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Regulation Instead of Symptom Management: The Role of Neural Therapy in Modern Sports Medicine Concepts

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Abstract

Sports injuries represent a central concern in modern sports medicine, particularly regarding prevention, rapid recovery, and recurrence avoidance. This retrospective study investigates the clinical effectiveness of neural therapy combined with manual medicine in treating acute sports injuries, based on data from 164 physically active patients aged between 15 and 38 years.

The focus lies on functional disorders, inflammatory processes, and autonomic imbalances, which were addressed using a regulatory therapeutic approach. Applied methods included segmental therapy, trigger point injections with local anesthetics, and manual medical interventions.

The most common injuries were muscle strains (40%), ligament sprains (35%), contusions (15%), and tendon irritations (10%). Clinical parameters such as pain intensity (VAS), range of motion, muscle strength, inflammatory markers (CRP, IL-6, TNF-α), psychometric burden, and recurrence rates were analyzed over a three-month period.

The findings demonstrate a significant reduction in pain levels (VAS from 7.8 to 2.1), rapid normalization of inflammatory markers, notable improvements in muscle strength, and a reduction in stress and anxiety scores by more than 60%. Notably, 88% of patients resumed training within an average of 10 days, and the recurrence rate within one year remained below 5%. Body weight did not significantly affect therapeutic outcomes.

These results highlight the effectiveness of neural therapy as a regulatory approach that supports microcirculation, pain relief, and autonomic nervous system rebalancing. When combined with manual medicine techniques, it allows for targeted correction of segmental dysfunctions and muscular imbalances.

This study suggests that the early, multimodal application of neural therapy and manual medicine can lead to faster functional recovery, sustained inflammation control, and a significant improvement in athletic performance capacity. The presented findings support the broader integration of these complementary approaches in both the acute and rehabilitative phases of sports injury management.

Keywords: Neural therapy, sports injuries, pain management, autonomic nervous system, microcirculation, trigger points

1. Introduction: The Role of Regulatory Medicine in Sports Health

Sports health is a multifaceted concept influenced by a wide range of physiological and environmental factors. In addition to physical performance, long-term health maintenance is of critical importance. Two core disciplines within regulatory medicine—**neural therapy and manual medicine**—are central to the treatment of functional disorders and the early management of sports-related injuries (1–3).

1.1. Neural Therapy and Sports Medicine / Sports Health

Neural therapy has emerged as an effective method to enhance athletic performance and reduce injury risk. By addressing interference fields (neuromodulatory triggers), it regulates stress-related imbalances and suppresses inflammatory processes. Furthermore, neural therapy enables the targeted identification and treatment of hidden dysfunctions that may impair physical performance (4–10). For a comprehensive understanding of the context, see Figure 1.

As both a diagnostic and therapeutic approach, neural therapy involves the use of local anesthetics such as procaine or lidocaine. Its primary aim is to regulate dysfunctions of the autonomic nervous system, modulate inflammatory responses, and alleviate pain and functional disorders. Due to its multifactorial mechanisms of action, neural therapy is considered an effective treatment option for both acute and chronic conditions (10–15).

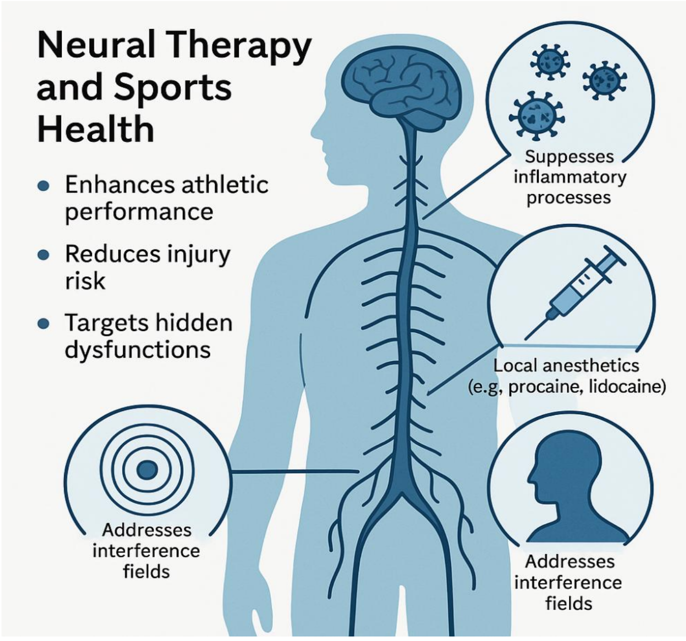

Figure 1: Neural Therapy and Sports Health. Neural therapy optimizes autonomic regulation and enhances athletic performance by targeting interference fields and suppressing inflammation. Local anesthetics such as procaine or lidocaine are used to restore neurophysiological balance, improve microcirculation, and prevent sports-related injuries.

1.2. Manual Medicine and Sports Medicine / Sports Health

Manual medicine focuses on correcting musculoskeletal imbalances, preventing injuries, and optimizing physical performance. It is especially valuable in sports injury management, where it serves to eliminate movement restrictions and support the rapid mobilization and reintegration of athletes into training routines (16–21). For a comprehensive understanding of the context, see Figure 2.

Figure 2: Manual Medicine and Sports Health. Manual medicine plays a crucial role in correcting musculoskeletal imbalances, preventing injuries, restoring mobility, and optimizing physical performance. Through precise manipulative and mobilization techniques, it enhances biomechanical function, supports postural alignment, and facilitates rapid rehabilitation in athletes.

1.3. The Holistic Approach of Regulatory Medicine

Regulatory medicine adopts a holistic approach by addressing not only damaged tissues or organs but also the underlying causes of dysfunction. It further supports preventive strategies that promote resilience and long-term health. Early detection and treatment of functional imbalances play a key role in maintaining athletes' health and optimizing performance. The combined application of neural therapy and manual medicine has proven particularly effective in this regard (2,12,22–24). For a comprehensive understanding of the context, see Figure 3.

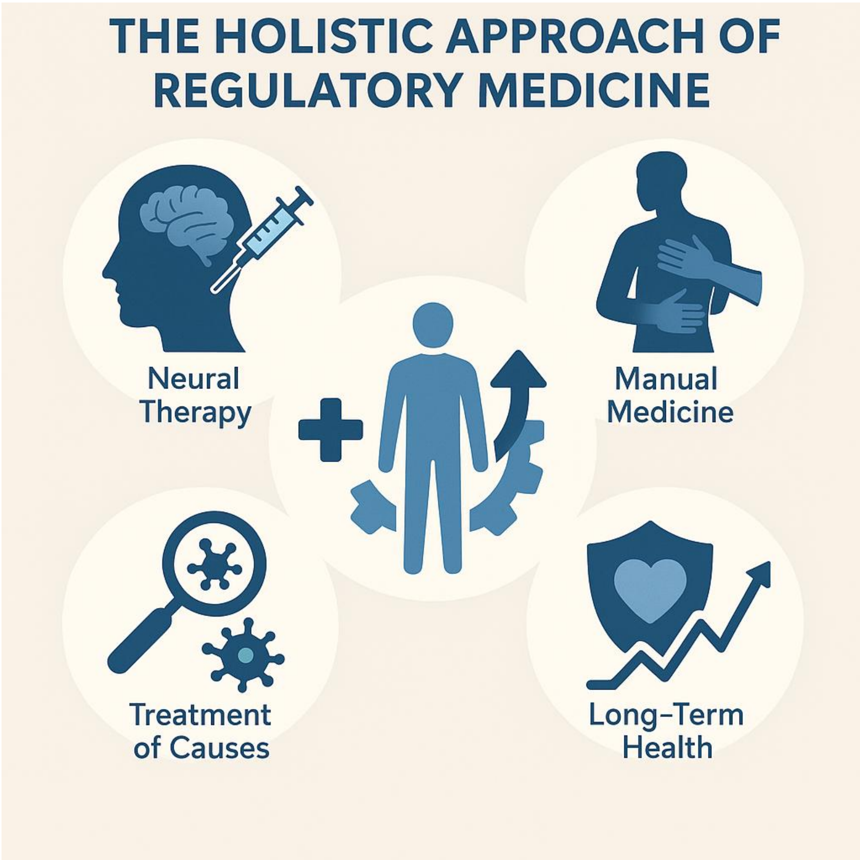

Figure 3: The holistic approach of Regulatory Medicine integrates Neural Therapy, Manual Medicine, and causal treatment to restore systemic balance and promote sustainable long-term health. Each modality complements the others, addressing both functional and regulatory dimensions of the human body.

The objective of regulatory medicine is to activate the body's self-healing mechanisms, thereby improving long-term health outcomes and overall quality of life. Its multidisciplinary nature offers both preventive and therapeutic benefits, making it a promising complement to contemporary sports medicine (2,25).

2. Regular Physical Activity: Benefits and Injury Risks

Engaging in regular physical activity has well-documented benefits for both physical and mental health. However, it also carries a measurable risk of injury. The most frequent types of sports injuries include sprains, contusions, swelling, and hematomas. Statistically, among the 23 million people who engage in regular sports activities, approximately 1.25 million individuals require medical treatment due to serious injuries. This translates to an estimated 5.4% of regularly active individuals facing the risk of major sports-related injuries that necessitate medical intervention. In other words, one in every 20 active individuals is likely to experience a serious injury over time (25–32). Preventive strategies, including appropriate training, warm-up routines, and biomechanical assessments, can significantly reduce both the frequency and severity of such injuries (26–32).

2.1. Causes of Sports Injuries

The etiology of sports injuries is multifactorial and requires a differentiated analysis. Injuries can generally be categorized into endogenous (internal) and exogenous (external) factors.

• **Endogenous injuries** result from individual factors such as overuse, inadequate recovery, improper technique, or unsuitable equipment. Excessive stretching, repetitive movements, or inappropriate footwear may overload the musculoskeletal system and elevate the risk of injury (26, 31)..

• Additionally, engaging in sports while experiencing health conditions or under the influence of medication significantly increases the likelihood of injury (26, 28, 31-34). For a comprehensive understanding of the context, see Figure 4.

Figure 4: Categorization of sports injuries into endogenous and exogenous causes, illustrating internal factors (overuse, poor recovery, improper technique) and external influences (collisions, environmental conditions, accidents) contributing to injury risk.

2.2. Exogenous Injuries

Exogenous injuries are caused by external forces, often beyond the athlete's control. These include collisions with other players, environmental conditions, or accidents. Common examples are fouls in football or strikes in contact sports such as boxing. Due to the external impact, such injuries are often more traumatic and severe (30, 31-37).

2.3. Types and Mechanisms of Sports Injuries

Sports injuries can affect various anatomical structures:

• **Musculature:** Injuries range from minor muscle strains to complete ruptures, the latter being the most severe (31).

• **Connective Tissues:** Tendons, ligaments, and joint capsules are frequently involved (31).

• **Cartilage and Bone:** Injuries can occur in both acute and chronic loading scenarios (31).

