

Electrical Stimulation Combined with Exercise Therapy for Chronic Ankle Instability: A Case Report

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Abstract

Background: Chronic ankle instability (CAI) is associated with recurrent ankle giving-way, pain, muscle weakness, impaired range of motion, balance deficits, and functional limitations.

Objective: To describe changes in pain, muscle strength, ankle range of motion (ROM), balance, and functional ability following electrical stimulation (ES) combined with therapeutic exercise in a patient with CAI.

Methods: This descriptive case report involved a 17-year-old female volleyball athlete with recurrent lateral ankle sprains and right-sided CAI. The patient completed four physiotherapy treatment sessions combining ES with strengthening, proprioceptive, balance, and functional exercises. Outcomes were assessed before and after the intervention using the Numeric Rating Scale (NRS), Manual Muscle Testing (MMT), goniometric ROM, Single Leg Stance (SLS), Y-Balance Test, and Foot and Ankle Outcome Score (FAOS).

Results: Pain during movement decreased from 4/10 to 1/10, and tenderness decreased from 2/10 to 0/10. Dorsiflexor and invertor strength improved from grade 3+ to 4, while plantarflexor strength improved from grade 3 to 3+. Ankle dorsiflexion increased from 15° to 20°, plantarflexion from 30° to 35°, and inversion from 15° to 20°. Right SLS increased from 10 to 35 seconds, and the right Y-Balance composite score increased from 69.9% to 79.7%. The FAOS increased from 73.97% to 92.64%.

Conclusion: Four sessions of ES combined with therapeutic exercise were associated with improvements across pain, ankle ROM, muscle strength, balance, and self-reported function in this patient with CAI. The findings should be interpreted as descriptive clinical observations because of the single-case design and absence of a comparison condition.

Keywords

Ankle Injuries; Electric Stimulation Therapy; Exercise Therapy; Postural Balance; Rehabilitation

Introduction

Chronic ankle instability (CAI) is a common consequence of recurrent lateral ankle sprains and is characterized by recurrent episodes of ankle giving-way, persistent symptoms, and impairments in mechanical and sensorimotor function. Contemporary models describe CAI as a heterogeneous condition involving pathomechanical, sensory-perceptual, and motor-behavioral impairments, including restricted ankle motion, weakness, impaired proprioception, altered neuromuscular control, and deficits in postural control.^{1,2} A systematic review of the epidemiology of perceived ankle instability further indicates that persistent instability is an important clinical consequence of ankle sprain and may affect physical function and participation.¹

The clinical burden of CAI is particularly relevant in athletes who repeatedly perform jumping, landing, cutting, and rapid changes of direction.³ Persistent instability can interfere with sports participation and increase concern about recurrent injury.³ Current clinical practice recommendations emphasize assessment and management of impairments in mobility, strength, balance, and movement coordination rather than focusing on a single impairment in isolation.^{3,4} Exercise-based rehabilitation is therefore a central component of conservative management.

Therapeutic exercise has been investigated extensively in CAI. A systematic review and network meta-analysis found that foot and ankle muscle strengthening exercises had a high probability of improving joint position sense, while balance-oriented interventions also demonstrated beneficial effects.⁵ More recent randomized and meta-analytic evidence supports the role of strengthening and balance training in improving proprioceptive and functional outcomes in people with CAI.^{6,7} Exercise-based interventions may also be incorporated into multimodal rehabilitation programs, in which treatment is directed toward the individual pattern of impairments and functional limitations.⁸

Electrical stimulation (ES) is commonly used in rehabilitation to facilitate muscle activation and neuromuscular recruitment and may provide an adjunct to active exercise.⁹ The present intervention combined ES with progressive strengthening, proprioceptive, balance, and functional exercises. The rationale was to address several impairments identified during the initial assessment within a short clinical rehabilitation program. However, because the intervention was multimodal, any improvement cannot be attributed to ES independently of therapeutic exercise.

Despite the established role of exercise therapy in CAI, clinical reports describing the combined use of ES and therapeutic exercise in routine physiotherapy practice remain limited.¹⁰ This case report therefore describes the changes observed after four physiotherapy treatment sessions in a 17-year-old volleyball athlete with CAI treated at ABR Physiotherapy Clinic, Bojonegoro, Indonesia. The outcomes of interest were pain intensity, ankle muscle strength, ankle ROM, static and dynamic balance, and self-reported ankle function.

