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Review Article

A Novel and Noninvasive Procedure in Diagnosing and Treating Sports-Related Musculoskeletal Injuries: The Safety and Efficacy of Manual Tissue Direction Test (MTDT)

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Abstract

Athletes-professional, amateur, and "weekend warriors"-strive to perform at their highest potential and to treat injuries to keep them in the game or recover more quickly to return to the game. In this observational study, specially trained medical personnel assessed and treated injured athletes at the 2016 United States Gaelic Athletic Association Finals (held in Seattle, Washington USA) and the 2016 Emerald City Classic Volleyball Tournament (held at the University of Washington, Seattle, Washington, USA). In addition to conventional assessment and treatment methods, the medical specialists employed manual tissue direction test (MTDT) to augment diagnosis and treatment. MTDT proved to be a noninvasive and valuable assessment tool used prior to the application of Kinesio tape®, an elastic therapeutic tape. MTDT was shown that it could be added as an assessment tool not only with Kinesio Tape® but also with other modalities that alter tissue movement to enhance treatment outcome.

Keywords: *Gate Control Theory; Manual Tissue Direction Test, Kinesio®, Resolvin D1, Sports Injuries*

Abbreviations

CITI: Collaborative Institutional Training Initiative; IRB: Institutional Review Board; MTDT: Manual Tissue Direction Test; NRS: Numerical Rating Scale; ROM: Range of Motion; RvD1: Resolvin D1; TGM: Tissue Glide Movement: VAS: Visual Analogue Scale

Introduction

Manual Tissue Direction Test (MTDT) was developed by Dr. Masahiro Takakura of Seattle, Washington USA to determine the direction and pressure of skin variance to alter pain perception in injured athletes. The technique originated from Kinesio Taping®, which is a method to apply Kinesio® tape (Figure 1), a therapeutic elastic tape, to emulate a practitioner's hand and manual pressure and direction. Kinesio® tape harnesses the ability of the tape to recoil; the recoil is elicited when the tape is elongated longitudinally. Kinesio® tape is typically applied to the skin to a specific tension and direction-determined by MTDT—which stimulates skin receptors to alter pain sensation and intensity. Due to the structure of the tape, it can manipulate the polyhedron shape of the epidermis and affect the dermis layer.

Figure 1: *Image of Kinesio® tape, in multiple colors.*
Note: Colors do not differentiate in strength or application; they are simply a preferential color choice.

Recoil is the physiological effect of the retraction reaction of Kinesio® tape. This recoil effect has only been observed in specific Kinesio Taping®. MTDT is not used to determine or assess the cause of pain. MTDT is an assessment tool to aid certain directional movements of tissues to decrease pain and or increase the range of motion (ROM) of joints. Moving tissue in certain directions can reduce pain and improve affected limb function [1,2] (Figure 2-5). This resultant reduction of pain and improved limb function may be due to the gate control theory of stimulating mechanoreceptors to block pain signals and allow greater limb motion.

