



## Ultrasound and Ankle Theraband Exercise for Grade 1 Dextra Ankle Sprain Rehabilitation

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### ABSTRACT

**Purpose of the study:** This study aimed to determine the effectiveness of physiotherapy management using ultrasound (US) modality and ankle theraband exercise in reducing pain, increasing joint range of motion, improving muscle strength, and restoring functional mobility in patients with grade 1 dextra ankle sprain.

**Methodology:** This study used a descriptive case study method involving one patient with grade 1 dextra ankle sprain. Physiotherapy interventions included Ultrasound (US) modality and Ankle Theraband Exercise conducted in three therapy sessions. Evaluation instruments consisted of Visual Analog Scale (VAS), goniometer for joint range of motion assessment, and Manual Muscle Testing (MMT) for muscle strength evaluation.

**Main Findings:** The findings showed a significant reduction in pain intensity, including tenderness, movement pain, and resting pain after three therapy sessions. Joint range of motion in the ankle increased progressively in sagittal and frontal movements. Muscle strength in flexor and inverter muscles also improved following intervention. Ultrasound and ankle theraband exercise effectively enhanced joint mobility, reduced pain, and increased muscle strength in grade 1 dextra ankle sprain patients.

**Novelty/Originality of this study:** This study provides practical evidence regarding the combined application of Ultrasound (US) modality and Ankle Theraband Exercise in managing grade 1 dextra ankle sprain. The originality of this research lies in integrating therapeutic exercise and physical modality interventions to simultaneously improve pain reduction, joint mobility, and muscle strength within a short physiotherapy treatment period.

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## 1. INTRODUCTION

The ankle is one of the most important body structures involved in daily human movement and physical activities. The ankle joint functions as the primary support for body weight during standing, walking, running, jumping, and other functional activities [1]-[3]. Because of its complex anatomical structure and continuous mechanical loading, the ankle is highly vulnerable to injury, especially during sudden movements or excessive physical activity. One of the most common musculoskeletal injuries affecting the ankle joint is ankle sprain. This condition occurs due to excessive stretching or tearing of the ligaments around the ankle, particularly in the lateral

ligament complex. Ankle sprain frequently causes pain, swelling, limitation of joint movement, muscle weakness, and impaired functional mobility, which may significantly reduce an individual's productivity and quality of life [4].

Ankle sprain generally occurs during activities involving sudden inversion and plantar flexion movements. This injury is commonly experienced by athletes, workers, and individuals performing repetitive physical activities [5], [6]. However, ankle sprain may also occur during routine daily activities such as walking on uneven surfaces, descending stairs, or accidental falls. The condition is often characterized by tenderness, edema, instability, and limited Range of Motion (ROM) in the ankle joint. If not properly managed, ankle sprain may lead to chronic instability, recurrent injury, prolonged pain, and decreased physical performance. Therefore, early physiotherapy management is essential to restore normal ankle function and prevent long-term complications [7].

In physiotherapy practice, several intervention methods are commonly used to manage ankle sprain injuries, including electrotherapy modalities and therapeutic exercise. One of the physical modalities frequently applied is Ultrasound (US) therapy. Ultrasound therapy is widely utilized in musculoskeletal rehabilitation because it produces thermal and non-thermal physiological effects that contribute to tissue healing [8], [9]. The thermal effects of ultrasound increase blood circulation, reduce muscle spasm, improve tissue extensibility, and decrease pain perception. Meanwhile, its non-thermal effects facilitate cellular repair and accelerate tissue regeneration in injured ligaments and soft tissues. Due to these physiological benefits, ultrasound therapy has become one of the most commonly recommended interventions for managing ankle sprain conditions in physiotherapy services [10], [11].