2.3.1. Acute Injuries

Acute injuries include contusions, sprains, fractures, dislocations, and tendon or ligament tears. Falls may also lead to significant skin trauma (31, 38). For a comprehensive understanding of the context, see Figure 5.

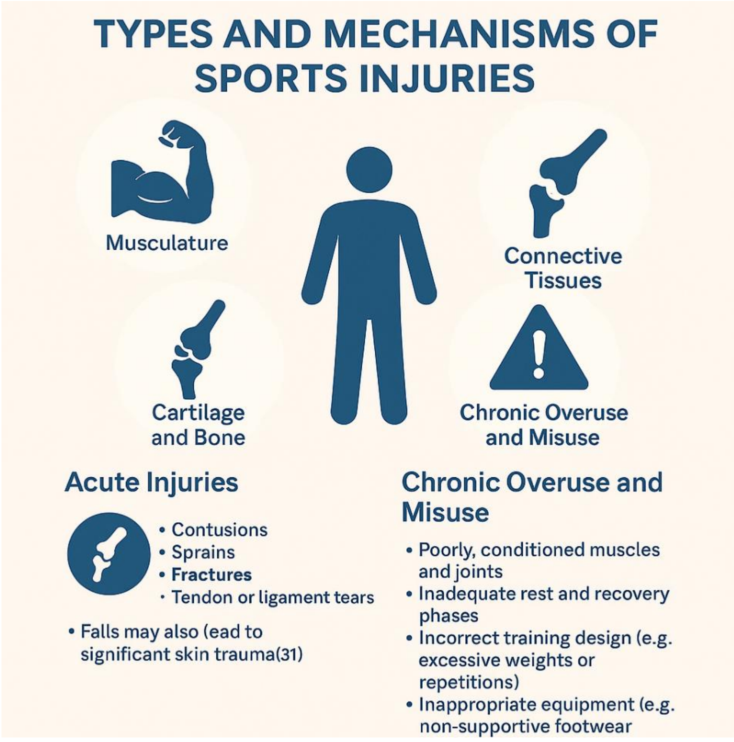

Figure 5: Classification of sports injuries by type and mechanism, illustrating affected structures (muscles, connective tissues, cartilage, and bone) and differentiating between acute injuries (e.g., contusions, fractures, sprains) and chronic overuse or misuse resulting from improper training, inadequate recovery, or unsuitable equipment.

2.3.2. Chronic Overuse and Misuse

Long-term injuries are frequently due to chronic overuse and improper use. Contributing factors include (31, 38-40):

• Poorly conditioned muscles and joints,
• Inadequate rest and recovery phases,
• Incorrect training design (e.g., excessive weights or repetitions),
• Inappropriate equipment (e.g., non-supportive footwear),
• Underlying illnesses or pharmacological influences.

2.3.3. Impact of Overtraining

Excessive training can lead to both physical and mental fatigue, significantly impairing athletic performance (31, 38).

2.3.4. Training and Nutritional Errors

Errors in training planning and nutrition increase the risk of overtraining (26):

• Excessive frequency and intensity,
• Overly long sessions,
• Protein and carbohydrate deficiencies,
• Dehydration impairing metabolism and performance.

2.3.5. Influence of Illness

The general health status is crucial in overtraining prevention (26, 40):

• Infections (e.g., colds, flu) reduce resilience,
• Gastrointestinal disorders limit nutrient absorption,
• Chronic illnesses weaken immunity and delay recovery.

2.3.6. Psychological Stress

Mental strain directly impacts physical recovery and increases injury risk (31, 40-44):

• Educational and occupational stress affects sleep and energy levels,
• Family conflicts disrupt mental stability,
• Competitive pressure can lead to long-term exhaustion.

2.3.7. Environmental and Lifestyle Factors

Environmental influences and lifestyle habits significantly impact the health and performance of athletes (31).

• **Climate changes:** Sudden weather fluctuations can impair the body's adaptability (30,31).
• **Air pollution:** Poor air quality can negatively affect the performance of athletes training outdoors.
• **Sleep deprivation:** Inadequate or poor-quality sleep delays physical recovery.
• **Unhealthy habits:** Alcohol and tobacco use, along with unbalanced diets, impair physical functionality.

2.2.8. Prevention of Overtraining

Overtraining is not solely the result of physical overload; it is also influenced by psychological, environmental, and health-related factors (30,31,33-36). The following measures are recommended for prevention:

• Developing a balanced training schedule
• Ensuring adequate and appropriate nutrition
• Applying effective stress management strategies
• Adhering to a healthy sleep routine and lifestyle

2.2.9. Inattention and Unrealistic Goal Setting

Several factors increase the risk of sports injuries, including:

- **Overambitious goals:** A rushed increase in performance capacity can lead to improper strain and overuse injuries.
- **Insufficient warm-up:** Inadequate preparation increases muscle and joint stress.
- **Lack of concentration:** Stress and distraction during training can impair focus, increasing the risk of falls, sprains, or collisions.
- **Incomplete recovery:** Premature return to physical activity can result in chronic injuries or new trauma (31, 23–41).

2.2.10. The Role of Sports Equipment and Environmental Conditions

The quality and appropriateness of sports equipment are essential for injury prevention:

- Inadequate footwear or missing protective gear can cause instability and biomechanical issues.
- Surface conditions and weather also influence injury risk during sports activities (31,39-42).

2.2.11. The Role of Psychological and Physical Stress

Both the physical condition and psychological stress must be considered during athletic activity:

- Competitive pressure can lead to loss of concentration and technical errors.
- Mental stress can affect body coordination, increasing the risk of improper movements and uncontrolled exertion.
- Chronic stress has a negative impact on the musculoskeletal system and can lead to long-term impairments (28,31,46-49).

2.2.12. Importance of Dynamic Stretching

Proper stretching techniques are essential in preventing injuries. Excessive static stretching may overload ligaments and joints, increasing injury risk, whereas dynamic stretching has been shown to support physical activation, improve performance, and reduce the likelihood of injuries. This method is especially advantageous in high-speed and reactive sports (31,41-49).

Understanding the causes of sports injuries and implementing preventive strategies are critical for maintaining athletes' health and performance. Therefore, both individual and environmental factors should be addressed through a multidisciplinary approach (31,46-49).

2.2.13. Consequences of Immobilization Following Injury

Restricted mobility after an injury has far-reaching health consequences. In addition to increased fat accumulation, immobilization acts as a pro-inflammatory factor on the body (31,44).

The activity of skeletal muscles stimulates the production of anti-inflammatory myokines that exert systemic anti-inflammatory effects:

- **IL-6,** typically known for its pro-inflammatory properties, can adopt anti-inflammatory functions under conditions of moderate and regular physical activity.
- Other anti-inflammatory myokines, such as **irisin, IL-15,** and decorin, have also been identified.
- These findings suggest that regular physical activity transforms skeletal muscles into an endocrine organ with systemic anti-inflammatory effects, benefiting not only muscle tissue but also all bodily systems, including the central nervous system (49–53).

2.2.14. Impact of Injuries and Immobilization

Following an injury, a phase of immobilization often begins, significantly altering physiological processes in muscles and connective tissues. This period of inactivity has notable implications for musculoskeletal health, metabolism, and systemic homeostasis.

2.2.15. Reduction in Muscle Protein Synthesis

Immobilization leads to a general decline in muscle protein synthesis, driven by three primary mechanisms (31,33,50–57):

- **Reduced myofibrillar protein synthesis:** The production of proteins forming the contractile structures of muscle fibers is significantly decreased.
- **Reduced sarcoplasmic protein synthesis:** The generation of supporting proteins within muscle cells is diminished, impairing cellular maintenance and metabolic processes.
- **Reduced mitochondrial protein synthesis:** The production of mitochondrial proteins, which are essential for cellular energy generation, is downregulated, thereby compromising the energy supply within muscle cells.

2.3. Decrease in Collagen Production

Collagen is essential for the structural integrity and regeneration of muscles and connective tissues. Immobility reduces collagen synthesis, which in turn impairs the regeneration of muscles and tendons.

2.3.1. Effects on Muscles and Tissues (31, 50–57)

- **Reduction in muscle mass:** The decreased production of myofibrillar proteins leads to a loss in muscle mass.
- **Decline in oxidative capacity:** The reduction in mitochondrial proteins diminishes energy production within the muscles.
- **Weakening of connective tissue:** The decrease in collagen synthesis compromises the structural stability of muscles and tendons.
- **Changes in tendon structure:** A lack of collagen leads to tissue damage and increased susceptibility to tendon injuries.

2.3.2. Effects on Muscle and Physical Function

- Decreased muscle strength and functionality
- Impairment of physical activity and athletic performance (51).

2.3.3. Consequences of Immobility

- The loss of muscle mass and function restricts daily activities and has long-term negative effects on athletic performance (51, 54).

2.4. The Role of the Autonomic Nervous System (ANS) in Sports Injuries

The autonomic nervous system plays a central role both in the development of injuries and in the effectiveness of the healing process. It regulates involuntary body functions, maintains homeostasis, and directly influences tissue regeneration after injury (6, 7, 24, 26). For a comprehensive understanding of the context, see Figure 6.

During an injury, the sympathetic branch of the ANS is activated, resulting in:

- Vasoconstriction that limits blood flow
- Increased muscle tension
- Heightened activation of nociceptors, which promotes pain and inflammatory responses (2, 6, 7, 24)

In contrast, activation of the parasympathetic nervous system:

- Regulates inflammation
- Enhances tissue perfusion
- Initiates the healing process

Thus, the ANS acts both as a protective mechanism during injury and as a critical factor in the regeneration process (24, 58–61).

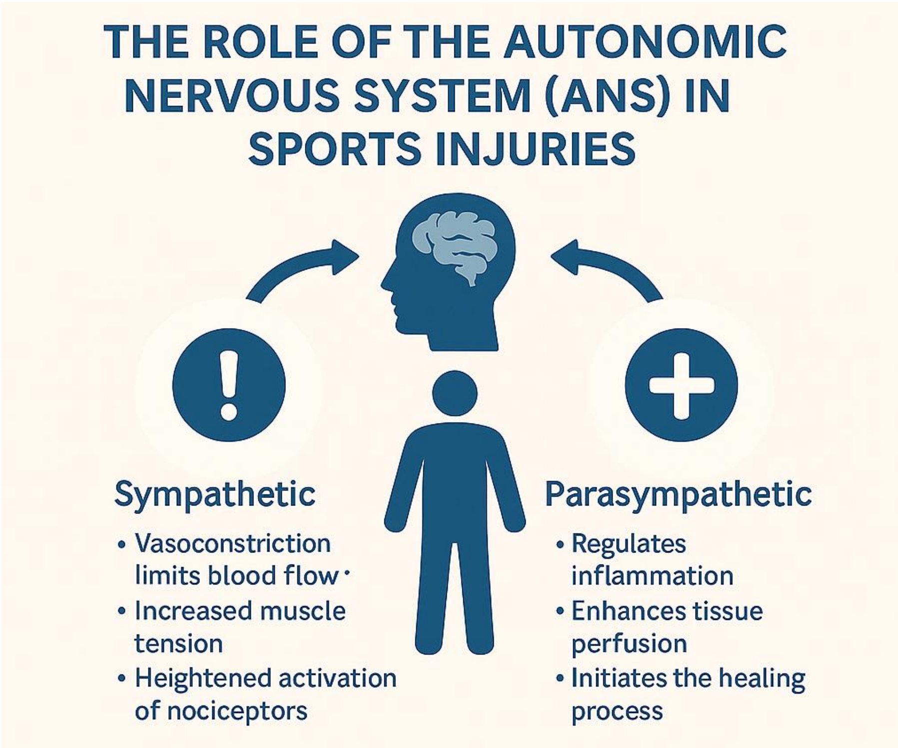

Figure 6: Illustration of the autonomic nervous system's dual role in sports injuries, showing sympathetic activation during trauma (vasoconstriction, muscle tension, pain response) and parasympathetic activation during recovery (inflammation regulation, improved perfusion, tissue healing).