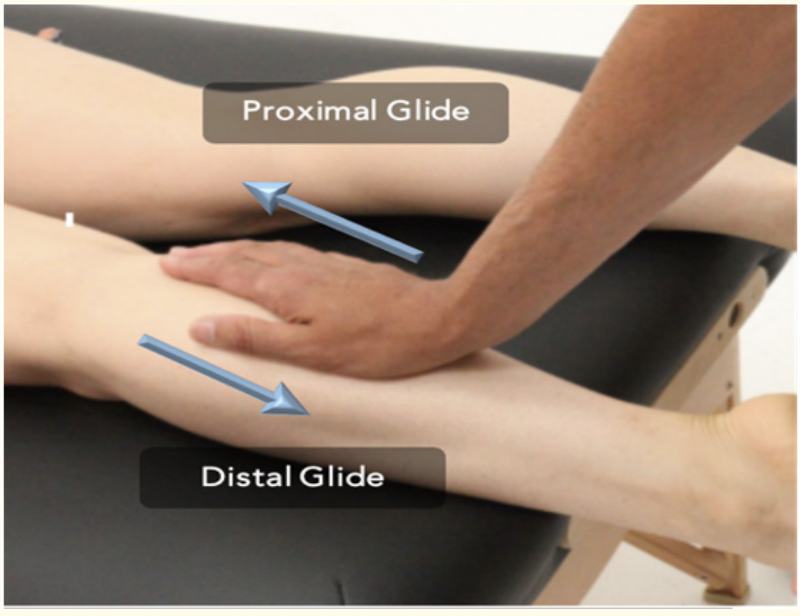

Figure 2: *A depiction of MTDT performed in proximal glide and distal glide.*

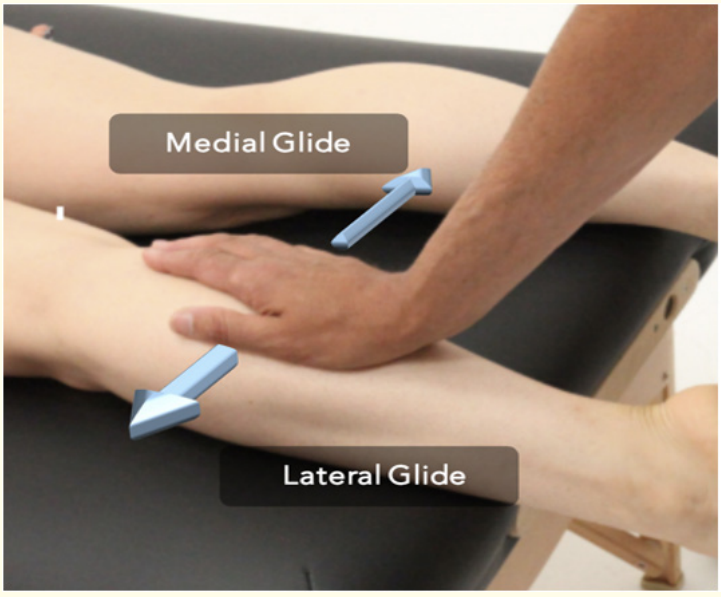

Figure 3: *A depiction of MTDT performed in lateral glide and medial glide.*

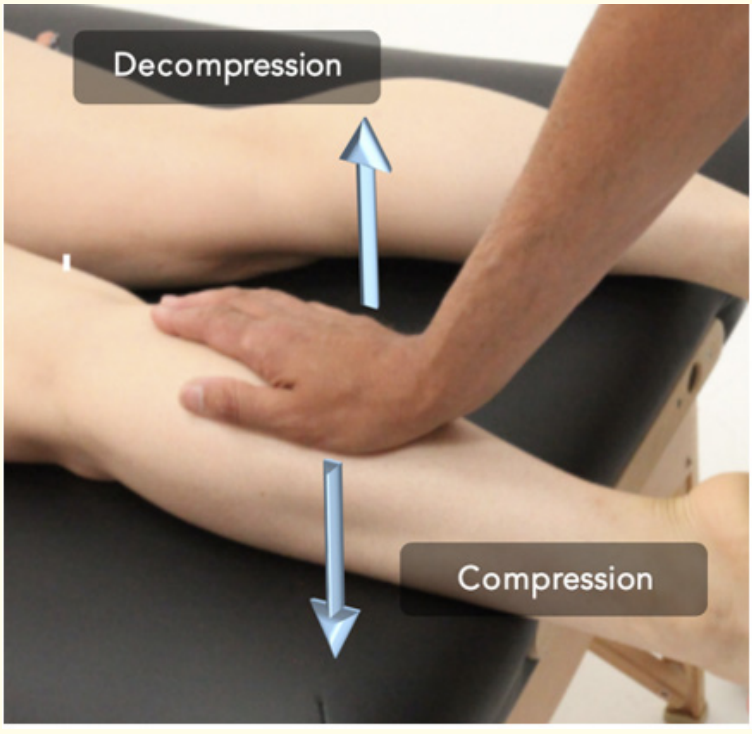

Figure 4: *A depiction of MTDT in compression and decompression.*

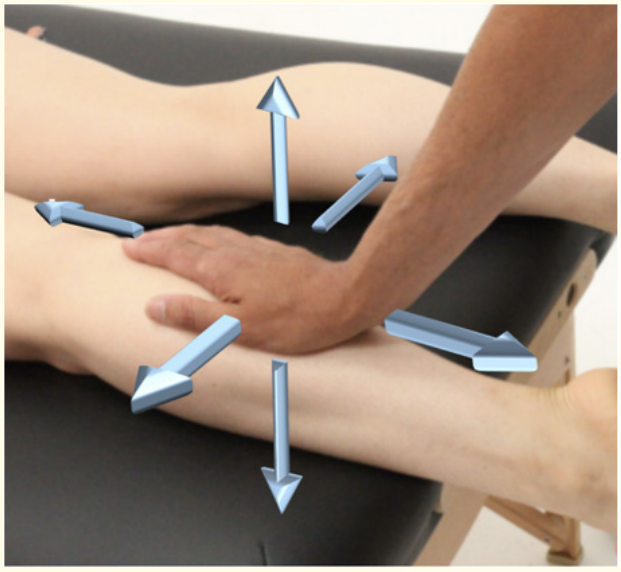

Figure 5: *A depiction of MTDT in all directions and glides.*

The mechanism is unknown as to how various mechanoreceptors or other receptors in different tissue layers affect pain receptors or the physiological system of fascia (Figure 6). In general, when there is pain, manipulating the affected area in multiple directions with varying pressure may alleviate pain. There may be a