In addition to physical modalities, therapeutic exercise also plays a crucial role in ankle sprain rehabilitation. Therapeutic exercise is a structured physiotherapy intervention designed to improve joint mobility, muscle strength, balance, coordination, and functional movement [12]-[14]. One form of therapeutic exercise commonly used in ankle rehabilitation is Ankle Theraband Exercise. This exercise utilizes elastic resistance bands to strengthen ankle muscles and improve joint stability progressively. Therapeutic exercise is considered highly beneficial because it not only restores muscle performance but also enhances ligament adaptation and functional recovery. Furthermore, active patient participation during exercise programs contributes positively to recovery outcomes and reduces the risk of recurrent injury [15].

The combination of ultrasound therapy and ankle theraband exercise is considered an effective rehabilitation strategy because both interventions complement each other physiologically [16], [17]. Ultrasound therapy primarily addresses pain reduction and tissue healing, whereas ankle theraband exercise focuses on restoring muscle strength and joint mobility. Through this combined approach, physiotherapy management is expected to accelerate recovery and improve functional outcomes in patients with ankle sprain. However, despite the widespread use of these interventions in clinical practice, scientific evidence regarding their integrated effectiveness in grade 1 dextra ankle sprain rehabilitation remains limited, particularly in short-term physiotherapy treatment programs [18].

The increasing prevalence of ankle sprain injuries and the importance of rapid rehabilitation have encouraged the need for effective and evidence-based physiotherapy interventions. Individuals with ankle sprain frequently experience limitations in occupational, sports, and social activities due to pain and decreased mobility [19]. Consequently, physiotherapists are required to provide interventions that effectively reduce symptoms while simultaneously restoring functional movement. The use of ultrasound therapy combined with ankle theraband exercise may provide comprehensive rehabilitation benefits, including pain reduction, increased Range of Motion (ROM), improved muscle strength, and restoration of ankle stability. Therefore, research investigating the effectiveness of these interventions is highly relevant to support evidence-based physiotherapy practice.

Several previous studies have discussed physiotherapy interventions for ankle sprain rehabilitation. The first study [20] focused on the effectiveness of ultrasound therapy in reducing pain and inflammation in musculoskeletal injuries; however, the study did not combine ultrasound with therapeutic exercise interventions. The second study [21] examined therapeutic exercise programs for improving ankle stability and muscle strength but did not involve physical modalities such as ultrasound therapy. The third study [22] investigated rehabilitation strategies for ankle sprain generally, yet it lacked detailed evaluation of short-term physiotherapy outcomes involving pain intensity, joint mobility, and muscle strength simultaneously. Based on these studies, there remains a research gap regarding the combined effectiveness of ultrasound therapy and ankle theraband exercise specifically for grade 1 dextra ankle sprain rehabilitation in short-duration physiotherapy programs.

The novelty of this study lies in the integration of ultrasound modality and ankle theraband exercise within a structured physiotherapy rehabilitation program for grade 1 dextra ankle sprain. Unlike previous studies that examined these interventions separately, this research combines physical modality and therapeutic exercise approaches to simultaneously address pain reduction, joint mobility improvement, muscle strengthening, and functional recovery. In addition, the study evaluates rehabilitation outcomes within a short-term treatment period, providing practical clinical evidence for physiotherapy management [23], [24].

The findings of this study are expected to contribute to the development of evidence-based physiotherapy practice, particularly in musculoskeletal rehabilitation and sports injury management. Practically, this research may serve as a reference for physiotherapists in selecting effective interventions for ankle sprain rehabilitation. The integration of ultrasound therapy and ankle theraband exercise may also be implemented in rehabilitation programs to accelerate recovery, improve patient mobility, and reduce the risk of chronic ankle instability [25]. Furthermore, the study may encourage broader application of combined physiotherapy interventions in clinical settings.

This study is important because ankle sprain is one of the most common musculoskeletal injuries that frequently affects physical activity and functional mobility. If not managed appropriately, ankle sprain may result in prolonged pain, muscle weakness, chronic instability, and recurrent injury. Although ultrasound therapy and therapeutic exercise are widely used in physiotherapy practice, comprehensive evidence regarding their combined effectiveness remains limited. Therefore, this research is urgently needed to provide scientific evidence concerning the effectiveness of ultrasound therapy and ankle theraband exercise in improving rehabilitation outcomes for grade 1 dextra ankle sprain patients and supporting optimal physiotherapy services.