2.5. Phases of Rehabilitation in Sports Injuries

Rehabilitation following sports injuries progresses through clearly defined phases, each requiring specific therapeutic approaches. In the acute phase (initial treatment), the focus is on reducing inflammation, pain, and tissue damage. In addition to classical methods such as RICE and NSAIDs, the early application of neural therapy is particularly valuable as it regulates autonomic imbalances and improves microcirculation.

The transition to the progressive rehabilitation phase enables targeted functional recovery through strength, stretching, and proprioception training. Neural therapy can be additionally applied to effectively treat segmental dysfunctions and myofascial trigger points (see also Table 1) (27, 46).

In the advanced rehabilitation phase, load capacity is further increased through sport-specific training. Neural therapy remains a significant component in this phase as well, to minimize residual symptoms, further optimize function, and prevent potential relapses.

Through continuous use in all phases, neural therapy supports not only acute healing but also the long-term restoration of full athletic performance (2, 3, 27).

Phase	Therapeutic Interventions
1. Initial Treatment	- RICE and NSAIDs: 24–72 hours - Local Anesthetics – Neural Therapy Applications
2. Progressive Rehabilitation	- Neural Therapy - Manual Therapy - Trigger point and segmental treatment of muscles using local anesthetics (LA-NT) - Strength training: isometric, isotonic, isokinetic - Stretching exercises - Speed drills - Proprioceptive exercises - Supportive aerobic training program
3. Advanced Rehabilitation	- Running training and sport-specific field exercises - Neural Therapy and Manual Medicine

Table 1: Phases of Rehabilitation in Sports Injuries and Therapeutic Approaches

3. The Role of the Autonomic Nervous System in the Treatment of Sports Injuries

Regulation of the autonomic nervous system (ANS) can significantly improve the speed and quality of healing in sports injuries. Techniques such as neural therapy influence the ANS by applying local anesthetics to eliminate interference fields and restore balance in neuronal communication systems. These interventions enhance circulation, reduce inflammation, and relieve pain (1, 3, 4, 6, 8, 10, 12, 24, 41, 58–61).

Manual medicine and other regulatory techniques activate the reflex mechanisms of the ANS to correct dysfunctions in the musculoskeletal system. The significance of the ANS lies not only in pain management but also in optimizing tissue regeneration. These approaches enable athletes to recover more quickly and sustainably from injuries (16–21, 24).

3.1. The Importance of Diagnosis in Manual Medicine and Neural Therapy

Manual medicine is a medical discipline offering an integrative approach to diagnosing, treating, and preventing reversible functional disorders of the musculoskeletal system and related organs. It is based on a thorough understanding of afferent and efferent neuronal structures (1–3, 16–21).

The segmental organization of the nervous system and its integration with higher control centers (brainstem and cerebral cortex) are essential to the effectiveness of manual therapy. Ascending afferent pathways act as feedback channels to the central nervous system, enabling reflexive regulation of body functions (1–3, 16–21, 23, 24).

3.2. Neural Therapy and Segmental Treatment

A well-established method within neural therapy is segmental treatment, which is based on the complex reflex relationships between the skin, musculoskeletal system, and internal organs (7, 24). Local anesthetics are injected into specific target areas including the skin, myofascial trigger points, tendon insertions, joints, and sympathetic ganglia (4–7, 24).

Segmental therapy has proven effective not only in treating pain and associated dysfunctions but also in reducing inflammation and accelerating the healing process. In the context of sports injuries, knowledge of segmental organization provides valuable therapeutic options for treating projected symptoms (3–10, 12–15, 61–64).

These findings emphasize the relevance of precise diagnosis and individualized treatment planning in modern medicine. Combining manual medicine, neural therapy, and other regulatory procedures offers effective means of improving functional recovery after sports injuries.

3.3. Clinical Examples and Therapeutic Approaches

In cases of inflammation, reflex loops can trigger hypertonia or protective tension in the abdominal wall muscles. Acute overstrain may lead to spastic tension in spinal muscles and segmental motion restrictions (4, 7, 22–25).

An example is the change in occlusion after dental procedures, which may lead to temporomandibular joint dysfunction. This can cause symptoms such as neck pain, limited mobility, headaches, auditory disturbances, and visual impairments (1, 2, 20, 21).

In such cases, manual medical interventions and neural therapy provide effective treatment. Manual therapy can stimulate proprioceptive afferents and modulate reflex control circuits (5–7, 65–68). The activation of pain-inhibitory systems can disrupt dysregulated control mechanisms and release joint restrictions.

3.4. Sports Injuries and Immobilization

One major issue in sports injuries is immobilization, which leads to muscle weakness. Inactive muscles can trigger systemic low-grade inflammation. Impaired microcirculation, cerebral dysregulation, myofascial pain, and sarcopenia may follow (26–27, 65–69).

Musculoskeletal pain is associated with neuromuscular dysfunction and metabolic changes in the brain. Trigger points are a key source of musculoskeletal pain (26), though their exact pathogenesis is still not fully understood (26, 27, 31, 44, 52, 53).

The treatment of trigger points using manual therapy and neural therapy plays a critical role. Studies have confirmed the effectiveness of endurance exercises in improving microcirculation and pain inhibition (8, 10, 12, 23, 62–67).

4. Recommendations for Clinical Practice

The integration of manual medicine and neural therapy significantly enhances treatment efficacy (12, 23). Segmental diagnostic assessments aid in identifying specific reflex connections and therapeutic targets. Improving microcirculation is essential, as it helps reduce inflammation associated with immobilization. The application of targeted techniques, alongside endurance training, can prevent muscular atrophy and regulate neuromuscular function (62–66).

In summary, manual medicine and neural therapy represent effective strategies for managing sports injuries and overuse syndromes. These methods accelerate functional recovery and facilitate a faster return to performance for athletes.

5. This study focuses on pain assessment from a regulatory medicine perspective, emphasizing neural therapeutic and manual medical approaches

Diagnosing painful conditions of the spine and extremities requires a systematic approach, beginning with detailed analysis to precisely determine the source of pain. The diagnostic process involves the following key steps:

- **Identification of the nociceptive generator:** Locating the origin of the stimulus that triggers pain is essential for formulating appropriate treatment strategies.
- **Assessment of reflex responses:** Motor, autonomic, and psychological reflexes provide a comprehensive view of systems involved in pain.
- **Analysis of chronicity mechanisms:** Determining the level of chronicity helps identify factors that influence the duration and intensity of pain.
- **Evaluation of psychosocial factors:** Understanding the patient's psychosocial context helps assess the impact of pain on quality of life and support structures. For a comprehensive understanding of the context, see Figure 7.

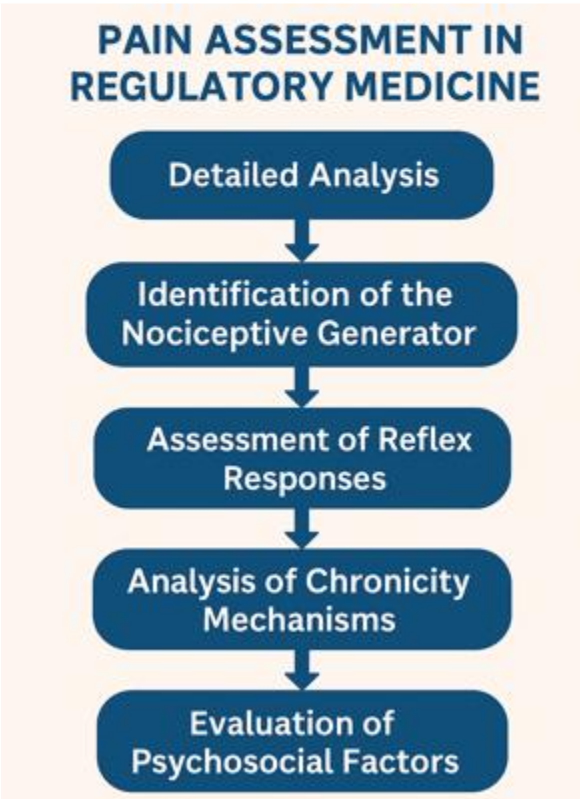

Figure 7: Diagnostic process for painful conditions of the spine and extremities from a regulatory medicine perspective, emphasizing detailed analysis, identification of the nociceptive generator, reflex assessment, chronicity evaluation, and psychosocial context.

5.1. Manual Therapy – Indications and Application Techniques

Manual therapy should be practiced in accordance with the principles of "good clinical practice." This includes a comprehensive medical history, neurological evaluation via clinical and functional tests, imaging studies when needed, and other diagnostics. Additionally, psychosocial context analysis and the development of an individualized treatment plan are necessary (16–21).

5.1.1. Core Techniques in Manual Medicine Include:

• **Massage therapy:** Enhances circulation and reduces pain by lowering muscle tension.

• **Spinal and joint traction:** Axial and vibrating traction techniques relieve joint pressure by widening joint spaces.

• **Joint mobilization and manipulation:** Aims to increase range of motion and alleviate pain.

• **Myofascial release and visceral techniques:** Reduces muscle tension through post-isometric relaxation and optimizes fascia and organ function.

• **Stretching and counter-resistance techniques:** Improve biomechanical balance in the musculoskeletal system. For a comprehensive understanding of the context, see Figure 8.