correlation to pressure, direction, and length of tissue movement to diminish pain. The stretching of tissues is one way to mobilize tissues, which can decrease inflammatory lesion thickness and neutrophil count and increase resolvin D1 (RvD1) concentrations in lesions [3].

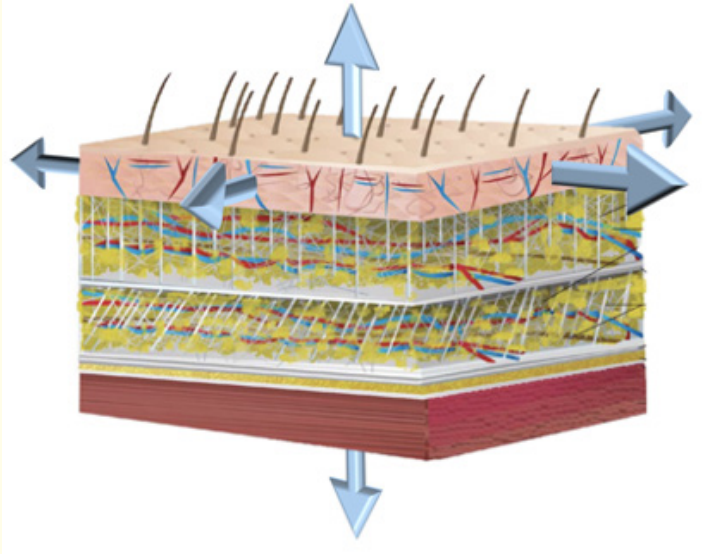

Figure 6: *MTDT in all directions and glides in animated tissue layers.*

Discussion

In this study, MTDT was used to assess injured athletes at the 2016 United States Gaelic Athletic Association Finals (held in Seattle, Washington USA) and the 2016 Emerald City Classic Volleyball Tournament (held at the University of Washington, Seattle, Washington, USA). During both events, a medical team provided triage and first aid to injured or compromised athletes.