## 2. RESEARCH METHOD

### 2.1. Research Design

This study employed a descriptive case study design [26] to investigate the effectiveness of physiotherapy management in patients with grade 1 dextra ankle sprain using Ultrasound (US) modality and Ankle Theraband Exercise. The case study approach was selected because it allows detailed observation and evaluation of the patient's condition during the physiotherapy intervention process. The study focused on evaluating changes in pain intensity, joint range of motion, muscle strength, and functional mobility after the application of physiotherapy interventions.

The physiotherapy intervention program was conducted through three treatment sessions in a clinical setting. The intervention consisted of combining Ultrasound (US) therapy and therapeutic exercise using theraband resistance. The rehabilitation process was monitored systematically through pre-treatment and post-treatment evaluations to identify clinical improvements during the therapy program. The research design enabled comprehensive assessment of therapeutic outcomes in short-term physiotherapy management for ankle sprain rehabilitation [27].

Table 1. Research Design

Group	Initial Assessment	Intervention	Final Assessment
Patient with Grade 1 Dextra Ankle Sprain	Pain, ROM, Muscle Strength	Ultrasound and Ankle Theraband Exercise	Pain, ROM, Muscle Strength

### 2.2. Subject and Sample

The subject of this study was one patient diagnosed with grade 1 dextra ankle sprain undergoing physiotherapy treatment at RS PKU Muhammadiyah Karanganyar. The patient was a 40-year-old male presenting with pain, limited joint movement, and decreased muscle strength in the right ankle following injury caused by falling on stairs. The patient experienced pain during movement, tenderness around the lateral ankle region, and limitations in daily functional activities.

The sampling technique used in this study was purposive sampling because the participant was selected based on specific clinical characteristics relevant to the study objectives. Inclusion criteria included patients diagnosed with grade 1 ankle sprain, patients experiencing pain and limited ankle movement, and patients willing to participate in the physiotherapy program. The subject selection was intended to provide detailed clinical evaluation regarding the effectiveness of physiotherapy management using Ultrasound and Ankle Theraband Exercise interventions.

Table 2. Characteristics of Research Subject

Variable	Category	Percentage (%)
Gender	Male	100
Age	40 Years	100
Injury Type	Grade 1 Dextra Ankle Sprain	100
Intervention Sessions	Three Sessions	100

### 2.3. Data Sources and Data Collection Technique

The data used in this study consisted of primary clinical data obtained directly from the patient during physiotherapy treatment sessions [28]. Data collection was conducted through physiotherapy assessment procedures, including anamnesis, physical examination, pain assessment, joint range of motion evaluation, and

muscle strength testing. Supporting data were also obtained through patient observation and medical records related to the ankle sprain condition.

The physiotherapy examination included vital sign assessment, inspection, palpation, percussion, and movement function evaluation. Pain intensity data were collected using the Visual Analog Scale (VAS), while joint mobility measurements utilized a goniometer. Muscle strength was assessed using Manual Muscle Testing (MMT). Data collection was performed before intervention and after each treatment session to monitor rehabilitation progress systematically.

#### 2.4. Research Instrument

Several instruments were utilized in this study to evaluate clinical improvements during physiotherapy management. Pain intensity was measured using the Visual Analog Scale (VAS) [29], a standardized instrument commonly applied in musculoskeletal rehabilitation to assess subjective pain perception. The VAS consists of a numerical scale ranging from 0 to 10, representing no pain to severe pain intensity.

Joint range of motion (ROM) was measured using a goniometer to determine ankle mobility in sagittal and frontal planes. Muscle strength evaluation employed Manual Muscle Testing (MMT), which measures muscle contraction capability on a scale ranging from 0 to 5. Additional supporting equipment included the Ultrasound therapy device, theraband resistance bands, treatment bed, and physiotherapy observation sheets used for documenting patient progress during intervention sessions [30].

