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Physiotherapy Management of Frozen Shoulder Dextra with InfraRed (IR), Transcutaneous Electrical Nerve Stimulation (TENS) and Active Exercise Modalities

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KEYWORDS
Frozen Shoulder; InfraRed; Transcutaneous Electrical Nerve Stimulation; Active Exercise

ABSTRACT
Frozen shoulder, commonly called adhesive capsulitis, is a painful condition in the shoulder and results in a limited range of motion of the joint (LGS). Frozen shoulder is a condition where shoulder movement becomes limited. Frozen shoulder has varying degrees of severity, ranging from mild to severe pain, and the degree of limitation to movement of the glenohumeral joint. To reduce pain and limited joint movement, which will later increase the ability for functional activities, the role and modalities of physiotherapy can be used in the form of InfraRed, Transcutaneous Electrical Nerve Stimulation, and Active Exercise. This scientific paper is a case study that raises patient cases and collects data through physiotherapy. InfraRed, Transcutaneous Electrical Nerve Stimulation, and Active Exercise are the modalities provided. After receiving physiotherapy treatment 3 times, the results of the shoulder already appear symmetrical; there is an increase in the Joint Scope of Motion (LGS) of the shoulder dextra, a decrease in pain in the shoulder dextra, the loss of spasm of the anterior and medial deltoid muscles, and the ability of the patient's functional activities using the Shoulder Pain and Disability Index (SPADI). Conclusion: Physiotherapy treatment of Frozen Shoulder Dextra using InfraRed, Transcutaneous Electrical Nerve Stimulation, and Active Exercise modalities has been proven to eliminate spasms, increase joint range of motion (LGS), reduce pain, increase muscle strength and increase functional activity capabilities using Shoulder Pain and Disability Index (SPADI).

Introduction

Frozen shoulder, referred to as adhesive capsulitis, is a condition of pain in the shoulder and results in a limited scope of joint motion (Akhadiany, 2022; Pandey & Madi, 2021). Frozen shoulder is a condition where shoulder movement is limited. Frozen shoulder has varying degrees of severity, ranging from mild to severe pain, and how much limitation there is on glenohumeral joint movement (Mertens et al., 2022; Suharti et al., 2018). The prevalence of frozen shoulder is 2% of the general population and 1029% in diabetics in the world. In Indonesia, frozen shoulder occurs in 2-3% of the

general population and often occurs at the age of more than 40 years. In women aged 50 years, as many as 15% experienced bilateral frozen shoulder (Suharti et al., 2018).

In the shoulder joint, it is generally preceded by a trauma or immobilization which can cause stiffness of the joint. This complaint can occur in people with hemiplegia or superior monoplegia, diabetes mellitus, which is also referred to as a triggering factor for frozen shoulder. The physiological problem in frozen shoulder is hypomobility or capsular pattern problems of the glenohumeral joint. Hypomobility is due to decreased synovial fluid volume in the joint, which results in increased pressure inside the joint during movement. Furthermore, the joint surface distance narrows due to the depletion of joint lubricant and an increase in the number of collagen fibers that are crossed and arranged irregularly. Tangled collagen fibers will reduce the flexibility of the connective tissue and limit joint movement (Suharyadi & Ismanda, 2021).

The symptoms caused by Mrs. H.Z's Frozen Shoulder which was examined on February 5, 2024 found pain in the shoulder area, spasm in the shoulder area, and limited LGS make a person's functional activity impaired, therefore as a medical physiotherapist has a role to help reduce pain, increase muscle strength, restore functional activity to reduce problems caused by Frozen Shoulder. As explained above.

The purpose of this study is to determine the process of physiotherapy management of Frozen Shoulder Dextra with the modality of "InfraRed, Transcuntaneous Electrical Nerve Stimulation and Active Exercise".

Given the importance of physiotherapy can develop and restore patients with cases of Frozen Shoulder Mrs. H.Z by providing InfraRed, Transcuntaneous Electrical Nerve Stimulation, and Active Exercise. Based on the description above, the authors are interested in making KTI with the title "Physiotherapy Management of Frozen Shoulder Dextra with InfraRed Modalities, Transcuntaneous Electrical Nerve Stimulation and Active Exercise".

