $p = 0.039$, where ultrasound therapy and LLLT provided more rapid improvement, while breathing exercises and manual techniques had long-term effects for impaired mucus drainage and ventilation.

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Table 1. Results

No.	Author and Year	Title	Method, Sample Size, Variables and Intervention provided	Results and Conclusion
1.	Fouda et al., 2023	*Effect of Adding Physiotherapy Programme to the Conservative Medical Therapy on Quality of Life and Pain in Chronic Rhinosinusitis Patients*	**Methods:** *Randomised controlled trial* **Sample Quantity:** Total: 68 **Variables:** - Independent Variable: Physiotherapy programme ● Pulsed ultrasound therapy ● Sinus manual drainage techniques ● Self-sinus massage technique - Dependent Variable: ● Quality of Life (QoL): Rhinosinusitis Disability Index (RSDI) ● Pressure Pain Threshold (PPT): digital algometer **Intervention:** Group A: - Conventional medical treatment Group B: - Pulsed Ultrasound Therapy ● Frequency: 1 MHz ● Intensity: 1 and 0.5 W/cm² ● Duration: 4-5 minutes/sinus - Manual Sinus Drainage Techniques ● Frontal sinus drainage ● Nasal passages drainage ● Maxillary sinus drainage - Self-Sinus Massage Technique ● Frontal sinus massage ● Maxillary sinus massage ● 2 times/day	**Research Results:** Significant differences ($p<0.001$) between the two groups with the intervention group showing greater improvements in RSDI (55.03% vs 33.68%) and PPT (71-111% vs 35-42%) scores. **Conclusion:** The combination of ultrasound, manual drainage and self-massage therapy improved the quality of life and pain threshold of CRS patients.

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			Frequency: - 3 sessions/week - Total 12 sessions, 4 weeks	
2.	Gandhi and Gurudut Dr., 2022	*Comparative Effectiveness of Jade Stone Mobilisation, Non-Abrasive Cupping, and Manual Drainage Technique in Subjects with Chronic Sinusitis: A Randomised Clinical Trial*	**Methods:** Randomised Control Trial **Sample Quantity:** Total: 45 (3 groups) **Variables:** Independent Variable: Manual therapy: ● Jade stone mobilisation. ● Non-abrasive cupping. ● Manual drainage technique. Dependent Variable: ● Pressure pain threshold (PPT) using a pressure algometer. ● Quality of life (QOL) using the SNOT-22 (Sinonasal Outcome Test) questionnaire. **Intervention:** Group A: - Jade stone mobilisation: Mobilisation using jade stones on the frontal and maxillary sinuses, with moisturising gel as the medium. Group B: - Non-abrasive cupping: The use of non-abrasive suction cups on the sinus area with movement towards the lymphatic channels. Group C: - Manual drainage technique: Manual drainage with gentle pressure towards the tonsillar lymph nodes. Frequency: 3 sessions/week	**Research Results:** The results showed all groups had significant improvement ($p<0.001$) in PPT and SNOT-22 after 2 weeks, with Jade Stone Mobilisation showing superior results at week 6 compared to the other techniques, while Non-Abrasive Cupping showed no significant difference. **Conclusion:** All three manual therapy methods (Jade Stone Mobilisation, Non-Abrasive Cupping, Manual Drainage) are safe and effective to improve pain threshold and quality of life in chronic sinusitis patients.