CAI is not limited to the sensation of instability.² The clinical presentation in the current case included pain during movement, reduced ankle dorsiflexion, decreased ankle muscle strength, impaired balance, and reduced functional performance. These impairments are consistent with the multidimensional nature of CAI described in contemporary clinical models.² In practical rehabilitation, the presence of several concurrent impairments supports an individualized program that combines strengthening with

sensorimotor and task-specific activities. The 2021 clinical practice guideline recommends interventions that target the specific impairments and activity limitations identified during examination.³

Dynamic balance is particularly relevant for athletes because the ability to control the body during single-leg loading and directional movement depends on coordinated sensory, muscular, and postural responses.³ The Y-Balance Test is commonly used to quantify dynamic reach performance, while the Single Leg Stance test provides a simple measure of static postural control.¹¹ Exercise interventions directed at proprioception and balance may therefore complement strengthening by challenging the patient to control the affected limb under progressively demanding conditions.^{5,6}

Functional recovery is also important because improvements in impairment-level measures do not necessarily translate into restored participation.³ Patient-reported outcome measures can capture symptoms, pain, activities of daily living, sports and recreational function, and quality of life. Multimodal rehabilitation studies have examined patient-reported outcomes alongside physical examination findings, supporting the value of assessing both impairment and function during CAI rehabilitation.¹² In the present case, the Foot and Ankle Outcome Score (FAOS) was used to describe changes across these domains.

The short duration of the present program also warrants careful interpretation. Exercise studies in CAI commonly involve several weeks of treatment, whereas this case report describes changes across four treatment sessions.^{6,7} Consequently, the observed changes may reflect early clinical responses rather than established long-term treatment effects. The case is therefore intended to provide a clinical description of the intervention and the associated changes in outcome measures rather than evidence of comparative treatment efficacy.

Accordingly, the objective of this case report was to describe the changes in pain intensity, muscle strength, ankle ROM, static and dynamic balance, and functional ability following a four-session physiotherapy program combining ES and therapeutic exercise in a patient with CAI. The report was prepared in accordance with the CARE case report framework.

Methods

This study used a descriptive case report design and was conducted at ABR Physiotherapy Clinic, Bojonegoro, Indonesia. The report described the clinical course of a patient with CAI who received a multimodal physiotherapy program combining ES and therapeutic exercise. The intervention was delivered by a licensed physiotherapist with clinical experience in musculoskeletal and sports rehabilitation.

The participant was a 17-year-old female volleyball athlete with recurrent lateral ankle sprains involving the dominant right lower limb. She reported recurrent episodes of ankle giving-way during sports activities for approximately six months before presentation. The initial clinical assessment identified pain during movement, reduced ankle dorsiflexion, impaired balance, decreased ankle muscle strength, and reduced functional performance. The patient had no reported history of fracture, neurological disorder, or lower-limb surgery. Baseline characteristics are presented in Table 1.

The diagnosis of CAI was established from the history of recurrent lateral ankle sprains, repeated episodes of giving-way, persistent symptoms, and clinical examination findings.³ The authors reported that the clinical assessment was consistent with recommendations from the International Ankle Consortium.¹³ The source record did not provide the complete International Ankle Consortium eligibility criteria or a standardized CAI questionnaire score.

The rehabilitation program comprised four treatment sessions, preceded by an initial assessment and followed by a final evaluation. Each treatment session lasted approximately 45 to 60 minutes. ES was administered during every treatment session. ES was delivered using a neuromuscular ES device with biphasic symmetrical current. Surface electrodes measuring 5 × 5 cm were positioned over the tibialis anterior and peroneus longus muscles of the affected limb. The stimulation frequency was 35 Hz, the pulse width was 250 µs, and the duty cycle was 10 seconds on and 30 seconds off. Intensity was adjusted to produce visible muscle contraction without discomfort, and ES was administered for 15 minutes per session. The stated clinical purpose was to facilitate neuromuscular activation and support ankle stability.

Therapeutic exercise consisted of strengthening, proprioceptive, balance, and functional activities. Exercises included Theraband ankle strengthening, bridging, short foot exercise, toe raises, calf raises, single-leg calf raises, glute sets, five-way straight leg raises, squats, squats with knee in and out, sumo squats, single-leg stance, wobble board exercise, dynamic balance drills, single stance on a BOSU, and throwing and catching on a BOSU. The exercise sequence and progression are summarized in Tables 2 and 3.