Materials and Methods

Case report

A general history was taken, and the patient's identity data obtained was Mrs H.Z, aged 50 years, Muslim, used to work as a domestic assistant abroad but is now a housewife and lives in Kendal. The patient came to RSI Muhammadiyah Kendal complaining of pain in her right shoulder. Approximately 5 months ago, the patient began to feel pain in the shoulder during activities. Then, on January 23, 2024, the patient felt uncomfortable and immediately came to RSI Muhammadiyah Kendal to do an examination with a neurologist; then, the patient was referred to medical rehabilitation for physiotherapy action. The patient had previously experienced frozen shoulder on her left shoulder but had recovered. The patient is a housewife.

The initial physical examination was carried out on February 6, 2024, and the following results were obtained: Normal vital signs were obtained, but the patient appeared in pain when the arm was moved. The right shoulder showed tenderness, decreased muscle strength, and muscle spasms.

There are three types of basic motion examination: active motion examination, passive motion examination, and active motion examination against resistance. Active Motion: Limited with pain in flexion, extension, abduction, adduction, exorotation, and endorotation. Passive Motion: Full range of motion but with pain and firm endfeel. Active Motion Against Resistance: Pain is felt against resistance, especially in abduction and adduction.

Other Examinations:

- Intra-personal: Patients are cooperative and eager to recover.
- Basic Functional: Difficulty lifting heavy objects and putting items on high shelves.
- Functional Activity: Using SPADI, the patient experienced moderate pain with a total score of 22 and a SPADI result of 16.9%.

Activity Environment: The home environment supports recovery; the patient does not do heavy work and is active in pendulum exercises.
Specific Inspection and Measurement

- Specific Test: Painful arm test shows positive results.
- Measurement with VAS: Used to assess motion, pressure, and stillness pain.
- LGS examination: A goniometer was used to show the the right shoulder's motion limitation.

Muscle Strength Test: The MMT test shows the difference in muscle strength between the right and left arms, with the right shoulder muscle weaker. Patients receive recommendations to continue physiotherapy to improve shoulder function and reduce pain.

Physiotherapy Diagnosis

Physiotherapy diagnosis aims to assess patients' physical capacity and functional abilities based on the interpretation of the data collected. From the results of the examination, there are several physiotherapy problems were identified:

- Body Structure: The patient experiences pain in the right shoulder area. There are muscle spasms in M. Deltoid Anterior, M. Deltoid Medial, M. Infraspinatus, M. Teres Minor, and M. Trapezius Upper. A decrease in muscle strength is detected. The joint range of motion (LGS) in the right shoulder is limited, especially in flexion, extension, abduction, adduction, extroversion, and end rotation movements.
- Activities: Patients can still perform daily cooking and sweeping.
- Participation: Patients can socialize well in the community.

This diagnosis provides a comprehensive picture of the patient's condition and serves as the basis for planning appropriate physiotherapy interventions.

Physiotherapy programs

Physiotherapy programs are designed with specific goals in mind, both in the short and long term. Short-term goals include reducing pain, especially in shoulder muscles such as M. Deltoid Anterior and M. Deltoid Medial, increasing the scope of motion of the right shoulder joint in the directions of flexion, extension, abduction, adduction, exhortation, and end rotation, increasing muscle strength, and reducing muscle spasm in M. Deltoid Anterior, M. Deltoid Medial, M. Infraspinatus, M. Teres Minor, and M. Trapezius Upper. The long-term goal is to improve the patient's functional activities to carry out their daily activities without obstacles. To achieve this goal, the physiotherapy actions provided include using modalities such as InfraRed and Transcutaneous Electrical Nerve Stimulation and exercise therapy in the form of active exercise. In addition, promotive and preventive measures were also given at home to support the success of therapy. Patients are asked to do independent exercises as the therapist teaches, avoid actions that cause shoulder pain, and reduce activities that aggravate pain, such as lifting heavy objects.