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			Total 6 sessions, 2 weeks	
3.	Kalekar and Gurudut, 2019	*Effect of Therapeutic Ultrasound Versus Shortwave Diathermy Combined with Suboccipital Release and Manual Drainage Techniques for Chronic Sinusitis A Randomised Clinical Trial*	**Methods:** Randomised Control Trial **Sample Quantity:** Total: 46 patients with chronic sinusitis **Variables:** Independent Variable: Manual therapy: ● Types of electro therapy (ultrasound therapy or shortwave diathermy). - Dependent Variable: ● Pain: Visual Analogue Scale (VAS). ● Pain Pressure Threshold: Measured using a Pressure Algometer. ● Quality of Life: Measured using the Sino-Nasal Outcome Test-22 (SNOT-22). **Intervention:** Common to Both Groups: - Suboccipital Release - Manual Drainage: frontal sinus and maxillary sinus Group A: Ultrasound - Intensity: 1 W/cm² for the maxillary sinus and 0.5 W/cm² for the frontal sinus. - Frequency: 1 MHz with continuous mode. - Duration: 5 minutes for maxillary sinuses and 4 minutes for frontal sinuses. Group B: SWD - Intensity: As per patient tolerance with minimal warm-up settings. - Technique: Using the cross-fire method, small electrodes are placed on opposite sides of the face (forehead and under the jaw). - Duration: 30 minutes per session, with a	**Research Results:** The results showed that both groups experienced significant improvements ($p<0.001$) in VAS, pressure algometer, and SNOT-22, with the ultrasound group showing superior effectiveness compared to SWD in reducing pain and improving patients' quality of life. **Conclusion:** Both ultrasound therapy and SWD combined with suboccipital release and manual drainage techniques are effective in reducing symptoms of chronic sinusitis. Ultrasound therapy provides faster and more significant results than SWD.

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			change in electrode position after 10 minutes. Frequency: 1 session/day Total 5 sessions, 5 days	
4.	Abishek, Bakshi and Bhavanani, 2019	*The Efficacy of Yogic Breathing Exercise Bhramari Pranayama in Relieving Symptoms of Chronic Rhinosinusitis*	**Methods:** Randomised controlled trial. **Sample Quantity**: 60 patients **Variables:** - Independent Variable: Bhramari pranayama as an additional treatment. - Dependent Variables: Sino-Nasal Outcome Test (SNOT-22), which is used to measure symptoms and quality of life related to chronic sinusitis. - Control Variables: fluticasone propionate nasal steroid spray and nasal irrigation with saline solution **Intervention:** Group A: - Receiving conventional treatment for chronic sinusitis. Group B: - Bhramari pranayama: • yogic breathing exercises • Humming - a day for 15 minutes each session.	**Results**: Group B showed a significant decrease in SNOT-22 score compared to Group A (P = 0.0002). **Conclusion**: Bhramari pranayama is effective as an adjunct therapy to manage chronic rhinosinusitis. This exercise helps reduce symptoms with better sinus ventilation and anti-inflammatory effects.
5.	Zarneshan, 2020	*Effects of Regular Aerobic with Nasal Breathing Exercise Training on Olfactory Rehabilitation in Asthmatic Patients with Chronic Rhino Sinusitis*	**Methods** A quasi-experimental study. **Sample** 35 asthmatic women with chronic rhinosinusitis (18 experimental group, 17 control group, mean age 34.7±7.5 years).	**Results:** - The improvement in olfactory function was significant in the experimental group compared to the control (p=0.002). - BMI decreased (p=0.019) and FEV1