During Session 1, the program included ES, Theraband ankle exercise, bridging, short foot exercise, toe raises, and calf raises. Strengthening exercises were performed for 3 sets of 10 repetitions. During Session 2, ES was combined with single-leg calf raises, glute sets, five-way straight leg raises, squats, squats with knee in and out, sumo squats, and single-leg stance. Strengthening was progressed toward functional lower-extremity exercises at 3 sets of 10 repetitions. During Session 3, ES was combined with wobble board exercise and dynamic balance exercise, with balance and proprioceptive training performed for 3 sets of 30 to 60 seconds. During Session 4, ES was combined with single stance on a BOSU and throwing and catching on a BOSU, representing the most advanced dynamic balance and sport-specific activities in the program, performed for 3 sets of 30 to 60 seconds. Exercise intensity and progression were adjusted according to the patient's functional capacity, clinical response, and observed functional improvement. No modification to the planned intervention was required during the study period. The patient attended all scheduled sessions and completed the prescribed exercises.

Outcomes were assessed before the first treatment session and after completion of the intervention program. Pain intensity was assessed using the Numeric Rating Scale (NRS), muscle strength using Manual Muscle Testing (MMT), ankle ROM using a goniometer, static balance using the Single Leg Stance (SLS) test, dynamic balance using the Y-Balance Test, and functional ability using the Foot and Ankle Outcome Score (FAOS). The same outcome domains were reassessed at the final evaluation. The source manuscript did not report formal psychometric coefficients or instrument-specific validity and reliability estimates; therefore, no additional measurement properties were added.

Because this was a single-case descriptive report, the data were analyzed descriptively. Pre-intervention and post-intervention findings were compared across the recorded sessions to describe changes in pain, muscle strength, ROM, balance, and functional ability. No inferential statistical tests, confidence intervals, or hypothesis testing were performed.

Written informed consent was reported to have been obtained for publication of the patient's clinical information and photographs. The source manuscript states that ethical approval was not required because the study was conducted as a single case report according to institutional policy.

Table 1. Patient Characteristics

Variable	Description
Age	17 years
Sex	Female
Height	154 cm
Weight	46 kg
BMI	19.4
Occupation	Student
Sport	Volleyball athlete
Dominant limb	Right lower limb
Affected limb	Right ankle
Diagnosis	Chronic ankle instability (CAI)
Duration of symptoms	6 months
Main complaints	Pain, ankle giving-way, instability during sports activities
Previous injury history	Recurrent lateral ankle sprains
Previous surgery	None
Neurological disorder	None

Results

The patient completed all four scheduled treatment sessions, with no missed sessions or deviations from the planned intervention. The intervention progressed from basic strengthening activities to functional lower-extremity exercise, balance training, proprioceptive activities, and sport-specific dynamic balance tasks. The treatment sequence and progression are shown in Tables 2 and 3.

Resting pain remained 0/10 throughout the intervention. Movement-related pain decreased progressively from 4/10 at Session 1 to 3/10 at Session 2, 2/10 at Session 3, and 1/10 at Session 4. Tenderness was 2/10 at Sessions 1 and 2, decreased to 1/10 at Session 3, and reached 0/10 at Session 4 (Table 4).

MMT findings are presented in Table 5. Hip abduction improved from grade 4 at Session 1 to 5+ at Session 4, while external rotation improved from 3+ to 4+. Ankle plantarflexion improved from grade 3 to 3+, dorsiflexion from 3+ to 4, and inversion from 3+ to 4. Eversion remained at grade 5+ across all sessions. Hip flexion and extension, adduction, internal rotation, and knee flexion and extension remained unchanged at 5+ across the recorded sessions. The remaining knee rotation measures also remained unchanged at 5+.

Active and passive ROM findings are presented in Table 6. Active ankle dorsiflexion increased from 15° to 20° by Session 3 and remained at 20° at Session 4. Active plantarflexion increased from 30° to 35° at Session 4. Active inversion increased from 15° to 20° by Session 3 and remained unchanged at Session 4. Active hip and knee ROM showed limited changes, with increases in hip abduction and external/internal rotation observed by Session 3. Passive ankle dorsiflexion increased from 15° to 20°, with plantarflexion reaching 35° by Session 3 and remaining at 35° at Session 4. Passive inversion increased from 15° to 20° by Session 3. Other passive hip and knee measurements were largely unchanged.