Methods

MTDT was used to assess the levels of pain and ROMs of associated joints in injured players. MTDT was performed by hand in applying pressure at the site of pain with tissue glide movement (TGM). The test was conducted by manually moving tissue layers at the site of pain in various directions. (Manual TGM can alter the biomechanics and fascia lining of the site of pain, thereby influencing pain level.) The safety and efficacy of MTDT were observed. More serious conditions, such as fractures, concussions, infections, and potential skin reactions or allergies were ruled out before performing MTDT on the injured athletes. Visual Analogue Scale (VAS)/Numerical Rating Scale (NRS 101) were recorded before and after MTDT and the application of Kinesio® tape. The direction of MTDT was recorded.

The methods included notifying all athletes that there was a first-aid medical tent at the event, and athletes were encouraged to present for medical consultation if they sustained an injury. First aid tents were staffed with volunteer physicians and student clinicians who were Certified Kinesio Taping Practitioners® and Instructors. Injured athletes proceeded to the tent for injury assessment, diagnosis, treatment, and rehabilitation (Figure 7-12). Athletes who provided signed consent forms were allowed to participate in the observational study. Physicians and student clinicians who had completed the Collaborative Institutional Training Initiative (CITI) were allowed to administer the study protocol; they had also trained as Certified Kinesio Taping Practitioners®.

Figure 7: *MTDT performed by trained medical staff on the low back of an injured athlete.*

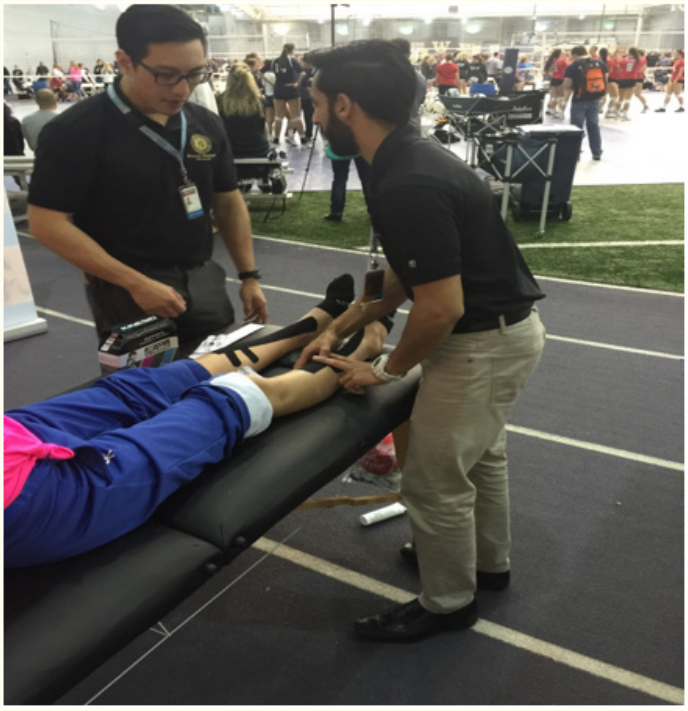

Figure 8: *Medical staff applying Kinesio® tape to the lower extremities of an injured participant, after MTDT.*

Figure 9: *Medical staff providing Kinesio Taping® to a participant's compromised knee.*

Figure 10: *Medical staff performing Kinesio Taping® of participant's injured finger, after MTDT.*

Figure 11: *Medical staff performing musculoskeletal diagnostic ultrasound to assess the tissue injuries, such as sprain/strain, muscle tear, and swelling of an injured participant's ankle joint (unrelated to MTDT).*

Figure 12: *Medical staff performing injection therapy to ankle joint of an injured participant (unrelated to MTDT).*

MTDT was applied to those athletes who experienced pain and required Kinesio Taping®. MTDT was performed at the sites of injury or pain on the patients, with varying pressures to isolate the depth of involved tissue. Directional glide was applied in a "clockwise" pattern to affect tissue. Physicians and student clinicians used their hands to directionally apply gentle gliding pressure on the affected areas of patients as part of the MTDT assessment. The "clockwise" pattern of TGM was as follows: proximal, distal, medial, and lateral; all directions were performed with decompression and compression. The pain level was measured before MTDT, and the therapeutic direction was determined by the decreased pain level. Kinesio® tape was applied in the direction that decreased pain, using recoil technique in most cases. VAS/NRS 101 was measured after the application of Kinesio® tape. (Note: there has been a strong correlation observed between iliotibial band tightness and decrease medial glide of the patella, tested by manual medial glide of the patella [4].)