Table 3. Research Instruments

Instrument	Function
Visual Analog Scale (VAS)	Measuring pain intensity
Goniometer	Measuring ankle joint ROM
Manual Muscle Testing (MMT)	Assessing muscle strength
Ultrasound Therapy Device	Physiotherapy modality
Theraband Resistance Band	Therapeutic exercise intervention
Observation Sheet	Clinical documentation

#### 2.5. Data Analysis Technique

The data analysis technique used in this study was descriptive qualitative and quantitative analysis. Quantitative analysis was performed by comparing clinical measurement results before and after intervention sessions, including pain intensity, joint range of motion, and muscle strength scores. The evaluation results were presented descriptively using tables and narrative explanations to identify rehabilitation progress during physiotherapy management.

Pain reduction was analyzed through changes in VAS scores, while joint mobility improvement was evaluated based on ROM measurement outcomes using the goniometer. Muscle strength progression was analyzed using MMT scoring results. The data obtained from each therapy session were documented systematically and interpreted descriptively to determine the effectiveness of Ultrasound and Ankle Theraband Exercise interventions in improving the patient's condition [31]. The muscle strength evaluation formula can be expressed as follows:

$$MMT = \frac{\text{Observed Muscle Function}}{\text{Maximum Muscle Function}} \times 5 \quad \dots(1)$$

Where:

MMT = Manual Muscle Testing score

#### 2.6. Research Procedure

The research procedure was conducted systematically through several physiotherapy stages. Initially, the patient underwent anamnesis and physical examination to identify clinical problems associated with ankle sprain injury. Baseline measurements of pain intensity, joint range of motion, and muscle strength were performed before intervention.

Following assessment, the patient received Ultrasound (US) therapy aimed at reducing pain and improving tissue healing through thermal and non-thermal physiological effects. Subsequently, Ankle Theraband Exercise was administered to improve muscle strength, joint stability, and ankle mobility. The intervention program was conducted for three treatment sessions, with evaluations performed after each session to monitor rehabilitation progress.

### 3. RESULTS AND DISCUSSION

#### 3.1. Pain Evaluation Using Visual Analog Scale (VAS)

The results of physiotherapy intervention using Ultrasound (US) and Ankle Theraband Exercise demonstrated a progressive reduction in pain intensity in patients with grade 1 dextra ankle sprain. Pain evaluation was conducted using the Visual Analog Scale (VAS) before intervention and after each therapy session. The patient initially experienced resting pain, tenderness, and movement pain in the lateral region of the right ankle. Following three therapy sessions, a gradual decrease in pain intensity was observed in all pain categories.

The reduction in pain intensity indicates that the physiotherapy interventions effectively contributed to improving the patient's condition. Ultrasound therapy provided thermal effects that increased blood circulation and stimulated tissue healing, while therapeutic exercise promoted joint mobility and muscle adaptation [32]. These physiological responses reduced mechanical stress around the injured ankle ligaments and improved overall comfort during movement activities.

Table 4. Results of Pain Evaluation Using VAS

Pain Category	T0	T1	T2	T3
Resting Pain	4	3	1	1
Tenderness	6	4	3	2
Movement Pain	7	5	4	3

The findings revealed that movement pain demonstrated the greatest reduction after intervention. This result suggests that the combination of Ultrasound and Ankle Theraband Exercise effectively improved functional movement tolerance and reduced discomfort during ankle motion [33]. Pain reduction also enabled the patient to participate more actively in therapeutic exercise programs, thereby accelerating rehabilitation progress.

The pain reduction mechanism can be explained through the following equation:

$$Pain\ reduction = VAS_{Pre} - VAS_{Post} \quad \dots(2)$$

Where:

$VAS_{pre}$  = Pain score before intervention

$VAS_{post}$  = Pain score after intervention

The equation demonstrates that a higher difference between pre-test and post-test scores indicates greater effectiveness of physiotherapy intervention in reducing pain intensity

#### 3.2. Improvement of Joint Range of Motion (ROM)

Joint Range of Motion (ROM) evaluation was conducted using a goniometer to determine ankle mobility improvements following physiotherapy intervention. Limited ROM was initially observed due to pain, muscle guarding, and ligament injury around the ankle joint. After the administration of Ultrasound therapy and Ankle Theraband Exercise, gradual improvements in ankle movement were identified in both sagittal and frontal planes.