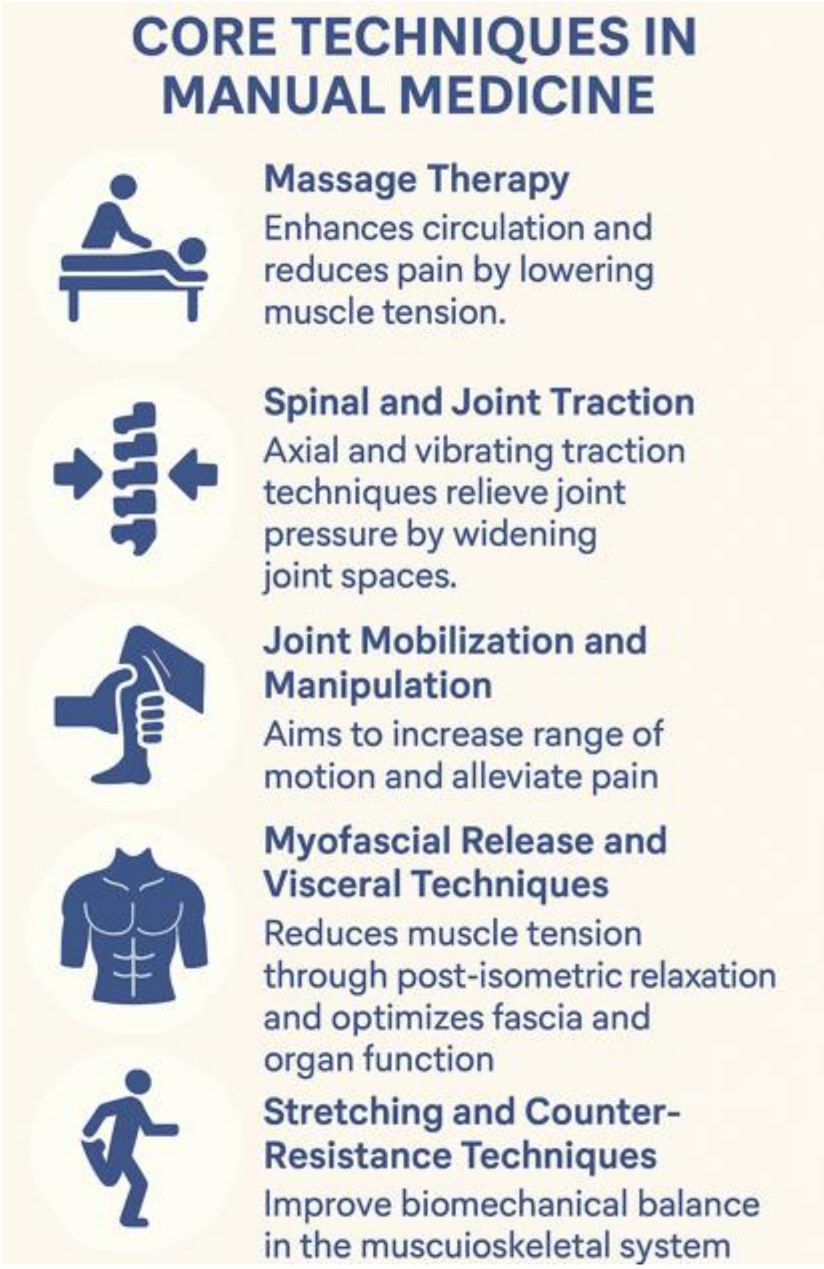

Figure 8: Overview of the principal manual medicine techniques, including massage therapy, spinal and joint traction, mobilization and manipulation, myofascial and visceral techniques, and stretching with counter-resistance, illustrating their roles in improving circulation, flexibility, and biomechanical balance.

Note: When combined within a regulatory medical framework, these methods offer sustainable treatment for functional disorders and positively influence pain modulation.

5.2. Neural Therapy: Scientific Foundations and Effective Application

Neural therapy is an effective method used within a multidisciplinary framework for sports health, inflammation regulation, and pain management (1, 2, 24, 60–67). It involves applying low-concentration local anesthetics to regulate the autonomic nervous system. This approach addresses tissue hypoxia, modulates inflammatory responses, and alleviates pain.

5.2.1. Circulatory Regulation and Anti-inflammatory Effects

One of the key mechanisms of neural therapy is the enhancement of tissue perfusion, which alleviates hypoxia and inflammatory responses. By modulating the sympathetic nervous system, a balance between pro-inflammatory and anti-inflammatory processes is achieved. This not only promotes tissue healing but also plays a vital role in pain reduction. Neural therapy has shown particular efficacy in the early phases of inflammation and contributes to long-term improvement in patient quality of life (72–74).

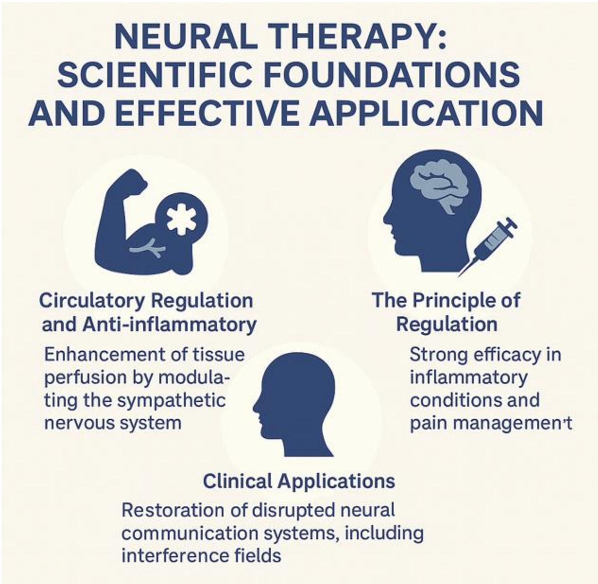

Figure 9: Summary of neural therapy's mechanisms and clinical effects, illustrating circulatory regulation and anti-inflammatory balance, restoration of disrupted neural communication through the regulation principle, and its effective application in pain management and inflammation control.

5.2.2. The Principle of Regulation

The core concept of neural therapy is restoring disrupted neural communication systems. Interference fields such as surgical scars, dental procedures, C-sections, or episiotomy scars are treated through the targeted injection of local anesthetics. This alleviates their adverse influence on the autonomic nervous system. By rebalancing afferent and efferent nerve pathways, circulation and tissue perfusion are normalized (1, 2, 24, 60–67, 74–77). For a comprehensive understanding of the context, see Figure 9.

5.2.3. Clinical Applications

Neural therapy has demonstrated strong efficacy in both acute and chronic inflammatory conditions as well as pain management. Local, segmental, and extended segmental approaches enhance wound healing and correct dysfunctions in the musculoskeletal system. Especially in sports injury rehabilitation, the combination of neural therapy and manual medicine has been associated with accelerated recovery and improved functionality in patients (1–3, 16, 21, 24, 66, 67)

6. Scientific Evidence and Clinical Effectiveness

The effectiveness of neural therapy is supported by scientific mechanisms such as the regulation of inflammatory processes, inhibition of nociceptive nerves, and the improvement of microcirculation (3–13, 23, 24, 62–68). Research has shown that local anesthetics not only provide temporary pain relief but can also lead to long-term adaptations in the nervous system, contributing to sustained improvements (24).

Clinical Recommendations

- **Treatment of interference fields:** Surgical scars, dental interventions, and areas affected by trauma should be regularly assessed and treated with neural therapy (3–13, 62–65).
- **Enhancement of blood flow:** Improved microcirculation is essential for inflammation control and tissue regeneration (74–77).
- **Multidisciplinary approach:** Neural therapy and manual medicine should be integrated with conventional medical and surgical treatments (1–5, 24, 75–77).
- **Early intervention:** Particularly in sports injuries, early application of neural therapy can control inflammation and accelerate the healing process.

The combination of neural therapy and manual medicine creates a powerful synergy for pain management, inflammation regulation, and overall health support. A multidisciplinary approach facilitates faster recovery, preserves athletic performance, and enhances the quality of life for affected individuals.

7. Importance of a Healthy Diet

A healthy diet plays a crucial role in the integration of neural therapy and manual medicine. In the context of sports and rehabilitation, adequate protein intake is essential for the regeneration of muscles and tendons. This process enhances protein synthesis, strengthens muscular force and function, supports athletic performance, and reduces the risk of metabolic diseases (71). An effective plan for rehabilitation and nutrition is vital to ensure optimal recovery following injury.

8. Sports, Rehabilitation, and Nutrition (Protein Intake)

- **Sports and rehabilitation activities** promote the regeneration and functional recovery of muscles and tendons (71).
- **Adequate protein intake** plays a decisive role in the repair and rebuilding of muscle and connective tissue (71).

A well-coordinated interaction between rehabilitation, nutrition, and targeted therapeutic approaches is essential for successful recovery and the promotion of general health (see Tables 2–5: Muscle and Connective Tissue Reconstruction, Effects on Muscles and Tissues, Functional Improvements, and Athletic Performance and Metabolic Health).

Type of Synthesis	Description
Myofibrillar Protein Synthesis:	• The production of structures responsible for muscle contraction is increased.
Sarcoplasmic Protein Synthesis:	• The synthesis of supportive protein structures within muscle cells is promoted.
Mitochondrial Protein Synthesis:	• The capacity of mitochondria, which support energy production, is enhanced.
Collagen Synthesis:	• The regeneration of connective tissue, which plays a central role in the structure of muscles and tendons, is facilitated.

Table 2: Mechanisms of Protein Synthesis and Collagen Formation in the Context of Muscle and Connective Tissue Reconstruction

Parameter	Description
Muscle Mass:	• Protein synthesis contributes to the increase in muscle mass.
Oxidative Capacity:	• The production of mitochondrial proteins enhances the muscle’s capacity for energy production.
Muscular Connective Tissue:	• Collagen synthesis strengthens the resilience of connective tissue.
Tendon Health:	• Collagen production supports the repair and strengthening of tendons.

Table 3: Positive Effects of Protein Synthesis and Collagen Formation on Muscle Structure, Energy Production, and Tendon Health

Parameter	Description
Muscle Strength:	• The increase in muscle mass and oxidative capacity enhances muscle strength.
Muscle Function:	• The resilience and elasticity of muscles and tendons are improved.
Activity Level:	• Improvements in muscle function lead to an increase in overall activity levels.

Table 4: Functional Effects of Muscle and Tissue Regeneration Processes

Parameter	Description
Athletic Performance:	• Increased muscle strength and function directly support athletic performance.
Reduction of Metabolic Risks:	• A higher activity level reduces the risk of metabolic disorders such as diabetes and obesity.

Table 5: Influence of Muscle Strength and Activity Level on Athletic Performance and Metabolic Health

9. Nutritional Strategies for the Prevention of Stress Fractures

An adequate intake of calcium and vitamin D plays a central role in bone mineralization (78–81). Randomized controlled trials involving female military recruits demonstrated that a daily supplementation of 1000 mg calcium and 800 IU of vitamin D can reduce the incidence of stress fractures by up to 20%. Cohort studies in athletic populations support these findings and indicate that a diet rich in calcium and vitamin D is associated with a reduced risk of stress fractures in the lower extremities (71, 78–81).

10. Effectiveness of Neural Therapy in Acute Sports Injuries: Analysis of 164 Cases

Summary:

This retrospective study investigates the effectiveness of Neural Therapy (NT) in the treatment of acute sports injuries in a cohort of 164 patients aged between 15 and 38 years. The aim was to evaluate clinical changes following the application of neural therapy and to analyze the time required to resume training activities.