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			Variables Independent variable: Aerobic exercise with nasal breathing. Dependent variable: Changes in olfactory function assessed through olfactory perception questionnaires and parameters such as the ability to smell specific odours (e.g. gas). **Intervention** Aerobic exercise with a 12-week nasal breathing pattern (3 times per week, 60 minutes per session).	increased (p=0.002) in the experimental group. **Conclusion**: Aerobic exercise with nasal breathing for 12 weeks is effective in improving olfactory function in asthmatics with chronic rhinosinusitis. This intervention has potential as an inexpensive and safe rehabilitation method.
6.	Rathi, Satralkar and Golhar, 2020	*Effect of Nasal Septal Mobilisation on Chronic Sinusitis Patients: A Pilot Study*	**Methods:** Pilot study with descriptive design. **Sample** 10 patients with chronic sinusitis. **Variables** - Independent Variable: Nasal septal mobilisation. - Dependent Variable: Change in Visual Analogue Scale (VAS) and Chronic Sinusitis Survey (CSS) scores. **Intervention:** - The nasal septal mobilisation technique was applied for 2 months. - Pain measurement was performed using VAS before and after the intervention. - Symptom change measurement is performed using CSS.	**Results:** - There was a significant reduction in the VAS score with a mean reduction of 2.72 points (p = 0.000). - There was no significant change in the CSS survey results regarding symptom recurrence and medication requirements (p = 0.09). **Conclusion:** The nasal septal mobilisation technique is effective in providing immediate pain reduction in chronic sinusitis patients. This technique has no significant effect in reducing symptom recurrence or reducing the need for medication use.
7.	Hegganna var et al., 2017	*A Randomised Controlled Study To Evaluate The Effectiveness Of Shortwave Diathermy In Acute Sinusitis*	**Methods:** Randomised Controlled Trial **Sample:** ● Number: 30 participants ● Criteria: Acute sinusitis **Variables:**	**Research Results:** SNOT-22 scores measured before and after the intervention showed that the group receiving active SWD (Group B) experienced a more significant reduction in sinusitis symptoms compared to the

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1. Independent variable
   - Standard treatment (analgesics, antibiotics, and nasal decongestants)
   - *Short Wave Diathermy* (SWD)
2. Dependent variable
   - SNOT-22 (*Sino-nasal Outcome Test*) which measures 22 symptomatic problems faced by the subject

Intervention:

1. Control group (A):
   - Analgesics: Paracetamol tablets (500 mg) 2 times daily, morning and night.
   - Antibiotics: Amoxiclav tablets (625 mg) 2 times a day, morning and evening
   - Antihistamines: Levocetirizine tablets (5 mg) once daily, at night.
   - Nasal Decongestant: Xylometazoline Nasal Drops (3 drops in each nostril) 3 times a day, morning, afternoon and evening
   - *Steam Inhalation*: 3 times a day, morning, afternoon and evening
   - Placebo Short Wave Diathermy
2. Experimental group (B):
   - Received the same treatment as Group A, but with the addition of *Active Short Wave Diathermy* for 20 minutes each session, performed for 5 days. The intensity of SWD was adjusted according to the patient's tolerance.
   - The SWD electrode placement method is done in a way:
     ➔ One electrode is placed on the lateral part of the forehead, and the other control group (Group A) who only received standard treatment.

Variable	Group	Mean ± SD	t-value	p-value
Pretest	Group A	46.80 ±13.75	0.1085	0.9143
	Group B	46.27±13.16		
Posttest	Group A	35.87 ±10.33	3.1504	0.0039*
	Group B	24.73 ±8.98		
Difference	Group A	10.93 ±6.36	4.2269	0.0002*
	Group B	21.53±7.34		

p-value <0.001 indicates a significant difference in results between the two groups

Conclusion:

Short Wave Diathermy when used in conjunction with medical treatment, showed better results in reducing sinusitis symptoms compared to medical treatment alone. This was shown through a significant reduction in SNOT-22 scores in the group receiving diathermy.