Results

A total of 246 athletes were evaluated and categorized, as follows:

- Gaelic Games: Males N=115, Females N=75 (Mean Age = 30 ± .2 years).
- Volleyball: All female N=56. (Mean Age = 17 ± .11 year) (Figure 13 and 14).
- The most common body areas that were assessed were knee, ankle, calf, and hamstrings in Gaelic Football athletes; shoulder, lumbar, knee, and ankle in Volleyball athletes (Figure 15).
- The VAS for pain: pre- and post-MTDT and Kinesio Taping® application showed a 25% reduction in pain in the Gaelic Football players and a 24% reduction in pain in the Volleyball athletes (Figure 16).
- Among the two sporting events, the most common directions of TGM were decompression, proximal and distal (Figure 17).

Side effects of increasing pain or limited range of motion with MTDT were not reported.

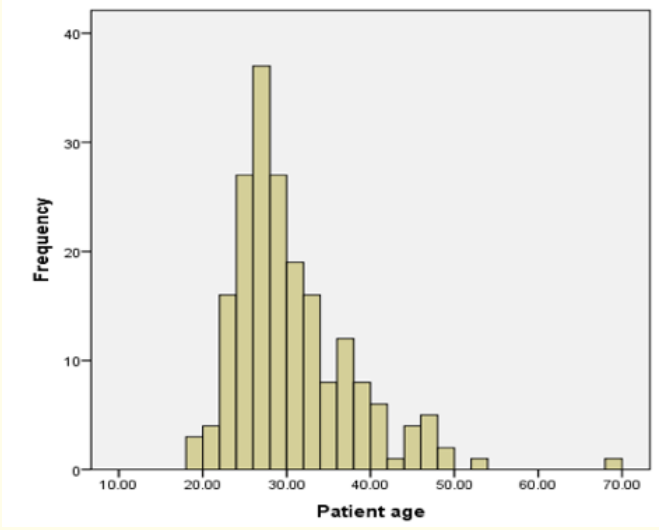

Figure 13: *Distribution of participants' age at Gaelic Football.*
Note. Gaelic Mean Age: 30.21yo. (The breakdown of male, female, and non-players: Mean of 115 Males: 30.37 yo, Mean of 75 Females: 30.23 yo, Mean of 7 Non-players: 27.28), N=197.

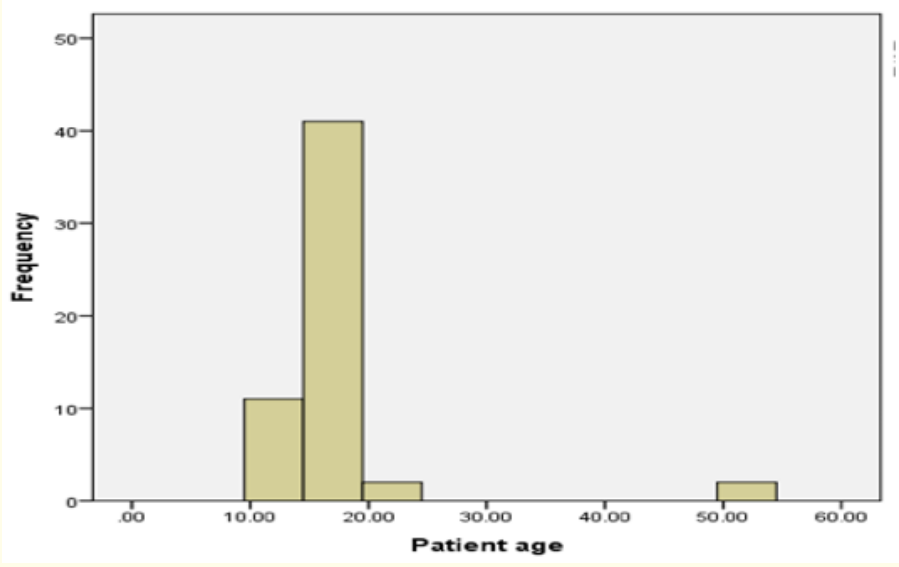

Figure 14: *Distribution of participants, age at Volleyball.*
Note. Volleyball Mean Age: 17.11yo; total number of Female N = 56 (including 2 non-players who are age above 40 yo).