Introduction:

Sports injuries represent a frequent challenge for both athletes and therapists. Rapid and effective recovery is essential for restoring athletic performance. Neural therapy, a regulatory approach targeting the autonomic nervous system, presents a promising therapeutic option in this context.

10.1. Materials and Methods:

• **Participants:** 164 patients (92 male, 72 female)
• **Age range:** 15–38 years (mean age: 26.4 years)
• **Most common injury types:** muscle strains (40%), ligament sprains (35%), contusions (15%), and tendon irritations (10%), as illustrated in Figures 1 and 4.
• **Interventions:** Neural therapy injections, segmental therapy, and trigger point therapy
• **Observation period:** 3 months
• **Evaluation criteria:**
o Pain reduction (measured via Visual Analogue Scale, VAS)
o Range of motion
o Inflammatory markers (CRP, IL-6, TNF-α)
o Muscle strength assessment
o Psychometric parameters (levels of stress and anxiety)
o Recurrence rate

Additional evaluation criteria:

• **Inflammatory markers:** CRP, IL-6, TNF-α levels were monitored throughout the course of therapy.
• **Muscle strength assessment:** Comparison between the injured and non-injured limb.
• **Psychometric parameters:** Assessment of stress and anxiety levels.
• **Recurrence rate:** Recorded at 3, 6, and 12 months post-treatment.
• **Body weight analysis:** Evaluation of the influence of body weight on the recovery process.

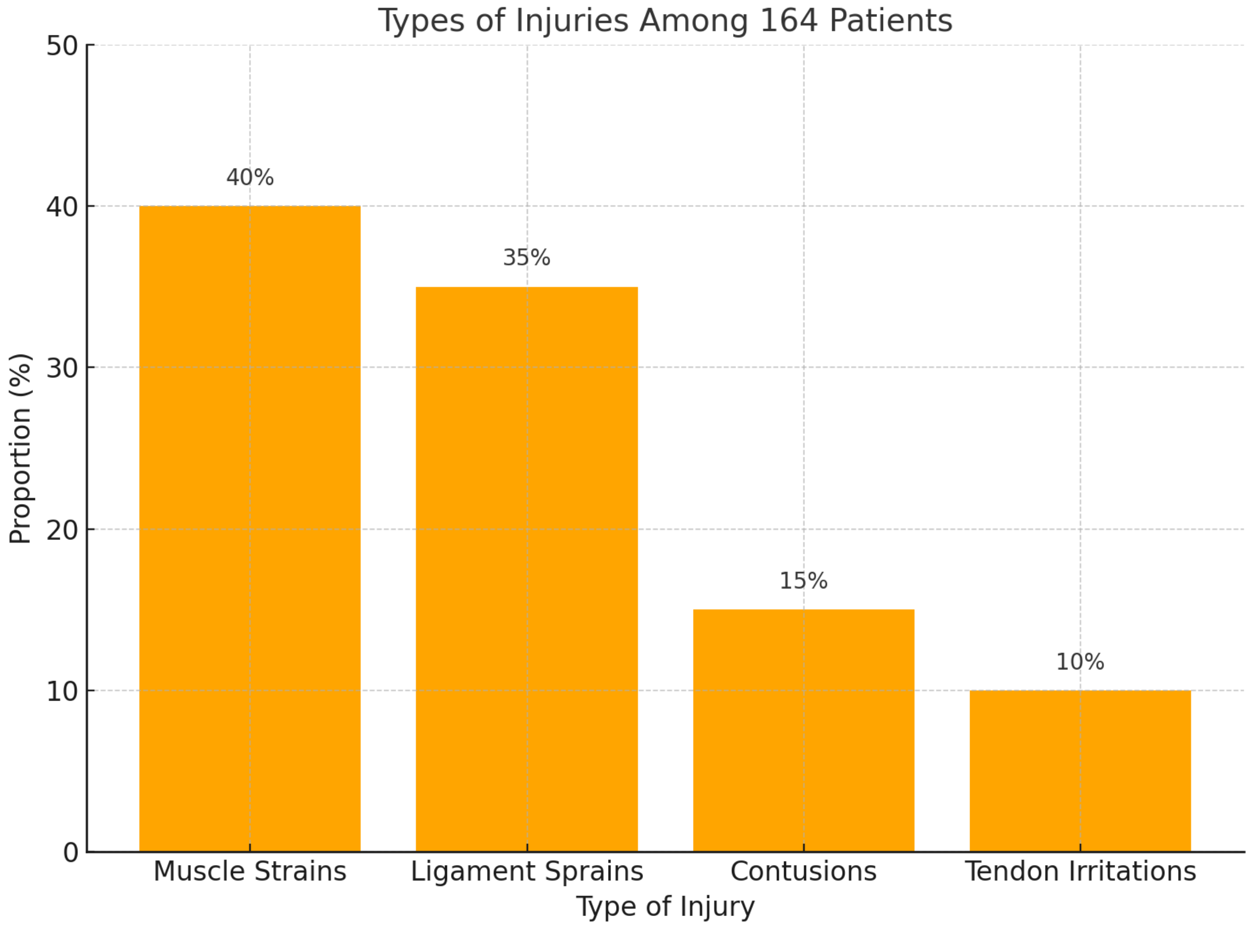

Figure 1: Distribution of injury types among 164 patients with acute sports injuries. Muscle strains were the most common (40%), followed by ligament sprains (35%), contusions (15%), and tendon irritations (10%).

10.2. Results:

• **Pain Reduction (VAS Scale, 0–10):**

o *Before therapy*: 7.8 ± 1.2

o *After 3 sessions of neural therapy:* 2.1 ± 1.0 ($p < 0.001$) (see Figure 2).

• **Range of Motion:**

o 72% of patients demonstrated a significant improvement in mobility after the second treatment session.

• **Inflammatory Markers:**

o At baseline, CRP, IL-6, and TNF-α levels were elevated in many patients. After 2–3 sessions of neural therapy, these markers normalized significantly.

• **Muscle Strength Assessment:**

o An initial reduction in muscle strength in the injured limb was observed; strength returned to normal levels following 2–3 treatments.

• **Psychometric Parameters:**

o Levels of stress and anxiety were markedly reduced after neural therapy.

• **Return to Sport (RTS):**

o 88% of patients were able to resume training within an average of 10.2 ± 2.8 days.

• **Recurrence Rate:**

o Prior to therapy, many athletes reported recurrent injuries. During follow-up at 3, 6, and 12 months, no new injuries occurred in over 90% of the cases.

• **Side Effects:**

o No severe side effects were reported. Only 5% of patients experienced mild local irritation.

• **Body Weight:**

o The distribution of body weight showed no significant deviation. Approximately 10% of patients experienced moderate weight gain.

o Body weight did not exhibit any observable influence on the duration of healing or therapy outcomes.

10.3. Figures and Graphs:

Pain progression on the VAS scale before and after neural therapy.

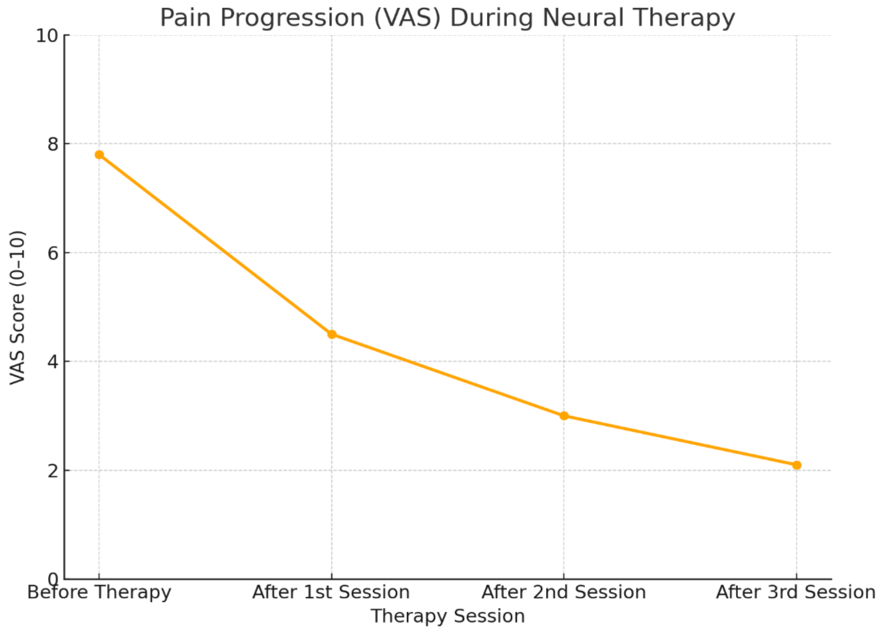

Figure 2: Significant reduction in pain intensity (VAS score) over the course of neural therapy in patients with acute sports injuries.

Figure 2 illustrates the progression of pain intensity, measured using the Visual Analogue Scale (VAS, 0–10), during the course of neural therapy.

At baseline, the mean pain score was approximately 7.8 points, indicating a high level of subjective pain burden among the patients.

Following just the first session of neural therapy, a marked reduction in pain intensity to approximately 4.5 points was observed. This early improvement suggests a rapid therapeutic effect of the intervention. As treatment progressed, a continued and gradual decline in pain was documented: after the second session, the average VAS score had decreased to around 3.0.

After the third therapy session, pain scores further decreased to approximately 2.1 points. This demonstrates a sustained and clinically relevant improvement in pain symptoms throughout the treatment period.

These findings highlight the high effectiveness of neural therapy in reducing chronic pain and show that even a limited number of sessions can lead to significant symptom relief. The results underscore the potential of neural therapy as a powerful interventional approach in the management of pain.

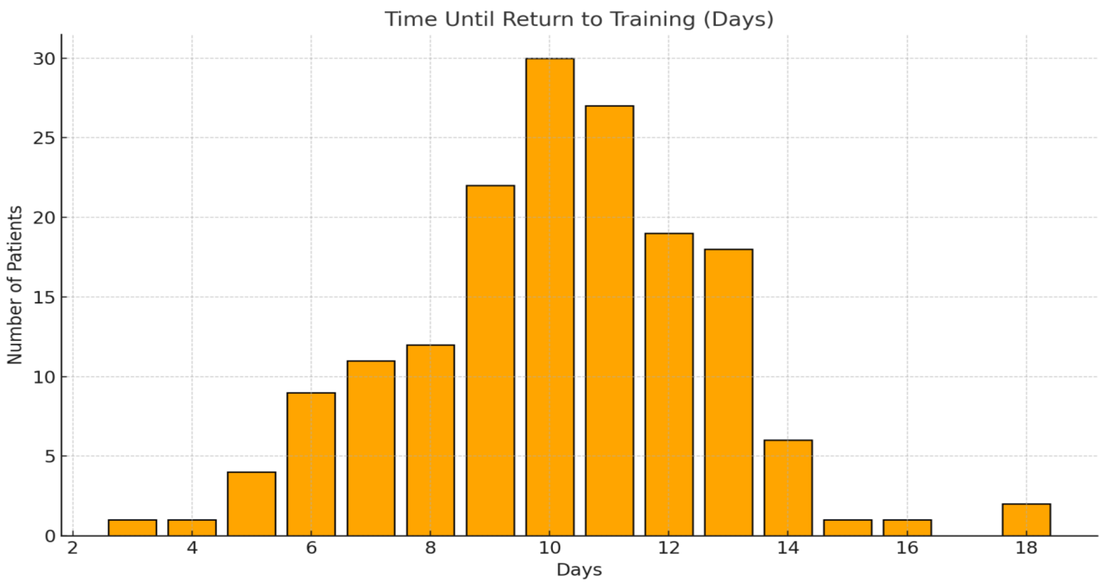

Figure 3: Distribution of the number of days until return to training following neural therapy in patients with acute sports injuries (n = 164). Most patients resumed training between days 9 and 12, with a peak at day 10. This distribution reflects the generally rapid recovery time associated with neural therapy interventions.