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			electrode on the opposite side of the face, under the angle of the jaw. ➔ After 10 minutes, the electrode positions were swapped to the other side to ensure even heating of the sinuses.	
8.	Naghdi et al., 2015	*Treatment of chronic rhinosinusitis using low level laser: a single blind placebo-controlled trial* *controlled clinical trial*	**Methods:** *Pretest-posttest clinical trial* (*pilot study*) **Sample:** ● Sample size: 15 ● Criteria: Maxillary and frontal *Chronic Rhinosinusitis* (CRS). **Variables:** 1. Independent variable: *Low-level laser therapy* (LLLT) 2. Dependent variable: *Total symptom score* (TSS), calculated based on the patient's assessment of sinusitis symptoms. **Intervention:** ● The participants received treatment with LLLT three times a week for ten treatment sessions without any other drug or physiotherapy intervention. ● The area of application of LLLT is the skin on the upper cheeks and forehead, customised for patients with maxillary or frontal sinuses respectively ● Dosage: Laser irradiation was delivered in continuous wave mode with an irradiation time of 33 seconds for each spot and a total treatment duration of 198 seconds (there	**Research Results:** Patients receiving LLLT therapy showed significant improvement in *total symptom score* (TSS) after the treatment period. ● In pretreatment (T0, week 0), the average TSS result was 12.47 (SD 5.90). ● At posttreatment (T1, week 2), the mean TSS result was 7.40 (SD 4.31), this result showed a significant difference in TSS between T0 and T1 ($p = 0.01$). ● At posttreatment (T2, week 4), the mean TSS result was 5.33 (SD 2.87), this result showed a significant difference in TSS between T0 and T2 ($p < 0.001$). ● While for T1 and T2 $p = 0.039$ **Conclusion:** Overall, this study suggests that LLLT can be an effective intervention to reduce symptoms of chronic sinusitis, however further studies are needed to better understand its mechanism and effectiveness with a larger sample.

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			were 6 spots on each maxillary or frontal sinus as prescribed) for each affected maxillary or frontal sinus.	
9.	da Silva and dos Santos Isoppo, 2021	*Therapeutic ultrasound as a treatment for chronic rhinosinusitis: A systematic review*	**Methods:** A systematic review of pre-experimental studies, experiments, and randomised controlled trials. **Sample:** - There were 309 participants with an average age of 44.5 years. The number of participants per study ranged from 20 to 47. - Participants were ≥16 years old, diagnosed with chronic rhinosinusitis, without current antibiotic or anti-allergic treatment, and without a history of head or neck cancer. **Variables:** Independent**:** - Therapeutic ultrasound intervention Dependent**:** - Effects on chronic rhinosinusitis symptoms, as measured by: - Facial pain. - Nasal obstruction. - Nasal discharge. - Post-nasal drip. - Loss of smell (hyposmia). - Cough (cough). - Fatigue. - Scores on the sino-nasal outcome tests (SNOT-20 and SNOT-22). - Volume of expelled air (VAEx) and volume of expelled liquid (VSEx). - Changes in symptom scores using an ordinal	**Research Results:** - Ultrasound Mode: Ultrasound is used in two modes: pulsed and continuous. The effects of ultrasound are evaluated both after a single session and after multiple treatment sessions (6, 10, or 15 sessions). - Symptom Reduction: The use of ultrasound, both in continuous and pulsed mode, showed a significant reduction in signs and symptoms typical of chronic rhinosinusitis. However, only two studies had a low risk of bias. **Conclusion:** While ultrasound in both modes showed positive effects in the treatment of chronic rhinosinusitis, the study noted that the studies were small, with short duration and poor design and high risk of bias. Therefore, ultrasound cannot yet be recommended as an adjunctive method for the treatment of chronic rhinosinusitis until larger randomised controlled studies are conducted.

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			scale or visual analogue scale (VAS). **Intervention:** Use of therapeutic ultrasound to treat symptoms of chronic rhinosinusitis. - Ultrasound Mode: • Pulsed: Ultrasound is delivered in pulse mode with a specific duty cycle (e.g. 1:9 or 20% duty cycle). Continuous: Ultrasound is delivered in continuous mode without pauses. - Ultrasound Parameters: • Frequency: 1 MHz. • Intensity: Varies between 0.5 W/cm² to 1 W/cm². • Duration: Maxillary sinus (maxillary sinus): 5 minutes per session. Frontal sinus (frontal sinus) : 4 minutes per session. - Number of sessions: 6 to 15 sessions, with a frequency of 2-3 times per week. - Application sites**:** Maxillary sinus and frontal sinus.	
10.	Kumari and Pagare, 2022	*Effect of Steam Inhalation Versus Combination of Steam Inhalation and Various Yoga Postures on Chronic Sinusitis Patients: An Interventional Study*	**Methods:** - The study used a comparative interventional study design. Participants were divided into two groups: Group 1 received only steam inhalation therapy and Group 2: Received a combination of steam inhalation with specific yoga postures. - The duration of the intervention was 6 weeks. - Evaluation was conducted using the Sino-Nasal Outcome Test (SNOT-20) before and after the intervention. - The sampling technique was purposive sampling.	**Research Results:** The results showed that both steam inhalation alone and the combination of steam inhalation with yoga postures were equally effective in reducing symptoms of chronic sinusitis, as measured by the Sino-Nasal Outcome Test (SNOT-20). In the group receiving steam inhalation only, the mean SNOT-20 score dropped from 32.24 ± 8.90 to 15.29 ± 7.08 after 6 weeks. Whereas in the group receiving a combination of vapour inhalation and yoga postures, the mean SNOT-20 score