SLS performance improved on both lower limbs (Table 7). Right SLS increased from 10 seconds at Session 1 to 20, 30, and 35 seconds at Sessions 2, 3, and 4, respectively. Left SLS increased from 35 to 45, 50, and 60 seconds across the same sessions. Y-Balance performance also increased progressively. On the right side, the composite score increased from 69.9% at Session 1 to 74.1%, 77.5%, and 79.7% at Sessions 2, 3, and 4, respectively. On the left side, the composite score increased from 76.6% to 79.8%, 83.9%, and 86.9%.

FAOS results are shown in Table 8. The overall score increased from 73.97% at Session 1 to 77.78% at Session 2, 90.97% at Session 3, and 92.64% at Session 4. Symptoms and stiffness increased from 67.86% to 89.29%, pain from 58.33% to 88.89%, activities of daily living from 89.71% to 100%, sport and recreation from 65.00% to 85.00%, and quality of life from 87.50% to 100%. The FAOS category changed from "Good" at Sessions 1 and 2 to "Very Good" at Sessions 3 and 4.

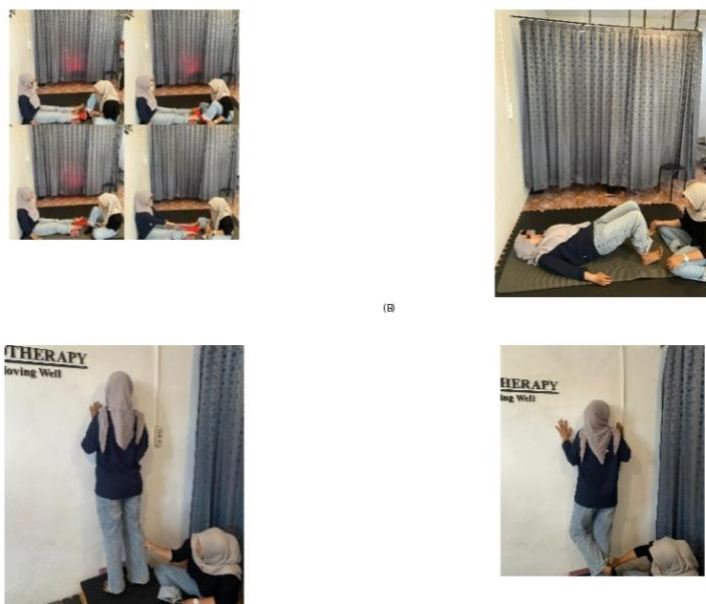


Figure 1. Strengthening exercises performed during the physiotherapy intervention. (A) Ankle Theraband; (B) bridging; (C) calf raise; (D) single calf raise.

Table 2. Intervention Timeline and Core Activities

Session	Core activities
Initial assessment	Patient interview, physical examination, NRS, MMT, ROM, SLS, Y-Balance Test, and FAOS assessment
Session 1	Electrical stimulation, Theraband ankle exercise, bridging, short foot exercise, toe raises, calf raises
Session 2	Electrical stimulation, single-leg calf raise, glute set, five-way SLR, squat, squat with knee in and out, sumo squat, single-leg stance
Session 3	Electrical stimulation, wobble board exercise, dynamic balance exercise, single stance on BOSU, throwing and catching on BOSU
Session 4	Electrical stimulation, single stance on BOSU, throwing and catching on BOSU
Final evaluation	Reassessment using NRS, MMT, ROM, SLS, Y-Balance Test, and FAOS

Table 3. Intervention Progression and Dosage

Session	Intervention components	Dosage/progression
Session 1	Electrical stimulation; Theraband ankle exercise; bridging; short foot exercise; toe raise; calf raise	ES: 35 Hz, 250 μ s, 15 min. Strengthening: 3 sets $\times$ 10 repetitions
Session 2	Electrical stimulation; single-leg calf raise; glute set; five-way SLR; squat; squat with knee in and out; sumo squat; single-leg stance	Progression to functional lower-extremity exercises; 3 sets $\times$ 10 repetitions
Session 3	Electrical stimulation; wobble board exercise; dynamic balance exercise	Balance and proprioceptive training; 3 sets $\times$ 30–60 seconds
Session 4	Electrical stimulation; single stance on BOSU; throwing and catching on BOSU	Advanced dynamic balance and sport-specific exercises; 3 sets $\times$ 30–60 seconds