Figure 3 illustrates the distribution of patients according to the number of days required to resume training following the completion of neural therapy. The x-axis represents the number of days, while the y-axis shows the number of patients.

It can be observed from Figure 3 that the majority of patients resumed training between days 9 and 12. The peak of the distribution is around day 10, during which more than 30 patients returned to physical activity. Following this peak, the frequency gradually decreases. From day 14 onwards, the number of patients who delayed training resumption drops significantly.

This distribution suggests that most treated individuals were able to resume physical activity within a relatively short period after therapy, indicating a rapid functional recovery. Exceptionally long recovery times exceeding 15 days were required only in rare cases.

Overall, the analysis indicates a favorable prognosis regarding physical performance following completion of neural therapy.

The distribution of body weight among the 164 patients is depicted in Figure 5. Most patients weighed between 70 and 75 kg, followed by the 65–70 kg and 75–80 kg groups. The most represented weight range was 70–75 kg, comprising more than 40 patients, while the extreme ranges (e.g., <60 kg or >90 kg) included only a few individuals each.

In total, the distribution demonstrates a moderate spread around the mean, with the majority of patients falling between 60 and 85 kg.

Despite these differences, statistical analysis did not reveal any significant correlation between body weight and therapy outcomes. This indicates that body weight had no relevant impact on the therapeutic result. These findings support the effectiveness of neural therapy across different weight categories and reinforce the hypothesis that other factors—such as autonomic dysregulation or chronic pain mechanisms—play a far more central role in treatment outcomes than body weight alone.

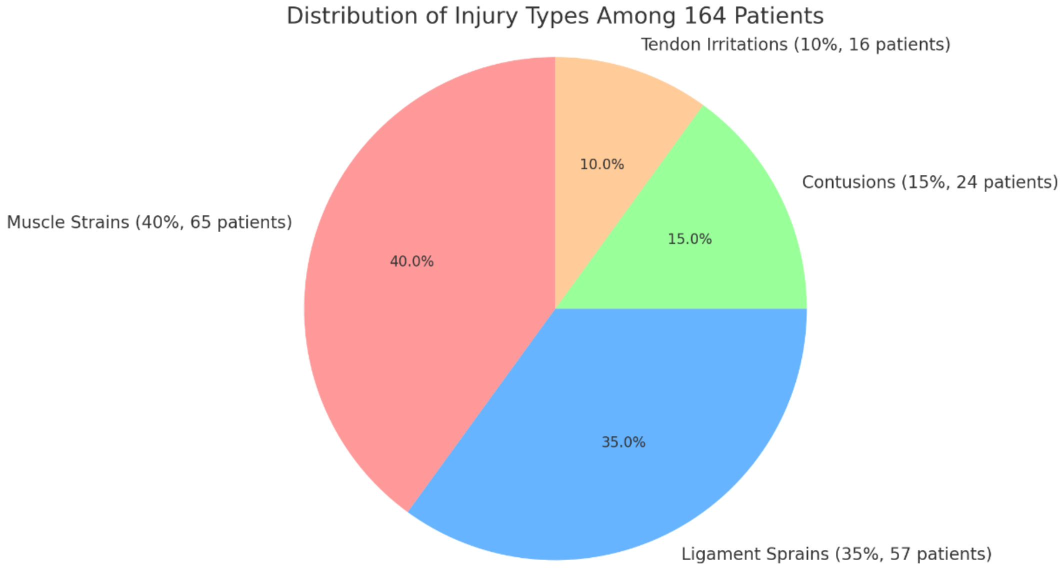

Figure 4: Pie chart illustrating the distribution of injury types among 164 physically active patients with acute sports injuries. Muscle strains were the most common (40%, 65 patients), followed by ligament sprains (35%, 57 patients), contusions (15%, 24 patients), and tendon irritations (10%, 16 patients).

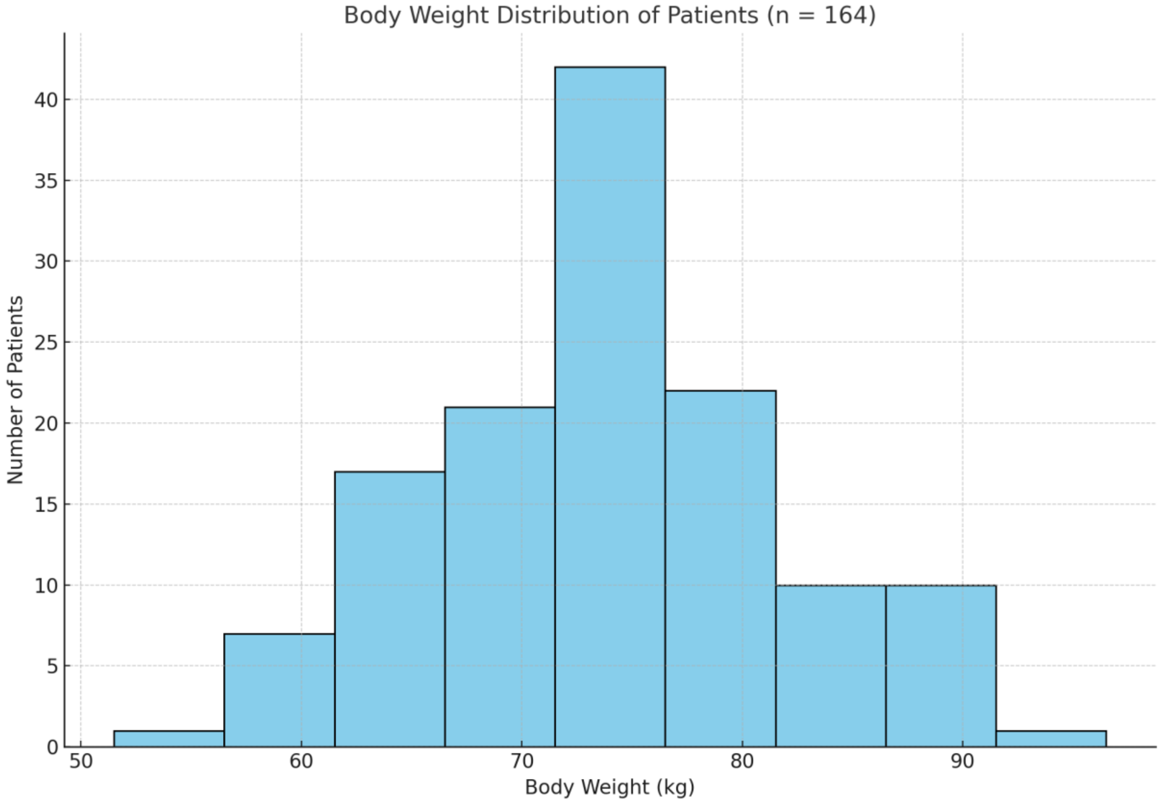

Figure 5: Distribution of body weight among 164 patients. The majority of patients weighed between 70 and 75 kg, followed by the 65–70 kg and 75–80 kg categories. Only a small number of patients fell into the extreme weight ranges (e.g., <60 kg or >90 kg). Statistical analysis revealed no significant correlation between body weight and therapeutic outcome, indicating that body weight had no relevant impact on treatment success

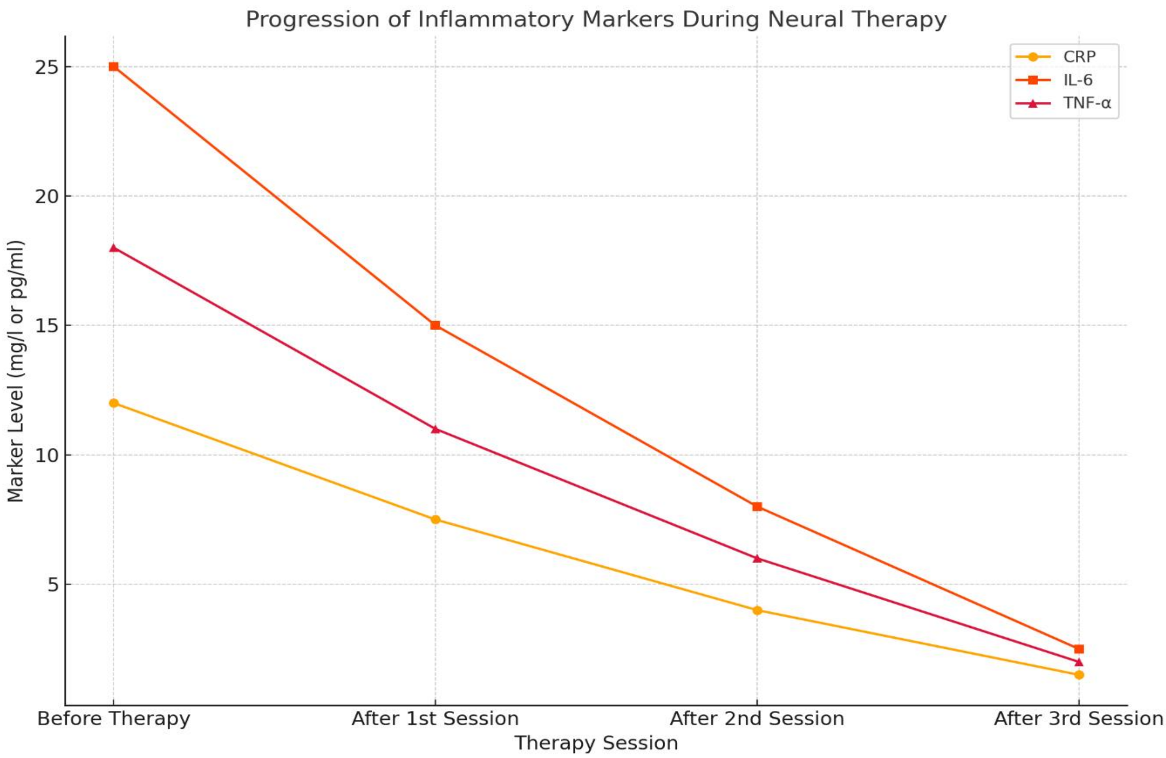

Figure 6: Progression of inflammatory markers (CRP, IL-6, TNF-α) in patients with acute sports injuries during neural therapy. A significant reduction in inflammatory values is observed after the first session, with normalization into the physiological range by the third session. This rapid decline in inflammatory markers highlights the regulatory effects of neural therapy on the immune system and microcirculation.