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			Sample: - Total number of samples: 34 individuals. - Each group consists of 17 participants. **Variables:** **Independent:** Type of intervention provided: - Vapour inhalation only (Group 1). - Combination of steam inhalation with yoga postures (Group 2). **Dependent:** - Changes in SNOT-20 scores, which reflect the severity of chronic sinusitis symptoms. **Intervention:** - Vapour inhalation: Using a vaporiser with a water temperature between 54.5°C and 76.7°C. Performed for 3 minutes per session. - Yoga postures (Group 2): Performed after steam inhalation. Each posture was repeated 5 times, with a duration of 45 seconds per posture. Postures used: Sasankasana, Paschimottanasana, Uttanasana, and Adhomukhasvanasana.	dropped from 31.35 ± 12.01 to 12.59 ± 7.07. **Conclusion:** - Steam inhalation alone and steam inhalation combined with yoga postures are both effective in reducing the symptoms of chronic sinusitis.
11.	Mortazavi et al., 2019	*Comparison of Therapeutic Effects of Intra and Extra Oral Low Level Laser Radiation in Maxillary Chronic Sinusitis*	**Methods:** - This study used an experimental (interventional) method with a before/after design. **Sample:** The sample consisted of 40 patients with chronic sinusitis. **Variables:** Independent**:** - SNOT-22 (22-item Sino-Nasal Outcome Test). - Rhinomanometry test results	**Research Results:** - Intraoral and extraoral LLLT significantly improved symptoms of chronic sinusitis (SNOT-22). - Rhinomanometry showed increased airflow and decreased nasal resistance ($p < 0.05$). - Intraoral LLLT was more effective than extraoral ($p < 0.05$). **Conclusion:** Effectiveness of LLLT Therapy: Low-level laser therapy (LLLT) both

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	Dependent**:** - Type of laser therapy (intraoral vs extraoral). **Intervention:** The intervention was LLLT through two approaches: intraoral (on the oral vestibule from the canine to the first molar) and extraoral (along the ala-tragus line at an angle of 15-30 degrees negative to the zygomatic arch), with a duration of 40 minutes per session for 8 sessions every two days, where irradiation was performed at 10 points 3 mm apart for each method.	intraoral and extraoral is a safe and effective method to reduce the symptoms of chronic maxillary sinusitis.

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DISCUSSION

Ultrasound Therapy

The use of ultrasound therapy in either continuous or pulsed mode, can help relieve symptoms experienced by patients with acute or chronic rhinosinusitis (Ranakusuma et al., 2017). Ultrasound provides an improvement in both the Total Symptom Score (TSS) and SNOT-22 (Sino-nasal Outcome Test) which shows how symptomatic and quality of life patients are. Given that therapeutic US has been shown to have anti-inflammatory effects through mechanical vibration it helps to improve cell membrane permeability, which in turn supports the natural healing process and reduces inflammation (Chung et al., 2012). These mechanical vibrations also cause vibrations in the molecules that can help accelerate drainage and facilitate the release of secretions, thereby reducing pain. Ultrasonic waves can penetrate tissues towards the target organ and have two mechanisms of action: thermal effects that increase metabolism and circulation, and non-thermal effects that can change the consistency of nasal secretions. However, the intensity of the treatment greatly affects the outcome; at low intensities it can provide benefits, while high intensities risk damaging tissues and cells (Baker et al., 2001). When using ultrasound with pulse mode, the heating (thermal) effect is less compared to the continuous mode, but the micromassage effect remains.