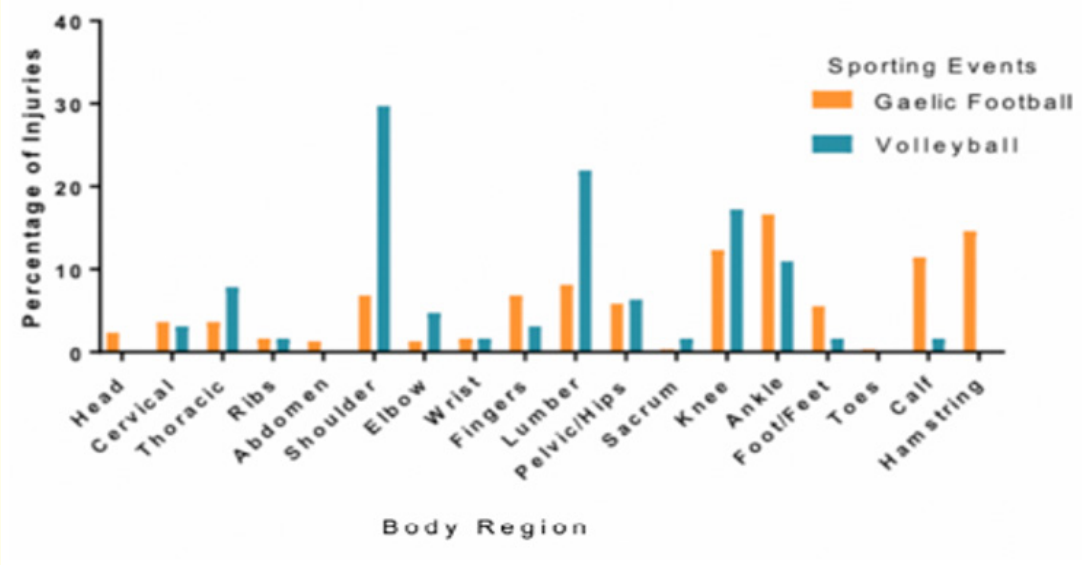

Figure 15: *Comparison of body injuries by region: Gaelic Football versus Volleyball. Note. Shoulder, lumbar, knee, and ankle in Volleyball players; knee, ankle, calf, and hamstrings in Gaelic football players.*

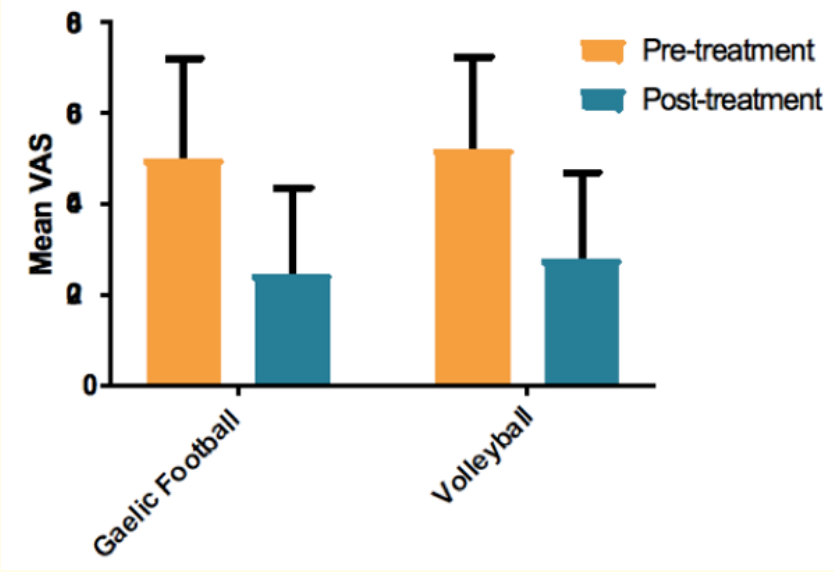

Figure 16: *VAS pre- and post-MTDT and Kinesio Taping®. Note: Similar results were noted between the two sporting events.*