Figure 6 illustrates the progression of three key inflammatory markers—C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor alpha (TNF-α)—during the course of neural therapy.

Marker levels were measured at baseline and after the first, second, and third therapy sessions.

At the beginning of treatment, all three inflammatory parameters were significantly elevated beyond physiological reference ranges:
• CRP was approximately 12 mg/l,
• IL-6 measured around 25 pg/ml,
• TNF-α was approximately 18 pg/ml.

Following the first therapy session, a substantial reduction in all markers was observed:
• CRP decreased to about 7 mg/l,
• IL-6 to approximately 15 pg/ml,
• TNF-α to around 11 pg/ml.

This downward trend continued over subsequent sessions. After the second session, further reductions were recorded.

By the third session, marker levels had nearly normalized:
• CRP was around 3 mg/l,
• IL-6 approximately 2.5 pg/ml,
• TNF-α about 2 pg/ml.

These findings demonstrate that neural therapy can not only lead to an improvement in clinical symptoms but also result in objectively measurable reductions in systemic inflammation.

Notably, the synchronized decline across all three markers suggests a consistent anti-inflammatory effect of the therapy.

Please refer to Figure 7, which depicts the development of muscle strength during neural therapy.

A significant improvement in muscle strength was already evident after the first session. By the third session, patients had nearly regained the baseline strength of the healthy limb. This underscores the regulatory influence of neural therapy on muscular function and highlights its role in facilitating rapid recovery of physical performance.

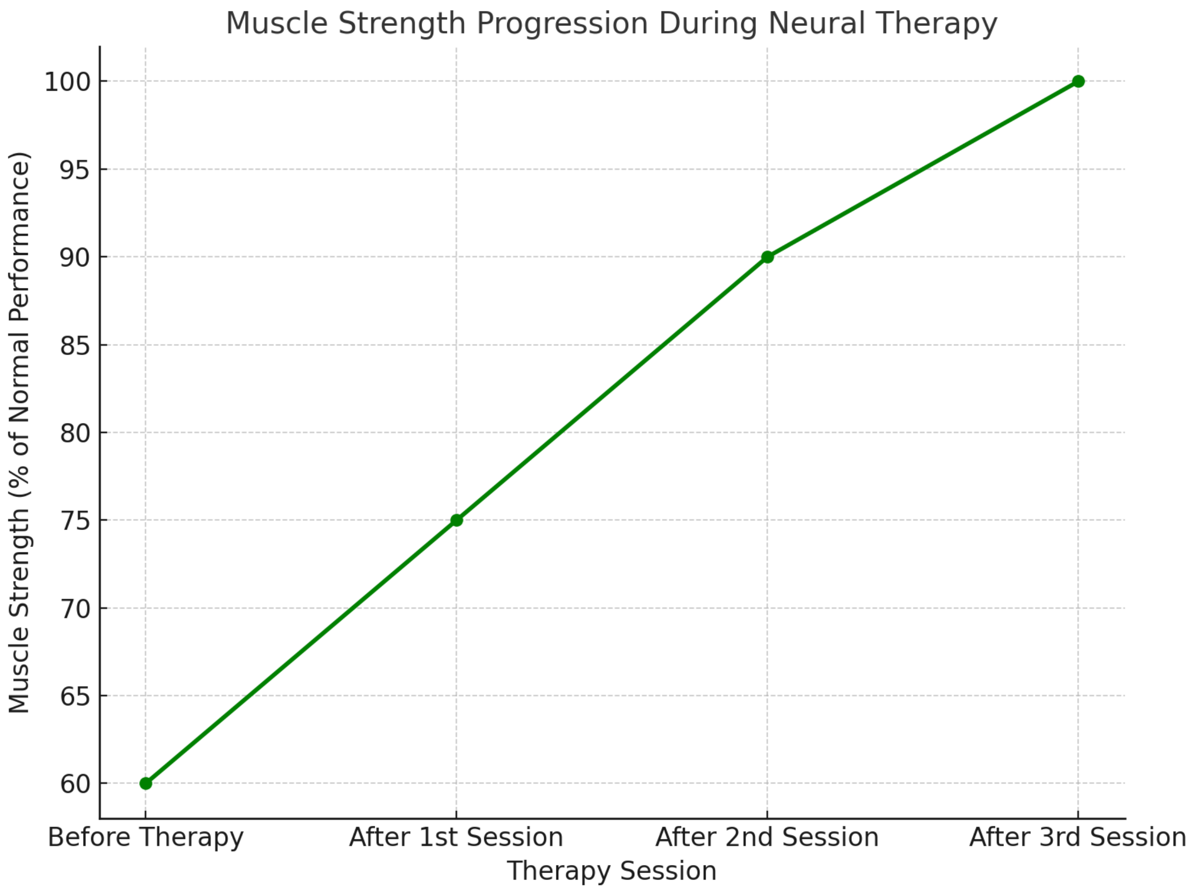

Figure 7: Development of muscle strength during neural therapy in patients with acute sports injuries. A marked increase in muscle strength was observed after the first therapy session. By the third session, patients had regained nearly 100% of the strength of the unaffected limb, indicating rapid restoration of physical function and the regulatory effect of neural therapy on muscular performance.

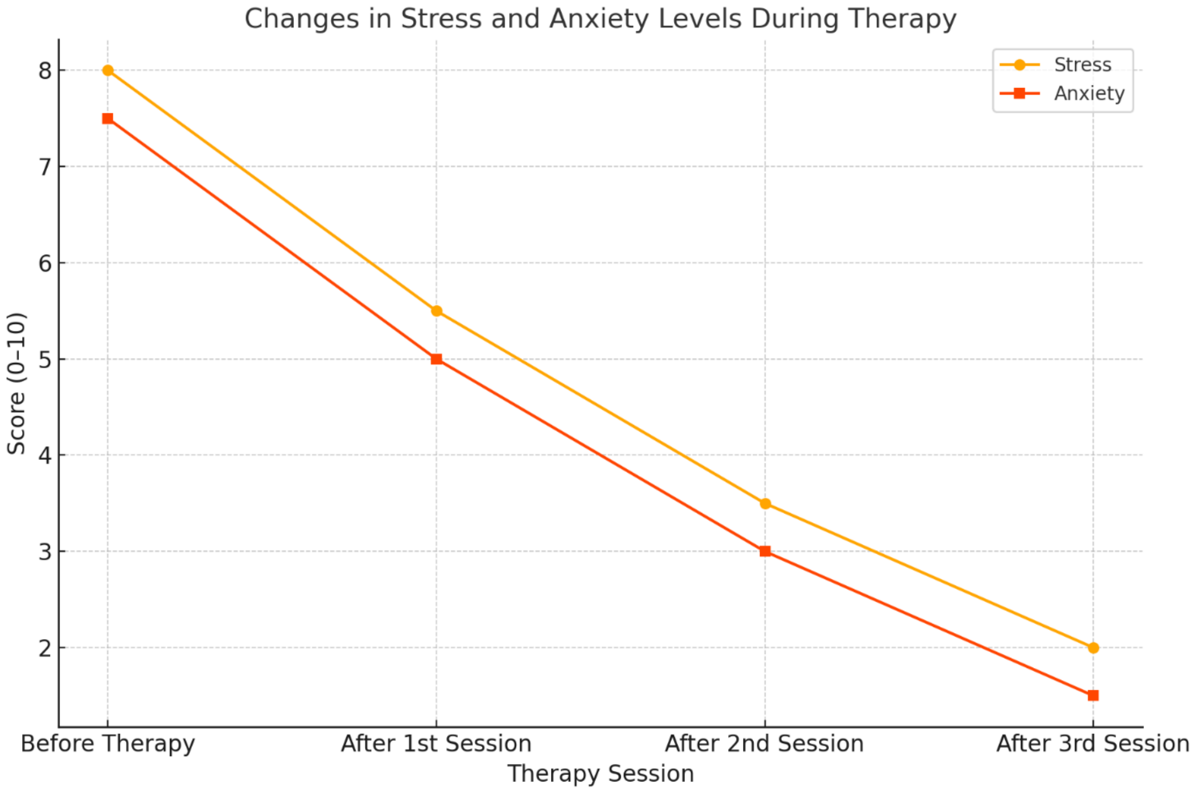

Figure 8: Progression of stress and anxiety scores during therapy. Both stress and anxiety levels decreased significantly after each session of neural therapy. Starting from high baseline values (stress: 8.0, anxiety: 7.5), the scores showed a continuous decline, reaching low levels by the third session (stress: 2.0, anxiety: 1.5). These findings reflect the regulatory impact of neural therapy on emotional and psychological well-being.

Figure 8 illustrates the progression of stress and anxiety scores (scale 0–10) during the therapeutic intervention.
At the beginning of therapy, the average stress score was 8.0, and the average anxiety score was 7.5.

A significant reduction in both parameters was already observable after the first session. The stress score decreased to 5.5, and the anxiety score dropped to 5.0.

This trend continued with further therapy. After the second session, the stress level declined to 3.5, and the anxiety level to 3.0. By the third session, additional improvements were recorded, with a mean stress score of 2.0 and a mean anxiety score of 1.5.

These trajectories clearly demonstrate that the therapeutic intervention effectively and sustainably reduced both stress and anxiety. Notably, the reductions occurred in a parallel and continuous manner, with stress levels consistently remaining slightly above anxiety levels.

This pattern indicates a consistent reduction of psychological burden throughout therapy and underscores the positive impact of the intervention on patients' emotional regulation.