Table 4. Pain Assessment Using the Numeric Rating Scale

Outcome	Session 1	Session 2	Session 3	Session 4
Resting pain	0/10	0/10	0/10	0/10
Pain on movement	4/10	3/10	2/10	1/10
Tenderness	2/10	2/10	1/10	0/10

Table 5. Manual Muscle Testing Results

Region	Movement	Session 1	Session 2	Session 3	Session 4
Hip	Extension	5+	5+	5+	5+
Hip	Flexion	5+	5+	5+	5+
Hip	Abduction	4	4+	5–	5+
Hip	Adduction	5+	5+	5+	5+
Hip	External rotation	3+	3+	4–	4+
Hip	Internal rotation	5+	5+	5+	5+
Knee	Extension	5+	5+	5+	5+
Knee	Flexion	5+	5+	5+	5+
Knee	External rotation	5+	5+	5+	5+
Knee	Internal rotation	5+	5+	5+	5+
Ankle	Plantarflexion	3	3	3+	3+
Ankle	Dorsiflexion	3+	3+	4–	4
Ankle	Inversion	3+	3+	4–	4
Ankle	Eversion	5+	5+	5+	5+

Table 6. Range of Motion Results

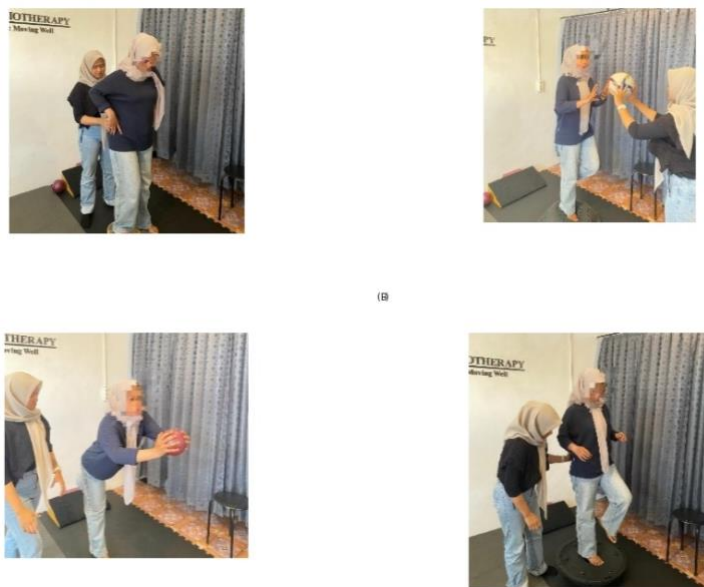
Region	Movement	Session 1	Session 2	Session 3	Session 4
Hip	Extension/Flexion	Active: 15°–0°–125°	15°–0°–125°	15°–0°–125°	15°–0°–125°
Hip	Abduction/Adduction	Active: 35°–0°–15°	35°–0°–15°	40°–0°–15°	40°–0°–15°
Hip	External/Internal rotation	Active: 35°–0°–45°	35°–0°–45°	40°–0°–45°	40°–0°–45°
Knee	Extension/Flexion	Active: 0°–0°–135°	0°–0°–135°	0°–0°–135°	0°–0°–135°
Knee	External/Internal rotation	Active: 40°–0°–35°	40°–0°–35°	40°–0°–35°	40°–0°–35°
Ankle	Dorsiflexion/Plantarflexion	Active: 15°–0°–30°	15°–0°–30°	20°–0°–30°	20°–0°–35°
Ankle	Eversion/Inversion	Active: 30°–0°–15°	30°–0°–15°	30°–0°–20°	30°–0°–20°
Hip	Extension/Flexion	Passive: 15°–0°–125°	15°–0°–125°	15°–0°–125°	15°–0°–125°
Hip	Abduction/Adduction	Passive: 40°–0°–15°	40°–0°–15°	45°–0°–15°	45°–0°–15°
Hip	External/Internal rotation	Passive: 40°–0°–45°	40°–0°–45°	45°–0°–45°	45°–0°–45°
Knee	Extension/Flexion	Passive: 0°–0°–135°	0°–0°–135°	0°–0°–135°	0°–0°–135°
Knee	External/Internal rotation	Passive: 40°–0°–35°	40°–0°–35°	40°–0°–35°	40°–0°–35°
Ankle	Dorsiflexion/Plantarflexion	Passive: 15°–0°–30°	15°–0°–30°	20°–0°–35°	20°–0°–35°
Ankle	Eversion/Inversion	Passive: 30°–0°–15°	30°–0°–15°	30°–0°–20°	30°–0°–20°