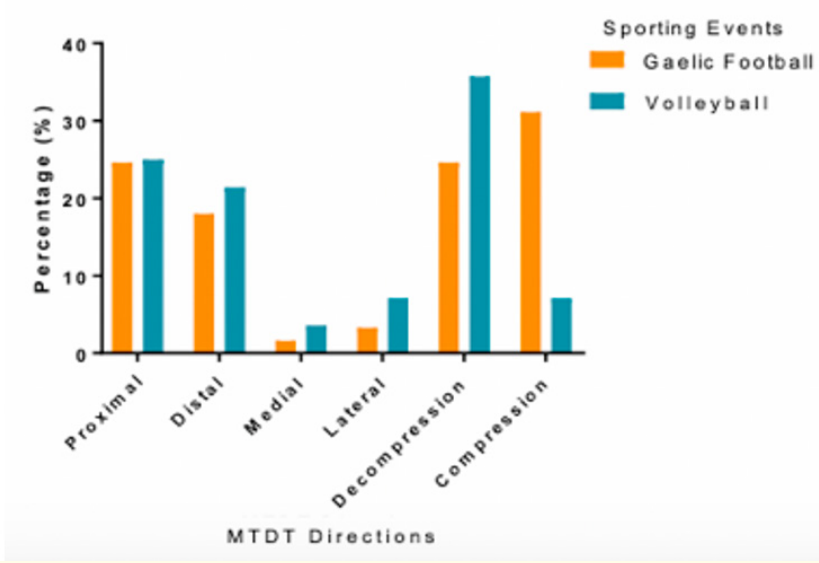

Figure 17: *Comparison of MTDT directions (Gaelic Football versus Volleyball).*

Note: Decompression, proximal, and distal were the most common movements among the two sporting events.

Conclusion

Novel, noninvasive, and easily-applied methods to diagnose and treat musculoskeletal injuries that typically result from sports trauma are a welcome addition to the tools that keep athletes competing at their optimal performance levels. The results of this study showed that the use of MTDT (in conjunction with Kinesio Taping®) was safe and, with a competent practitioner, improved VAS/NRS pain scales of injured athletes by nearly 25%. MTDT was used as an effective assessment tool to aid in Kinesio Taping® and augment treatment modalities. MTDT direction distribution varied with the type of sport. Distal and proximal directions were similar in both sports studied and reported herein. Decompression appeared to be prevalent in volleyball-associated injuries. Compression appeared to be prevalent in Gaelic Football-associated injuries.

In this study, MTDT proved to be a valuable adjunct to established assessment and treatment methods. However, further clinical studies are necessary to establish inter-practitioner consistency and analysis of tissue depth involvement. Future studies regarding MTDT could be designed to analyze tissue depth (using musculoskeletal ultrasound) and evaluate functional range of motion. In theory, MTDT—if performed improperly—has the potential to worsen the pain experienced by injured athletes as well as restrict joint range of motion. However, data collection for exacerbation of symptoms may help to better determine and understand the correlation between tissue movement in pain and joint range of motion.

Conflict of Interest Statement

The authors declare that this paper was written in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

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Supplementary Note

Gaelic Games North America and Emerald City Classic Volleyball studies were approved as IRB exempt observational studies (16-1566) and (17-1587) respectively. Also, certain data used in this study and the concept of MTDT was presented at the 2017 Kinesio Taping Association International Symposium.

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