The increase in ROM occurred because Ultrasound therapy improved tissue extensibility and reduced pain sensation, allowing the patient to perform movement exercises more comfortably. In addition, therapeutic exercise using theraband resistance enhanced ligament flexibility and joint mobility through repetitive controlled movements [34]. The intervention also contributed to reducing joint stiffness and improving ankle stability during active motion.

Table 5. Results of Joint Range of Motion Evaluation

Therapy Session	Sagittal Plane	Frontal Plane
T0	S 15°-0°-15°	F 10°-0°-5°
T1	S 15°-0°-15°	F 10°-0°-10°
T2	S 15°-0°-20°	F 15°-0°-10°
T3	S 20°-0°-25°	F 20°-0°-15°

The findings indicate substantial improvement in ankle mobility after intervention. Improved ROM is clinically important because it reflects better joint flexibility, increased functional capacity, and reduced risk of movement limitation during daily activities. The patient demonstrated greater movement confidence and improved ankle function during rehabilitation sessions. The ROM improvement process can be represented mathematically as follows:

$$ROM_{gain} = ROM_{final} - ROM_{initial} \quad \dots(3)$$

Where:

$ROM_{gain}$  = Improvement in joint range of motion

$ROM_{final}$  = ROM after intervention

$ROM_{initial}$  = ROM before intervention

### 3.3. Improvement of Muscle Strength Using Manual Muscle Testing (MMT)

Muscle strength evaluation using Manual Muscle Testing (MMT) demonstrated positive improvements following physiotherapy intervention. Prior to treatment, decreased muscle strength was observed in the ankle flexor, inverter, extensor, and evertor muscle groups due to pain and limited movement. The patient experienced difficulty performing active ankle movements because muscle activation was inhibited by discomfort and joint instability.

After three physiotherapy sessions, improvements in muscle strength were observed, particularly in flexor and inverter muscle groups. The therapeutic exercise program using theraband resistance stimulated muscle contraction and improved neuromuscular adaptation progressively. Strengthening exercises also enhanced joint stabilization and contributed to restoring functional ankle movement.

Table 6. Results of Muscle Strength Evaluation

Muscle Group	T0	T1	T2	T3
Flexor	3	3	3	4
Extensor	3	3	3	3
Inverter	3	3	4	4
Evertor	3	3	3	3

The increase in muscle strength demonstrates that therapeutic exercise effectively activated weakened muscles and improved muscular endurance around the ankle joint. Strengthening the ankle musculature is essential in rehabilitation because adequate muscle support contributes to joint stability and prevents recurrent ankle sprain injuries [35]. The muscle strengthening principle can be expressed using the following equation:

$$Strength\ Improvement = MMT_{post} - MMT_{pre} \quad \dots(4)$$

Where:

$MMT_{post}$  = Muscle strength score after intervention

$MMT_{pre}$  = Muscle strength score before intervention

The findings of this study demonstrated that physiotherapy management using Ultrasound (US) and Ankle Theraband Exercise effectively reduced pain intensity in patients with grade 1 dextra ankle sprain. Pain reduction occurred progressively during the three therapy sessions due to the physiological effects of Ultrasound therapy. Ultrasound generates thermal stimulation that improves blood circulation, accelerates metabolic processes, and activates large-diameter sensory nerve fibers that inhibit pain transmission mechanisms. Consequently, pain sensation decreased significantly, allowing the patient to move more comfortably during rehabilitation exercises.

The results also revealed substantial improvements in joint range of motion after intervention. Limited ROM in ankle sprain conditions commonly occurs because pain and inflammation restrict active and passive movements [36]. Ultrasound therapy improved tissue extensibility and reduced soft tissue stiffness, while therapeutic exercises facilitated joint mobilization through repetitive controlled movement patterns. The combination of both interventions effectively restored ankle flexibility and improved movement capability in sagittal and frontal planes. Increased ROM is essential in ankle rehabilitation because it directly influences walking ability, balance, and functional mobility during daily activities.