Physiotherapy Treatment

In the case of N.y H Z, physiotherapy was performed thrice on February 9, 13, and 16, 2024. This implementation should follow the planned guidelines while communicating with relevant parties and documenting the program's results and methodology. The evaluation was conducted before, during, and after the physiotherapy sessions to monitor the patient's response. In this case, the management involved the use of InfraRed (IR), Transcutaneous Electrical Nerve Stimulation (TENS), and exercise therapy in the form of active exercise.

For InfraRed, preparation of the device includes checking the cables and switches, ensuring the device is well connected, and warming up the device for 5 minutes before therapy. The patient is positioned as comfortably as possible and informed about the heat sensation that will be felt. The therapist is next to the patient, setting the dose by positioning the IR lamp on the right shoulder at a distance of 35-45 cm for 16 minutes while monitoring the patient every 5 minutes.

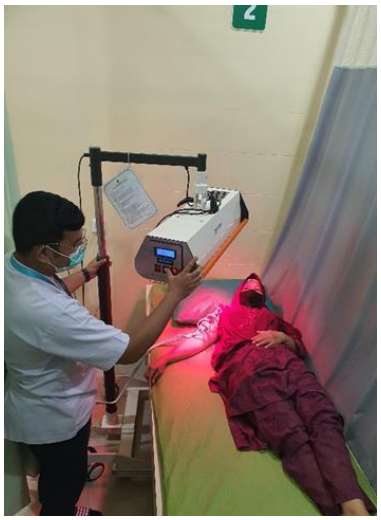


Figure 1. Intervention InfraRed

Source: (Personal Documentation,2024)

In Transcutaneous Electrical Nerve Stimulation, the device is checked to ensure the wires and electrodes are in good condition. The patient was positioned comfortably and the shoulder area was freed from clothing. Electrodes were placed on the right shoulder, and the dose was set according to the patient's pain threshold for 16 minutes, with monitoring every 5 minutes.

Figure 2. Intervention TENS

Source: (Personal Documentation,2024)

Exercise therapy includes Towel Stretch, Pandulum Exercise, and Active Exercise. In Towel Stretch, the patient stands or sits with their hands behind their back, pulling the towel for 8 seconds with 5 repetitions. Pandulum Exercise is performed with the patient standing at the edge of the bed, moving the hand in various directions and rotations according to the pain limit, with 8 movements per session. Active Exercise involves flexion, extension, abduction, adduction, exorotation, and endorotation movements, with 8 movements per session. All exercises are performed in a clean and comfortable environment, with the therapist giving instructions from the patient's side.

Figure 3. a) *Intervention* Towel Strech, b) *Intervention* Pendulum Exercise, c) Active Exercise Movement

Source: (Personal Documentation,2024)

Evaluation

After undergoing therapy three times, the patient experienced a slight decrease in tenderness and motion pain. Evaluation of pain using the VAS scale showed that silent pain remained at 0, but tenderness decreased from 4 to 2, and motion pain decreased from 3 to 2. Evaluation of active joint motion scope (LGS) with a goniometer showed improvement, especially in extension-flexion movements, which increased from 30 ° - 0 ° - 150 ° to 40 ° - 0 ° - 160 °, as well as an increase in vertical and horizontal abduction-adduction, and exorotation-endorotation. Passive LGS evaluation also showed improvement, especially in horizontal abduction-adduction and exorotation-endorotation. Functional activity evaluation using SPADI showed a decrease in pain and difficulty scores, with the total SPADI score reducing from 16.9% (moderate) at T1 and T2 to 12.3% (mild) at T3. This indicates an improvement in the patient's pain and functional ability after therapy.