Table 7. Balance Assessment Results

Test	Session 1	Session 2	Session 3	Session 4
Single Stance	Leg Right: 10 s; Left: 35 s	Right: 20 s; Left: 45 s	Right: 30 s; Left: 50 s	Right: 35 s; Left: 60 s
Y-Balance Test, right	A: 52.1; PL: 65.5; PM: 56.5; composite: 69.9%	A: 54.0; PL: 72.5; PM: 58.1; composite: 74.1%	A: 57.6; PL: 76.2; PM: 59.4; composite: 77.5%	A: 59.0; PL: 79.2; PM: 60.5; composite: 79.7%
Y-Balance Test, left	A: 56.5; PL: 77.0; PM: 57.3; composite: 76.6%	A: 59.6; PL: 79.0; PM: 60.3; composite: 79.8%	A: 62.4; PL: 82.2; PM: 64.5; composite: 83.9%	A: 66.3; PL: 83.7; PM: 66.5; composite: 86.9%

Table 8. Foot and Ankle Outcome Score Results

Subscale	Session 1	Session 2	Session 3	Session 4
Symptoms and stiffness	67.86%	78.57%	89.29%	89.29%
Pain	58.33%	66.67%	80.56%	88.89%
Activities of daily living	89.71%	89.71%	100.00%	100.00%
Sport and recreation	65.00%	65.00%	85.00%	85.00%
Quality of life	87.50%	87.50%	100.00%	100.00%
Overall score	73.97%	77.78%	90.97%	92.64%
Category	Good	Good	Very Good	Very Good

**Figure 2.** Balance and functional exercises performed during the physiotherapy intervention. (A) Wobble board exercise; (B) dynamic balance drills; (C) throwing and catching on BOSU; (D) single stance on BOSU.

Discussion

This case report describes early changes in pain, ankle ROM, muscle strength, balance, and self-reported function after four physiotherapy treatment sessions combining ES with therapeutic exercise in a young volleyball athlete with CAI. The most notable changes were a reduction in movement-related pain and tenderness, improved ankle dorsiflexion, plantarflexion, and inversion ROM, gains in selected ankle muscle strength, improved single-leg stance, higher Y-Balance composite scores, and an increase in FAOS. Because the intervention was multimodal and there was no comparison condition, these findings describe the patient's clinical course rather than demonstrate the independent efficacy of ES.

The clinical presentation is consistent with the multidimensional model of CAI. CAI can involve mechanical and functional impairments that include weakness, restricted motion, impaired proprioception, altered neuromuscular control, and postural-control deficits.^{1,2} The patient's baseline findings included several of these domains, providing a clinical rationale for a rehabilitation program that did not focus on a single impairment. Current clinical practice guidance similarly supports impairment-based rehabilitation for ankle stability and movement coordination problems.³

Pain during movement decreased from 4/10 at the first assessment to 1/10 at the final assessment, while tenderness decreased from 2/10 to 0/10. The reduction occurred progressively across the four treatment sessions. The ES component may have contributed to symptom modulation, while the active exercise program may also have reduced pain by improving movement capacity and confidence.⁹ However, the present design cannot determine which component was responsible for the change. The absence of resting pain throughout the intervention also indicates that the primary symptomatic change occurred during movement rather than at rest.

Strength improvements were most apparent in the muscles relevant to ankle control. Dorsiflexor and invertor strength increased from grade 3+ to grade 4, while plantarflexor strength increased from grade 3 to 3+. The broader MMT profile also showed improvement in hip abduction and external rotation, whereas several proximal and knee muscle groups remained unchanged. This pattern is compatible with the concept that CAI may involve deficits across the lower-extremity kinetic chain rather than at the ankle alone.² Evidence syntheses have identified strength deficits in people with CAI and support strengthening as an important rehabilitation component.⁵ Exercise-based evidence also suggests that strengthening the foot and ankle may be particularly useful for proprioceptive recovery.^{5,7}

Ankle ROM improved selectively. Active dorsiflexion increased from 15° to 20°, plantarflexion from 30° to 35°, and inversion from 15° to 20°. Passive ROM showed similar improvement in ankle dorsiflexion and inversion, whereas several hip and knee measures remained stable. Restricted ankle motion is recognized as one component of CAI and can interact with other mechanical and sensorimotor impairments.² The improvement observed over four sessions suggests that the patient's mobility limitation was responsive to the rehabilitation program, although the short observation period prevents conclusions about the durability of the change.