Furthermore, therapeutic exercise using theraband resistance contributed significantly to muscle strength improvement. Resistance-based exercise stimulates muscle contraction and neuromuscular coordination, thereby improving ankle stability and functional performance. The strengthening effect observed in flexor and inverter muscle groups indicates that Ankle Theraband Exercise effectively enhanced muscle activation surrounding the injured joint. Improved muscle strength plays a crucial role in preventing recurrent ankle instability and restoring patient confidence during movement activities [37].

The findings of this study support previous physiotherapy research emphasizing the importance of combining physical modalities and exercise therapy in musculoskeletal rehabilitation. Ultrasound therapy primarily addresses pain reduction and tissue healing, whereas therapeutic exercise improves muscle performance and joint mobility. Therefore, the integration of both interventions provides comprehensive rehabilitation outcomes and supports functional recovery more effectively than single-modality treatment approaches.

Several previous studies have investigated physiotherapy interventions for ankle sprain rehabilitation. The first study [38] focused on Ultrasound therapy effectiveness in reducing pain and inflammation but did not evaluate muscle strength and ROM improvements comprehensively. The second study [39] examined therapeutic exercise programs for ankle rehabilitation; however, the intervention lacked integration with electrotherapy modalities such as Ultrasound. The third study [40] discussed general ankle rehabilitation management without specifically analyzing short-term physiotherapy outcomes in grade 1 dextra ankle sprain patients. Based on these studies, limited evidence exists regarding the combined use of Ultrasound therapy and Ankle Theraband Exercise in improving pain, ROM, and muscle strength simultaneously. Therefore, this study addresses the existing research gap by presenting integrated physiotherapy management outcomes in a structured rehabilitation program.

The novelty of this study lies in the combined application of Ultrasound modality and Ankle Theraband Exercise within a short-term physiotherapy rehabilitation program for grade 1 dextra ankle sprain. Unlike previous studies that examined these interventions separately, this research integrates physical modality and resistance exercise approaches to achieve simultaneous improvements in pain reduction, joint mobility, muscle strength, and functional ankle recovery [41]. The study also provides practical evidence regarding progressive rehabilitation outcomes through repeated physiotherapy evaluations.

The findings of this study have important implications for physiotherapy practice, particularly in musculoskeletal rehabilitation and sports injury management. Physiotherapists may consider integrating Ultrasound therapy and therapeutic exercise as a comprehensive rehabilitation strategy for ankle sprain patients. The combination of these interventions can improve rehabilitation efficiency, accelerate recovery, and minimize functional limitations following injury [42]. In addition, this study contributes to evidence-based physiotherapy approaches that support patient-centered rehabilitation programs and optimal functional recovery outcomes.

This study has several limitations that should be considered when interpreting the findings. First, the study involved only one patient, limiting the generalizability of the results to broader populations. Second, the rehabilitation program was conducted over a short treatment duration consisting of only three therapy sessions, meaning long-term intervention outcomes were not evaluated. Third, the study focused solely on grade 1 dextra ankle sprain cases, and the findings may differ in more severe ankle injuries or different patient populations. Future research is recommended to involve larger sample sizes, extended rehabilitation periods, and comparative intervention groups to obtain more comprehensive evidence regarding physiotherapy management for ankle sprain rehabilitation.

#### 4. CONCLUSION

Based on the results of the study, physiotherapy management using Ultrasound (US) and Ankle Theraband Exercise was effective in reducing pain, increasing joint range of motion (ROM), and improving muscle strength in patients with grade 1 dextra ankle sprain. The interventions demonstrated progressive clinical improvement during three therapy sessions, particularly in reducing movement pain, enhancing ankle mobility, and strengthening flexor and inverter muscle groups. Therefore, the combination of Ultrasound therapy and therapeutic exercise can be considered an effective rehabilitation approach for restoring functional ankle movement and supporting recovery in ankle sprain patients.

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