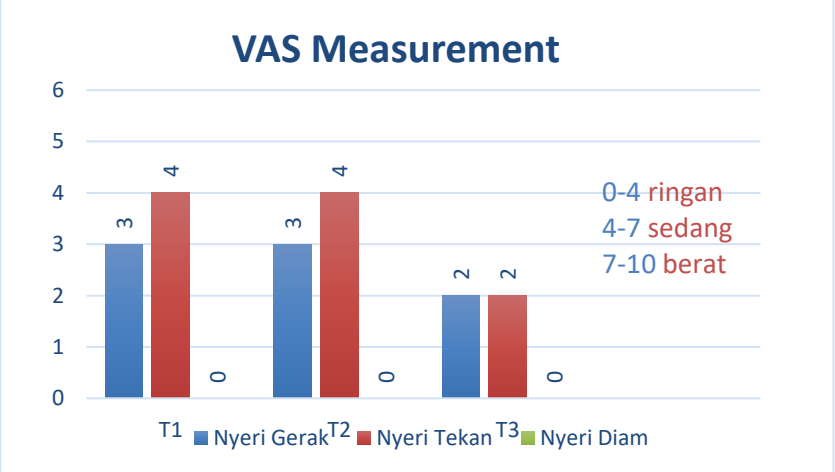
Final Theraphy Result

After undergoing three therapy sessions, patient Mrs. H.Z, diagnosed with a frozen shoulder on the right shoulder, showed positive results through the use of TENS modality, InfraRed (IR), and exercise therapy with Active Exercise. There is a decrease in tenderness in the right shoulder and an increase in the scope of joint motion, especially in flexion, abduction, and endorotation movements. In addition, the strength of the M. Deltoid anterior and M. Deltoid middle muscles increased, and there was a decrease in spasm in the M. Supraspinatus, M. Infraspinatus, and M. Deltoid anterior muscles. Overall, the patient's functional activity also improved, showing significant progress in the recovery of the patient's shoulder condition.

Results and Discussions

After getting treatment 3 times against the patient, the results: Decreased pain, increased LGS and muscle strength, and increased functional activity ability. The long-term goal in therapy this time is to continue the short-term and improve functional activity abilities such as lifting heavy objects, and activities without pain barriers.

Pain reduction using VAS



Graph 1. Results of pain reduction evaluation

Source: (Personal Documentation,2024)

The results of 3 times of physiotherapy evaluation with pain measurement using VAS obtained results of movement pain and tenderness. Based on the graph above, it can be seen that there is a decrease in pain in the third therapy. Decrease in the intensity of motion pain from 3 to 2, decrease in the intensity of pressure pain from 4 to 2. This decrease in intensity resulted from the administration of *InfraRed*, *Transcutaneous Electrical Nerve Stimulation.* After being administered, the nociceptive TENS modality will spur algogenic chemical pain, which plays a role in continuing the nociceptive stimulus by stimulating enkephalin receptors. Stimulation of enkepline receptors is a prodromic stimulus that will be followed by the release of endorphins to reduce pain. On the other hand, the activation of the algogenic chemical pain will spur the P substance, which causes the vasodilation of capillary blood vessels. It is a way of using electrical energy to stimulate the nervous system or other body tissues through the surface of the skin (Astuti, 2018) and *infrared* which aims to stimulate heat receptors and nociceptors to feel warmth, thereby increasing blood flow in the muscles and improving stiffness and muscle pain. When infrared radiation is applied to the patient's body, it will increase local blood flow and tissue metabolism (Febrianto et al., 2024; Tsai & Hamblin, 2017).

The infrared light, given in the case of a frozen shoulder, can reduce pain. This is because infrared radiation can increase the temperature of tissues. According to Hoff's Varit Law, chemical changes can be accelerated by the presence of heat. Thus, tissue heating will accelerate chemical changes, namely metabolic processes. The supply of O2 and food juices will increase so that the tissue needs for O2 and food juices will be quickly met. This will happen because heating will activate the glandulagudoifera (sweat glands) of the tissue area that is given irradiation or heating so that it will increase the elimination of the remnants of the metabolic system through automatic sweating, pain can be reduced (Hardini & Putri, 2021; Saputro Bintang, 2022).