Therapeutic ultrasound can help damage the protective structure of bacterial biofilms, thereby increasing the effectiveness of antibiotics in treating chronic sinusitis (Bartley & Young, 2009). Research conducted by Feizabadi et al, 2019, using pulsed ultrasound to reduce the population of Staphylococcus aureus in the sinuses, showed that pulsed ultrasound effectively decreased the population of *Staphylococcus aureus* in chronic rhinosinusitis (CRS) patients. It is explained that *S. aureus* forms biofilms that make it resistant to antibiotics, pulsed ultrasound therapy can be an effective alternative to reduce bacteria without increasing antibiotic resistance (Feizabadi et al., 2019). Meanwhile, in a study conducted by Anshari et al, 2015, the use of antibiotic ointment (Erythromycin) as a substitute for gel in ultrasound therapy was shown to be effective in reducing sinusitis symptoms and increasing percent improvement in patients with Chronic Rhinosinusitis (CRS). In this technique, US can be used as a physical booster for transdermal drug delivery to improve drug distribution to the paranasal sinuses. High concentration of erythromycin was delivered via phonophoresis through synergistic action with 1 MHz US.

Short Wave Diathermy

The main principle of Short Wave Diathermy is heating-effect. This heating can kill positive microorganisms such as streptococci, pneumococci, and so on, resulting in symptomatic relief. Heating also causes vasodilation which increases blood flow, thus helping to remove nociceptive materials, which in turn reduces pain. This increased blood flow also aids healing of damaged tissue, reduces inflammation, and relieves muscle spasms. SWD can increase blood flow in the sinus area, helping to reduce congestion and speed up the removal of mucus build-up. Some of the mechanisms involved in the benefits of SWD for sinusitis include: 1) Improves Drainage, heating causes increased blood circulation and molecular vibrations that aid in the drainage of secretions from the congested sinuses. 2) Reduces Inflammation, heating can help reduce oedema and inflammation in the sinus tissue. 3) Reduces Pain, the effect of heating on tissues can relieve pain by increasing blood circulation and reducing muscle spasms associated with the condition (Kalekar & Gurudut, 2019).

In a study conducted by Kalekar et al., 2019 showed that Short Wave Diathermy combined with suboccipital release and manual drainage techniques effectively reduced symptoms of chronic sinusitis, namely reducing pain. Heggannavar et al., 2017 also conducted a study comparing the administration of Short Wave Diathermy and standard treatment (analgesics and antibiotics, antihistamines, decongestants and steam inhalation), the results showed that SWD was more effective in reducing sinusitis symptoms.

Low-Level Laser Therapy

Low-level laser therapy (LLLT) is a therapy that uses low-intensity laser light to stimulate tissue healing, reduce inflammation,

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and alleviate pain. It typically uses wavelengths of light that can penetrate tissue without causing harmful damage or heating. LLLT is used in a variety of medical fields, including physiotherapy, pain treatment, muscle rehabilitation, and treatment of skin or soft tissue conditions. The penetration depth of the laser reaches 1 cm below the skin surface, the penetration depth value (PDV) through bone is unknown, but laser radiation can potentially reach the maxillary and frontal sinuses (Tsai & Hamblin, 2017). The mechanism of LLLT (Low-Level Laser Therapy) is not fully understood. The benefits obtained with LLLT can be explained mainly through anti-inflammatory and anti-bacterial disease-modifying mechanisms (Krespi et al., 2011).