Static and dynamic balance also improved. Right SLS increased from 10 to 35 seconds, whereas the left side increased from 35 to 60 seconds. The right Y-Balance composite score increased from 69.9% to 79.7%, and the left score increased from 76.6% to 86.9%. Improvements were observed across the anterior, posterolateral, and posteromedial reach directions. These changes are clinically relevant because impaired postural control and proprioception are recognized features of CAI.^{1,2} Exercise-based

interventions targeting proprioception and balance have demonstrated beneficial effects in CAI, and strengthening and balance training have both been investigated as strategies for improving sensorimotor function.^{5,6} The progressive increase in reach performance in this case is therefore compatible with the expected direction of change from a program that increasingly challenged single-leg control and dynamic balance.

The FAOS increased from 73.97% to 92.64%. Improvements were observed in symptoms and stiffness, pain, activities of daily living, sport and recreation, and quality of life, although the magnitude of change differed across domains. The greatest domain-level changes were observed in pain and sport-related function, while activities of daily living and quality of life reached 100% by the later sessions. Patient-reported outcomes provide information that cannot be obtained from impairment measures alone and are relevant to judging whether physical improvements translate into meaningful activity and participation. Multimodal rehabilitation has also been studied using patient-reported outcomes as indicators of treatment response.¹²

The patient's reported improvement in confidence during walking, running, jumping, and volleyball-related activities provides additional clinical context. She reported greater perceived ankle stability, less fear of recurrent sprain, and improved participation in sport. These observations are consistent with the objective improvements in balance and FAOS, although they were not measured with a validated psychological or return-to-sport instrument. They should therefore be regarded as supplementary clinical observations.

The findings are broadly consistent with contemporary evidence supporting exercise-based rehabilitation for CAI. A network meta-analysis found favorable effects of foot and ankle strengthening on proprioception, while a randomized study demonstrated improvements in proprioceptive outcomes following strength or balance training.^{5,6} A recent meta-analysis also found that exercise therapy can improve functional outcomes and dynamic balance in CAI, particularly when programs are implemented for several weeks.⁷ The present case extends this clinical context by describing a short, multimodal program that incorporated ES together with progressive strengthening, proprioceptive, balance, and sport-specific activities.

Several limitations substantially affect interpretation. First, the report includes only one patient, so the findings cannot be generalized to other athletes or to the broader CAI population. Second, ES and exercise were delivered together, preventing separation of their individual effects. Third, there was no untreated, exercise-only, or alternative-intervention comparison condition. Fourth, the intervention lasted only four treatment sessions and no long-term follow-up was reported. Fifth, the study relied partly on MMT and descriptive clinical measures, and the source manuscript did not report measurement reliability or minimal detectable change for the instruments used. Finally, the case did not report inferential statistics or effect sizes, which is appropriate for a descriptive single-case report but limits quantitative interpretation.

The main strength of this report is its detailed description of a clinically oriented multimodal rehabilitation program and its repeated assessment across multiple impairment and functional domains. The intervention sequence also progressed from basic strengthening toward dynamic balance and sport-specific activities, providing a clinically coherent rehabilitation trajectory. Future studies should use larger samples, controlled comparative designs, standardized CAI diagnostic criteria, validated outcome measures, longer intervention periods, and follow-up assessments. Studies directly comparing ES plus exercise with exercise alone would be particularly valuable for determining whether ES provides an incremental benefit beyond structured therapeutic exercise.

Conclusion

This case report describes favorable short-term clinical changes following four physiotherapy treatment sessions combining ES with progressive therapeutic exercise in a 17-year-old volleyball athlete with CAI. Improvements were observed across multiple outcome domains, including movement-related pain, tenderness, ankle ROM, selected ankle muscle strength, static and dynamic balance, and self-reported ankle function. The affected right ankle showed an increase in dorsiflexion, plantarflexion, and inversion ROM, while right SLS and the right Y-Balance composite score also improved. FAOS increased from 73.97% to 92.64%, indicating improvement across symptoms, pain, activities of daily living, sport and recreation, and ankle-related quality of life.

The findings support the clinical rationale for a multimodal rehabilitation approach that combines neuromuscular ES with strengthening, proprioceptive, balance, and functional exercises. Nevertheless, the observed improvements cannot be attributed specifically to ES because both ES and exercise were administered concurrently and no comparison condition was included. The single-case design, short treatment period, absence of long-term follow-up, and lack of inferential analysis further limit causal interpretation and generalizability.