Decrease in muscle spasm

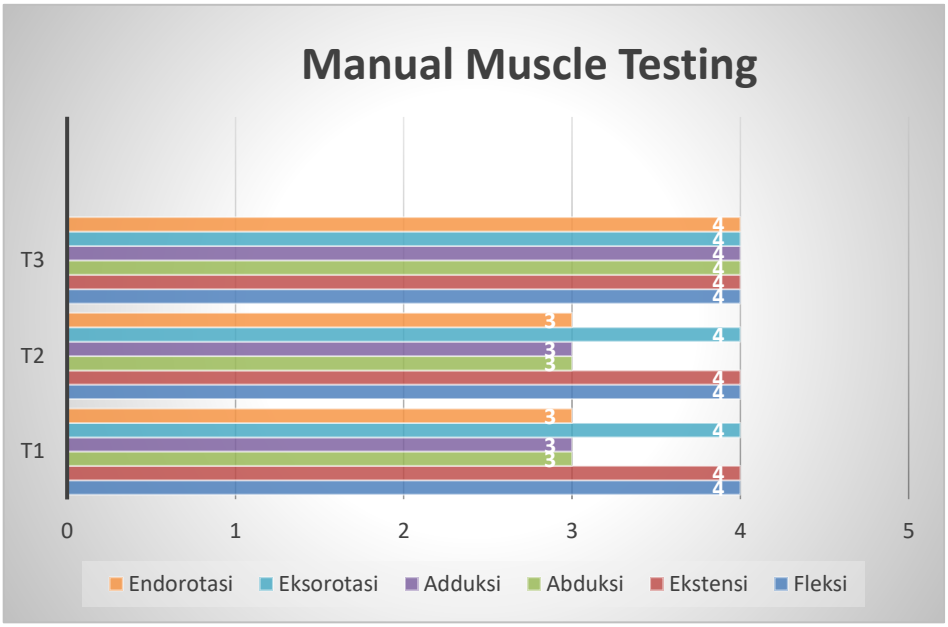
Table 1 Evaluation results of decreased muscle spasm

Otot	T1	T2	T3
M.Deltiod anterior.	There's spasm	There's spasm	No spasm
M. Infraspinatus	There'sspasm	There's spasm	No spasm
M. supraspinatus	There'sspasm	There's spasm	No spasm

Source: (Personal document,2024).

The table above shows a decrease in a spasm of the anterior M. deltoid muscle and M. Infraspinatus, M. deltoid, *middle Dextra* from T1 there is a spasm to T3 reduced *spasm.* This is due to the effect of infrared irradiation, which allows relaxation to be easily achieved if the tissue is warm. Infrared radiation can increase the temperature of tissues to eliminate spasms and relaxation in the muscles and increase the muscles' ability to contract. According to Agustiningsih (2023), active exercise reduces pain and spasms in the shoulder muscles, especially Active Exercise, which aims to maintain physiological elasticity and muscle contractility.

Improvement of MMT evaluation results



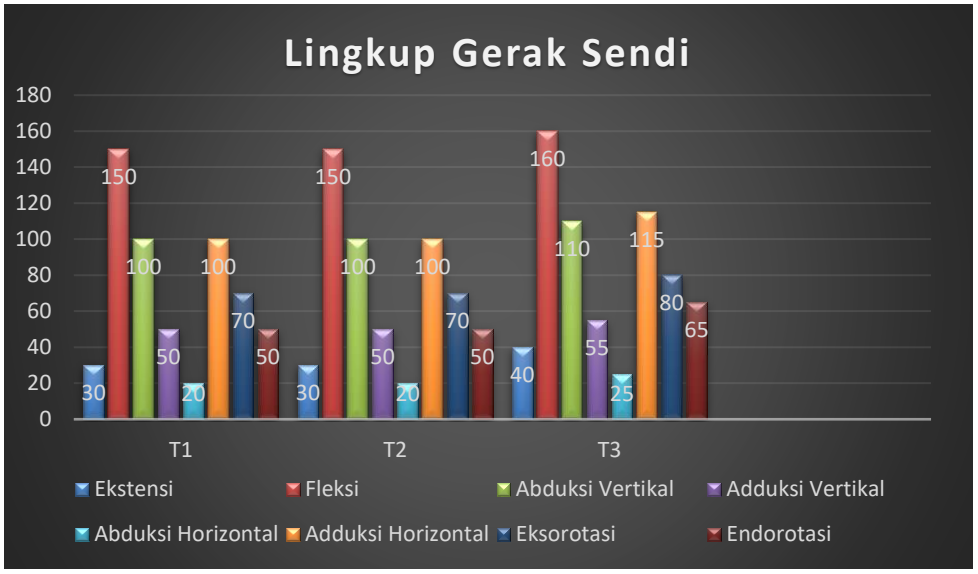
Graph 2. MMT shoulder dextra evaluation results

Source: (Personal document, 2024).