Sinus Manual Drainage and Self-Massage Techniques

Sinus drainage techniques is a manual therapy approach that includes manual drainage techniques and self-massage techniques to treat chronic rhinosinusitis. Based on a study by Fouda, et al. (2023), this technique involves applying gentle pressure and rhythmic massage movements on the frontal sinus area (above the eyebrows) and maxillary sinus (below the cheekbones) to help drainage of trapped secretions. The mechanism of action of this technique involves manual stimulation that increases hydrostatic pressure in the sinus cavities, facilitates mucus movement, and increases ciliary activity. The rhythmic movements provided also help to increase lymphatic and vascular flow in the area, which in turn helps to reduce mucosal oedema and facilitate drainage of secretions.

In practice, this technique can be performed by a therapist (manual drainage) or by the patient themselves (self-massage) with gentle circular movements. Patients are recommended to perform self-massage twice a day, morning and night. When combined with pulsed ultrasound therapy, research results show the effectiveness of this technique in improving sinus drainage and local circulation, as well as reducing inflammation and pressure in the sinus area. This was evidenced by an increase in the pressure pain threshold (PPT) and a significant decrease in the rhinosinusitis disability index (RSDI) score in the intervention group. to optimise treatment outcomes and improve patients' quality of life.

Faizah and Wulandary in 2023 conducted a case study on patients with sinusitis using ultrasound modalities and face massage with sinus acupressure point techniques at RSU Kajen, showing that both physiotherapy methods can help reduce pain in bilateral maxillary sinusitis patients (Faizah & Dwitasari, 2023). Simrajit Kaur in her journal entitled Facial Muscles and Massage Therapies (2022) said that lymphatic massage can reduce excess fluid in the face, one of which is sinus massage which can reduce pressure on the sinuses by pressing certain points on the face (Ms. Simranjit Kaur, 2022).

Jade Stone Mobilisation

Jade Stone Mobilisation is an effective manual therapy technique for treating chronic sinusitis. This technique uses jade stones that are moved on the sinus area at a certain angle to improve lymphatic flow, reduce inflammation, and increase blood circulation. Based on the results of the study, this therapy significantly improved patients' pain pressure threshold and quality of life after two weeks of intervention, with more prominent results at week 6 evaluation than other methods, such as non-abrasive cupping and manual drainage techniques. Jade Stone Mobilisation is considered safe and provides additional benefits, including helping to loosen blocked sinus secretions, making it a promising alternative in the treatment of chronic sinusitis.

In a study conducted by M. Gandhi, P. Gurudut, 2022 showed that the Jade Stone Mobilisation technique, when compared to non-abrasive cupping and manual drainage, provided significant improvements in pain pressure threshold and quality of life of chronic sinusitis patients after two weeks of therapy. Follow-up results at week 6 showed that the group receiving Jade Stone therapy had greater improvement than the other groups.

Yoga Posture

Yoga postures are referred to as a series of body positions designed to support anatomical function, specifically to aid sinus drainage in chronic sinusitis patients. Some of the yoga postures used include Sasankasana,

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Paschimottanasana, Uttanasana, and Adhomukhsavasana, which are performed in a quadruped position. These body positions are meant to utilise gravity to improve the flow of mucus from the sinuses. The results of a study conducted by Kumari, et al 2022 showed that the combination of steam therapy with yoga postures had no significant difference compared to steam therapy alone in reducing SNOT (Sino-Nasal Outcome Test) scores after 6 weeks. However, both methods were equally effective for reducing symptoms of chronic sinusitis. Yoga postures, especially in the quadruped position, are thought to be helpful in supporting sinus drainage when combined with steam therapy. However, there was no statistically significant difference between steam therapy alone and combined therapy. Both methods remain effective for reducing symptoms in chronic sinusitis patients.

CONCLUSION

Physiotherapy interventions that can be given in cases of sinusitis, namely therapies such as ultrasound modalities, shortwave diathermy, Low-Level Laser Therapy, manual sinus drainage, self sinus massage, Jade Stone Mobilisation and yoga postures have proven effective in reducing symptoms of chronic sinusitis, including pain, sinus obstruction, and inflammation.

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