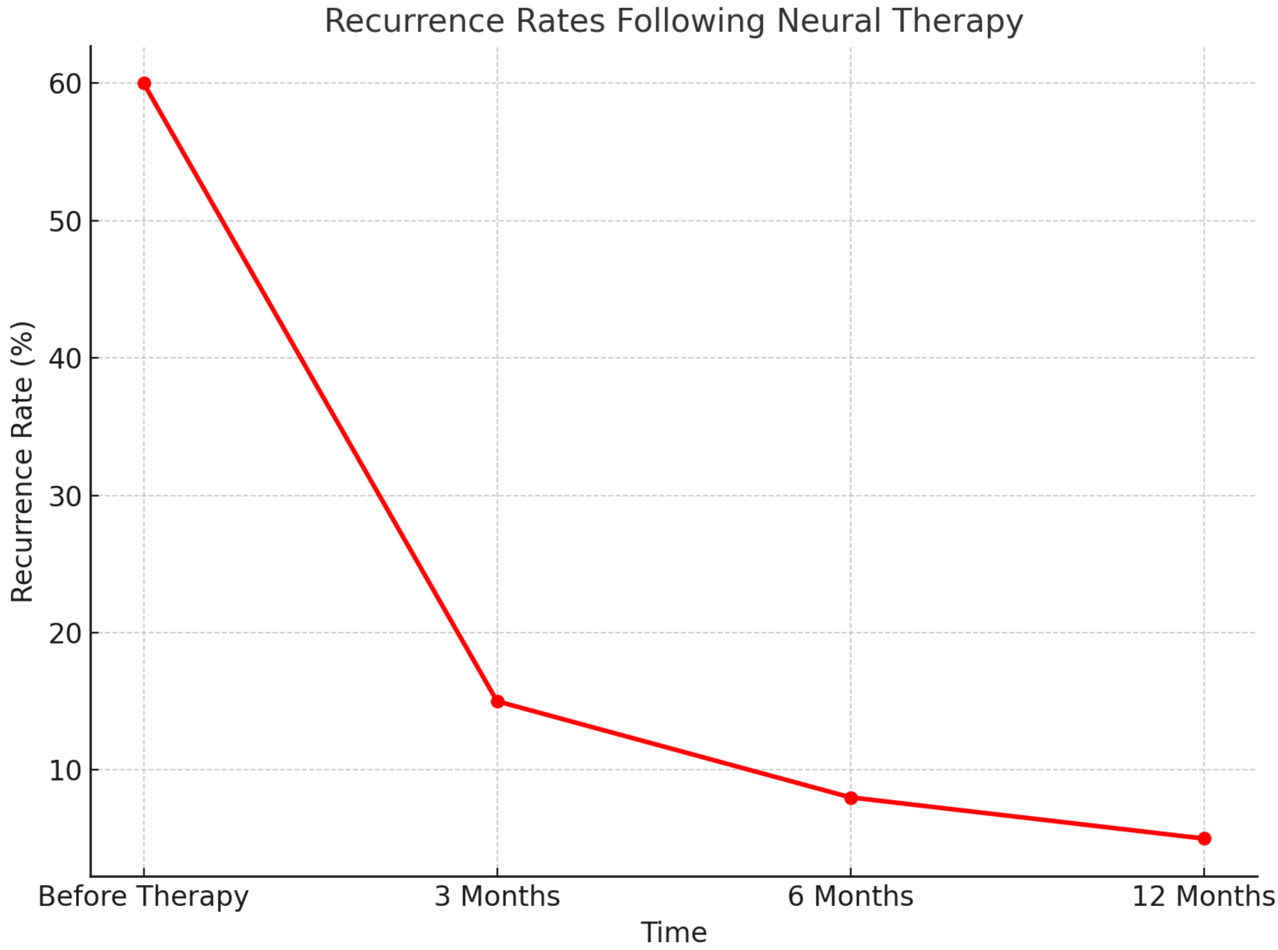

Figure 9: Recurrence rates over time following neural therapy. Prior to therapy, the recurrence rate was 60%. This dropped significantly to 15% after 3 months, further decreased to 8% at 6 months, and reached 5% after 12 months. These results highlight the long-term effectiveness of neural therapy in reducing the recurrence of injuries.

Figure 9 illustrates the change in recurrence rate (%) over time following the administration of neural therapy. Before the initiation of therapy, the recurrence rate was approximately 60%, indicating a high frequency of relapses or recurring symptoms.

As shown in Figure 9, a marked decline in recurrence was already evident three months after the completion of neural therapy, dropping to around 15%. This early and substantial reduction suggests a prompt therapeutic effect. The positive trend continued over the following months: by six months, the recurrence rate further decreased to approximately 8%, indicating a sustained stabilization of therapeutic success.

After twelve months, the recurrence rate had declined to just about 5%. This remarkable reduction highlights the long-term efficacy of neural therapy and confirms that the majority of patients benefited from a durable therapeutic outcome. Particularly noteworthy is the fact that the decrease in recurrence rates began early and remained stable over time.

The presented findings emphasize the significance of neural therapy as an effective intervention for the long-term reduction of relapses and for the stabilization of clinical outcomes.

des Gesundheitszustandes über einen Zeitraum von mindestens einem Jahr.

11. Discussion

The findings of this study underscore the central role of improved microcirculation in the healing of sports injuries. Optimal blood flow is essential for the efficient removal of inflammatory mediators, the promotion of cellular metabolism, and the acceleration of tissue regeneration. Numerous studies confirm that targeted regulation of microcirculation has a decisive impact on both the speed and quality of recovery (1–8, 10–16, 22–25, 62–68).

The close interconnection between microcirculation and the autonomic nervous system (ANS) plays a key role in this process. Disturbances in autonomic balance—particularly persistent sympathetic overactivity—can significantly impair healing mechanisms. Neural therapy addresses precisely this aspect: through the targeted injection of local anesthetics such as procaine, imbalances in the ANS are modulated, local circulation is improved, and inflammatory responses are controlled. This provides a crucial foundation for accelerated regeneration (3–8, 74–77, 85, 86).

Moreover, neural therapy offers an effective strategy in combating persistent inflammation and pain, which are major barriers to the early resumption of training. The present study demonstrates that with the early application of neural therapeutic techniques, patients were often able to resume moderate training as early as the following day. This finding highlights the high therapeutic potential of neural therapy in sports medicine (3–7, 10–16, 62–68, 74–77, 83–84).

In addition to neural therapy, the integration of manual medicine into the treatment concept is of critical importance. Mechanical dysfunctions—such as joint blockages, restrictions in movement, or myofascial trigger points—can be both causes and consequences of injury. Manual medicine enables the precise diagnosis and effective treatment of these disorders. Particularly noteworthy is the synergistic effect of combining neural therapy with manual techniques: while neural therapy regulates autonomic and inflammatory processes, manual medicine restores biomechanical function (2, 3, 24, 82–84, 87, 88).

Recent studies have shown that this combined approach not only shortens the healing process but also improves the athletes' functional capacity in the long term. Especially in the case of mechanical blockages (e.g., in the sacroiliac joint or upper cervical spine), the combination of both methods has proven to be highly effective (2–4, 24, 88–91).

In summary, a regulation-based therapeutic approach that integrates both neural therapy and manual medicine can establish new standards in the preventive and therapeutic management of sports injuries. Enhancing microcirculation, modulating the autonomic nervous system, and correcting mechanical dysfunctions all contribute significantly to expediting athletes' return to training and ensuring their long-term performance capacity (24, 58–59, 62–68, 89–91). Further multicenter studies will be necessary to substantiate these promising results and to develop standardized treatment protocols.

12. Conclusion

A multidisciplinary approach is essential for the holistic and effective treatment of sports injuries and for promoting the overall health of athletes. The combination of neural therapy and manual medicine not only provides significant relief from pain and inflammation but also contributes to the acceleration of the healing process. Early identification of triggering factors and targeted interventions not only enhance athletic performance but also significantly reduce the risk of recurrent injuries.

Neural therapy holds a special place in the treatment of sports injuries due to its regulatory effects on the autonomic nervous system. It promotes the restoration of physiological balance, suppresses inflammatory processes, and addresses functional disturbances. Manual medicine, on the other hand, focuses on the biomechanical optimization of the musculoskeletal system, resulting in improved mobility, pain reduction, and faster recovery.

These two therapeutic approaches complement each other ideally and offer an effective strategy to facilitate a quicker return to competition. The application of neural therapy and manual medicine reduces strain on the musculoskeletal system, minimizes the risk of injury, and stabilizes physiological functions in the long term. By restoring segmental function and optimizing body balance, both athletic performance and overall health can be sustainably improved.

In addition to their direct effects on injury recovery, these methods also help compensate for metabolic imbalances caused by inflammation. This not only promotes healing but also contributes to the long-term maintenance of athletes' health. Scientific evidence supports that a multidisciplinary approach to sports health significantly shortens recovery times and enhances the effectiveness of preventive strategies. Finally, the systematic use of neural therapy and manual medicine in sports medicine represents an innovative and cost-effective approach. The combination of these methods enables not only efficient treatment but also long-term prevention of sports injuries. Therefore, further promotion of large-scale, multicenter studies investigating the efficacy of these approaches is of great importance to advance evidence-based standards in sports medicine.

Conflict of Interest Statement:
Nazlikul,H., Ural Nazlikul, F.G., Acarkan, T., Özkan, N., Tamam, Y., Orak, M., Türk, A., and M. D. Bilgin declare that they have no conflicts of interest related to the content of this publication. The authors further declare that there are no financial or personal relationships that could inappropriately influence the work reported in this paper.

Ethical Statement:
No new studies involving humans or animals were conducted by the authors in the preparation of this article.

All studies cited within the manuscript were performed in accordance with the ethical standards and guidelines stated in their respective sources.

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Author Contributions
Prof. Dr. Dr. H. Nazlikul and Prof. Dr. F. G. Ural Nazlikul contributed equally to the conception, development, and critical elaboration of this article on acute sports injuries.

Both authors are specialists in Physical and Rehabilitative Medicine (PRM) and hold additional qualifications in Neural Therapy, Manual Medicine, and other integrative therapeutic approaches.

Prof. Dr. Dr. H. Nazlikul is additionally specialized in the fields of Biophysics, Algology (Pain Medicine), and Sports Medicine, both scientifically and clinically.

His contributions were essential in linking the biophysical, neuroregulatory, and clinical aspects of acute injury management.

His integrative perspective significantly enhanced the scientific depth of the article—particularly with regard to microcirculation, autonomic regulation, and tissue regeneration.

Both main authors coordinated the retrospective analysis of clinical data obtained from five outpatient centers, primarily from the Nazlikul Clinic and its partner institutions.

Their structured case documentation and systematic evaluation form the clinical foundation of the manuscript.

Dr. Tijen Acarkan, PhD, specialist in Pathophysiology and trained Neural Therapist and Manual Medicine practitioner, was responsible for the literature review concerning the role of Neural Therapy and Manual Medicine in understanding the pathophysiology of acute injuries.

Dr. N. Özkan and Dr. PhD. T. Acarkan participated under the coordination of the main authors in patient interviews, data collection, and documentation of results.

Dr. Ayşen Türk, as a specialist in Sports Medicine, contributed her expertise particularly in developing sections concerning classical treatment protocols for acute sports injuries and manual medicine-oriented therapeutic approaches.

Prof. Dr. Y. Tamam made valuable contributions to the literature research and analysis of neurophysiological mechanisms related to trauma adaptation.

As a neurologist, he contributed to the integration of classical medical diagnostic and therapeutic concepts with Neural Therapy.

Prof. Dr. M. D. Bilgin, senior author and Chair of the Department of Biophysics, played a major role in the conceptual structuring, scientific elaboration, and final critical revision of the manuscript.

His expertise enabled a profound understanding of the biophysical and neurophysiological processes underlying musculoskeletal trauma and its regeneration.

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