The graph above shows that at T1, there is a value of 3, but at the second and third meetings, there is an increase in muscle strength from a value of 3 to 4.

Decreased muscle strength is common in frozen shoulder sufferers, especially in the shoulder-driving muscles. This is due to immobilization in the shoulder area for a long time. Patients will avoid movements that make the shoulder painful so that spasm in the shoulder area occurs. From this, infrared intervention and towel stretch can reduce muscle pain and spasms in the shoulder area, especially in towel stretch, which has to maintain physiological elasticity and muscle contractility. Towel exercise is a soft tissue stretching technique with certain techniques to reduce muscle tension physiologically so that the muscles become relaxed and can increase the range of motion of the joints and increase muscle strength (Tri Nurhayati et al., 2023). Towel exercise is a soft tissue stretching technique with certain techniques to reduce muscle tension physiologically so that the muscles become relaxed and can increase the range of motion of the joints (Tri Nurhayati et al., 2023).

Increase in the Range of Motion of Dextra active Joint Motion



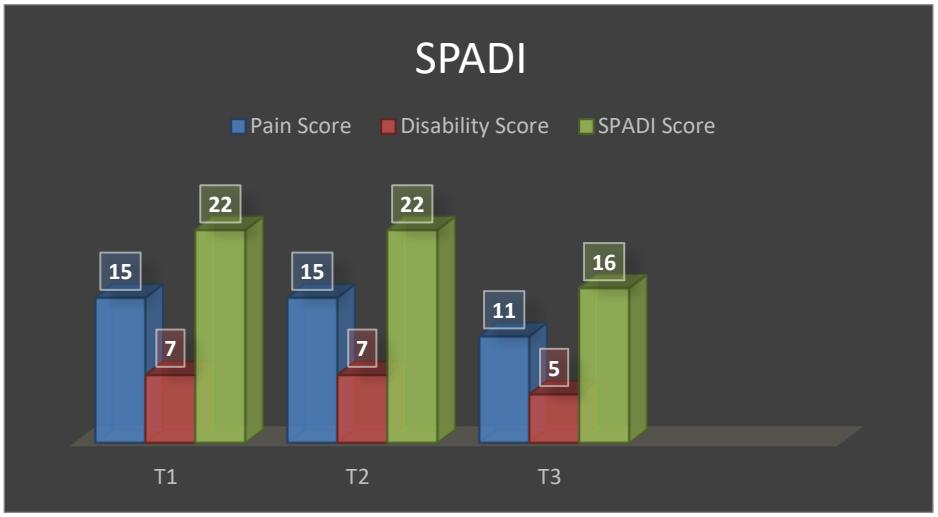
Graph 3. Results of LGS *evaluation on dextra*

Source: (Personal Documents, 2024)

Based on the graph above, it can be seen that there is an increase in the range of motion of the active *shoulder joint*, in *flexion motion – extension* T1 shows (S) 30° – 0° – 150° after T3 increases to (S) 40° – 0° – 160°, *vertical abduction* – T1 shows (F) 100° – 0° – 50° after T3 increases to (F) 110° – 0° – 55°, *abduction – horizontal* adduction T1 shows (T) 20° – 0° – 100° after T3 increases to (T) 25° – 0° – 115°, *Exorotation – Endorotation* T1 shows (R) 70° – 0° – 50° after T3 increases to (R) 80° – 0° – 65°. Mobilization in patients was obtained as a result of the examination, namely an increase in LGS in stiff joints, heat combined with joint mobilization and an increase in the elongation of collagen and an increase in physiological movement. The intervention given to the patient is in the form of pendulum exercises to prevent active adhesion to the shoulder joint and is given weights and self-mobilization techniques that utilize the influence of gravity to produce the effect of pulling the humeri os from the glenoidalis fossa (Tri Nurhayati et al., 2023).