Accordingly, this report should be interpreted as a descriptive clinical observation rather than evidence of treatment efficacy. Controlled studies with larger samples, standardized CAI diagnostic criteria, longer intervention and follow-up periods, and validated outcome measures are needed. Direct comparison of ES combined with exercise versus exercise alone would help determine whether ES provides an additional clinical benefit beyond structured therapeutic exercise.

Author Contribution

Anisa Rizky Isnaini: Conceptualization, Methodology, Investigation, Data Curation, Writing Original Draft.

Dimas Arya Nugraha: Conceptualization, Methodology, Formal Analysis, Supervision, Writing Review and Editing.

Yeni Tri Nurhayati: Methodology, Investigation, Data Curation, Supervision, Writing Review and Editing.

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Conflict of Interest Statement

The authors declare no conflict of interest.

Funding Sources

This study received no external funding.

Ethics Statement

Written informed consent was reported to have been obtained for publication of clinical information and photographs. The source manuscript states that ethical approval was not required because the report was treated as a single case report under institutional policy. The institution and any waiver or approval reference number were not provided in the source manuscript.

References

1. Lin C, Houtenbos S, Lu Y, Mayer F, Wippert P. The epidemiology of chronic ankle instability with perceived ankle instability: a systematic review. *J Foot Ankle Res.* 2021;14(1):41.
2. Hertel J, Corbett RO. An updated model of chronic ankle instability. *J Athl Train.* 2019;54(6):572-588.
3. Martin RL, Davenport TE, Fraser JJ, Sawdon-Bea J, Carcia CR, Carroll LA, et al. Ankle stability and movement coordination impairments: lateral ankle ligament sprains revision 2021. *J Orthop Sports Phys Ther.* 2021;51(4):CPG1-CPG80.
4. Gribble PA, Bleakley CM, Caulfield BM, Docherty CL, Fourchet F, Fong DTP, et al. Evidence review for the 2016 International Ankle Consortium consensus statement on the prevalence, impact and long-term consequences of lateral ankle sprains. *Br J Sports Med.* 2016;50(24):1496-1505.
5. Han J, Luan L, Adams R, Witchalls J, Newman P, Tirosh O, et al. Can therapeutic exercises improve proprioception in chronic ankle instability? A systematic review and network meta-analysis. *Arch Phys Med Rehabil.* 2022;103(11):2232-2244.
6. Yekdaneh A, Mutlu ÇY. Effects of balance and strength training for ankle proprioception in people with chronic ankle instability: a randomized controlled study. *J Am Podiatr Med Assoc.* 2024;114(3):23008.
7. Zhang C, Luo Z, Wu D, Fei J, Xie T, Su M. Effectiveness of exercise therapy on chronic ankle instability: a meta-analysis. *Sci Rep.* 2025;15:11709.
8. Yang Y, Wu Y, Zhu W. Recent advances in the management of chronic ankle instability. *Chin J Traumatol.* 2025;28(1):35-42.
9. Hu L, Zhong M, Jia M, Gao C, Liu Y. Neuromuscular electrical stimulation improves stability and function in chronic ankle instability: a systematic review and meta-analysis. *BMC Musculoskelet Disord.* 2026;27(1):448.
10. Obeng-Frimpong L, Winter SL, Fong DTP. Electrotherapy as a rehabilitation modality for chronic ankle instability: a systematic review. *J Athl Train.* 2025;60(11):772-782.
11. Plisky P, Schwartkopf-Phifer K, Huebner B, Garner MB, Bullock G. Systematic review and meta-analysis of the Y-Balance Test Lower Quarter: reliability, discriminant validity, and predictive validity. *Int J Sports Phys Ther.* 2021;16(5):1190-1209.
12. Zhang R, Qi Q, Song W, Chen Y. Predicting the success of multimodal rehabilitation in chronic ankle instability based on patient-reported outcomes. *BMC Musculoskelet Disord.* 2022;23(1):706.
13. Gribble PA, Delahunt E, Bleakley C, Caulfield B, Docherty CL, Fourchet F, et al. Selection criteria for patients with chronic ankle instability in controlled research: a position statement of the International Ankle Consortium. *J Orthop Sports Phys Ther.* 2013;43(10):585-591.