Implementation of LGS improvement in accordance with research (Ii & Bahu, 2023), that *pandulum exercise* and *active exercise* interventions can reduce shoulder pain in *frozen shoulder conditions*. With a frequency of 2 times a week for 3 weeks, interventions are carried out. *Pendulum exercises* are able to expand the structure of soft tissues such as muscles and tendons so that the flexibility of these tissues can be maintained so that there is an increase in the scope of motion of the shoulder joint and reduce pain.

Functional Enhancement with SPADI



Graph 4 SPADI evaluation results

Source: (Personal Document, 2024).

From the graph above, it shows that the results of measuring functional activity using SPADI dimna got a decrease in first therapeutic pain from a score of 15 to 11. Then for the first therapy disability score from a score of 7 to 5. For the total number of SPADI T1 scores of 22 to 16, so that the total SPADI score from 16.9% moderate pain to 12.3% mild pain.

The results of the SPADI measurement in the form of a percentage, the greater the value, the lower the functional ability of the shoulder joint. SPADI has been proven to be reliable and valid as a measure of shoulder functional ability in various populations (Suharyadi & Ismanda, 2021). Increased functional activity resulted in a decrease in pain, spasms, and an increase in LGS as well as an increase in the strength of *the Dextra shoulder muscles.* Reduced pain will improve the patient's functional activities such as raising the hand up, placing objects on a high shelf, buttoning clothes. The evaluation results of improving functional activities are also supported by activities and exercises carried out by patients at home. For this reason, physiotherapy provides education, namely doing *active* exercises, *pandulum exercises* and *towel strech*. From various exercises carried out in hospitals and homes, they affect the speed of recovery from the patient's illness so that patients can return to normal activities (khoerul ummah, 2022).

This study has demonstrated the significant impact of physiotherapy modalities such as InfraRed, TENS, and Active Exercise on improving the condition of patients with Frozen Shoulder, particularly in reducing pain, increasing muscle strength, and improving joint range of motion. However, it is important to acknowledge the limitations of this research. First, the study is based on a **single case study**, which limits the generalizability of the findings. While the results are promising for this patient, the treatment outcomes may vary for other patients with different severity levels of Frozen Shoulder or other underlying conditions. Future studies involving a larger sample size are necessary to verify the efficacy of these physiotherapy treatments in a broader population. Second, the **short duration of the therapy** (three sessions) may not provide a comprehensive view of the

long-term effects of the treatment. A more extended follow-up period could better understand how sustained treatment affects recovery and whether these improvements are maintained over time. Lastly, **no control group** was included in the study, which makes it difficult to compare the effectiveness of these specific modalities against other potential treatments for Frozen Shoulder, such as manual therapy or different types of physical rehabilitation techniques. Future research could address this by including randomized controlled trials to compare the efficacy of these interventions. While, the study provides valuable insights into the benefits of InfraRed, TENS, and Active Exercise modalities, future research with a larger sample, longer therapy duration, and control groups would help to strengthen the validity and applicability of these findings to the broader population of Frozen Shoulder patients.

Conclusion

Frozen shoulder is a condition in which shoulder movement is limited. The severity varies from mild pain to severe pain or how much the limited range of motion of the Frozen shoulder joint causes the capsule that wraps around the shoulder joint to wrinkle, and scar tissue is formed so that it causes pain and stiffness in the shoulder joint so that it will affect shoulder movement and is difficult to move. The physiotherapist's treatment with TENS, IR and exercise therapy in the case of Frozen shoulder experienced by Mrs. H.Z obtained the following results: 1) There are benefits of giving TENS, and IR where it reduces pain. 2) There are benefits of exercise therapy, namely the administration of *pendulum exercises* and *active exercises*, there is a slight increase in LGS. 3) There are benefits of exercise therapy, namely *towel stretches*, there is a slight increase in muscle strength. 4) There is a measurement using SPADI and the results are a slight change in activity and an increase in functional activity ability.

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