Neurodynamic Technique on Functional Ankle Instability: A Case Report

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ABSTRACT
Athletes who encountered repeated Functional Ankle Instability (FAI), exhibit excessive foot inversion during the various phases of gait than non-injured ankle. In gait, heel strike to toe off inversion ankle movement of the foot is controlled by eccentric function of the peroneus muscle, which stabilizes the ankle joint. As such, the purpose of this study was to investigate the response of biomechanical characteristics during gait cycle by applying neurodynamic exercise technique. An athlete with repeated FAI was checked for dynamic balance (Y-balance) and knee range of motion (using a electro-goniometer). To test the peroneal longus muscle activity and gait parameters synchronisation of Surface Electromyography (sEMG) (Noraxon Myo-Muscle) was done with an instrumented myo-pressure treadmill in both injured and non-injured legs. Six-week post intervention measurements exhibited significant improvement in dynamic balance, knee range of motion, pain score, efficient peroneal muscle response and gait parameters. This ascertains the effect of neurodynamic technique.

Keywords: Dynamic balance, Electro-goniometer, Functional ankle instability, Peroneus longus muscle, Surface electromyography.

CASE REPORT
A 17-year-old male, a medium pacecricket bowler reported with numerous ankle sprains on his right side during his training sessions, especially in trailing foot during contact phase prior to the delivery of a ball. For the past five months before the intervention, the patient experienced right ankle medial roll three times. He was referred by a sports medicine specialist for physiotherapy management at National Sports Institute, Malaysia. He walked independently with ankle brace support and was worried on his performance. The informed consent was taken from the patient and his subjective findings revealed that he was experiencing right lateral ankle pain during ankle inversion movements and especially while repeating bowling actions and the numeric pain rating score was 4/10.

Dynamic balance: Dynamic balance was measured by using Y Balance Test Kit [1], which consists of a stance platform to which three pieces of a bamboo wooden bar scale is attached in the anterior, posteromedial, and posterolateral reach directions. The posterior bars are positioned at 45° and 135° from the anterior wooden bar. Each wooden bar is marked at 5 millimetre increments to record the dynamic balance measurement score. The participant was instructed to stand on the centre wooden block in single leg and to push the indicator over the wooden scale bar anteriorly, posterolaterally and postero-medially along the stick, with the foot reaching the bar by bending the hip, knee and ankle joint of the tested leg. The participant was also instructed to return to the starting position without pushing off with the foot reaching the bar and without losing his balance. A standardised test protocol was created with sufficient rest in between the trails and it was ensured that the test was disregarded if the subject lost his balance and touched his reaching foot to the ground [2] as shown in [Table/Fig-1].

Range of motion: The participant was positioned on a high seated bench and instructed to place his hands behind to adopt a slumped spinal posture, facilitating the thoracic and lumbar spine to maintain a flexed posture. The hip joints were at 90° flexion, as measured by a universal goniometer and the active knee extension range of motion was measured with a neutral ankle joint by using the twin axis electro-goniometer as shown in [Table/Fig-2]. The accuracy of placement of the electrogoniometer was obtained by identifying the zero position in long sitting posture prior to the start of test.

Gait analysis: Dynamic gait phase and spatial parameters were measured using Noraxon FDM-T SciFit myo-pressure Treadmill. The Noraxon FDM-T is fitted with 5376 Capacitive Sensors, with density of 1.4 sensors/cm² embedded underneath the belt. The treadmill’s contact surface measures 62 feet x 22 feet. The treadmill sensors were set at a sampling rate of 100 Hz to record the force exerted by the participant while walking on the treadmill as shown in [Table/Fig-3].

Surface Electromyography (sEMG) analysis: The participant’s peroneal muscle activation response was recorded with a Noraxon myo-muscle wireless sixteen-channel sEMG system. sEMG response was obtained from the peroneus longus, bilaterally using eight-shaped, disposable, self-adhesive pre-gelled Ag/AgCl electrodes with dimensions 4 cm x 2.2 cm; diameter of the two circular adhesive areas was 1 cm with the inter-electrode distance was 2 cm and centered over the peroneus longus muscle bellies by following the guideline from Surface EMG For Non-invasive Assessment of Muscles (SENIAM). [3] The skin was prepared by shaving off hair, by rasping the area gently with sandpaper and by cleaning with alcohol swab before electrode was placed. The EMG signals were acquired by a standardized test protocol was executed with sufficient rest in between the trails and it was ensured that the test was disregarded if the subject lost his balance and touched his reaching foot to the ground [2] as shown in [Table/Fig-1].
at a sampling rate of 500 Hz. The Root-Mean Square (RMS) amplitude for peroneus longus muscle burst was calculated as follows: the raw EMG signals were full-wave rectified, band-pass filtered with a hamming window to remove movement artefacts with a cut-off frequency of 40 Hz to 500 Hz, and smoothed with a 50 millisecond RMS algorithm. The myo-synch was used to synchronise the myo-pressure instrumented treadmill and myo-muscle sEMG. Testing was recorded to identify the injured and non-injured leg gait parameters by maintaining at 2 km/hour speed and the muscle activation of peroneus longus were recorded during stance phase of gait as shown in [Table/Fig-4].

Neurodynamic Technique (NDT): The subjects underwent a six-week NDT, which consists of mobilization of the peroneal nerve, which commenced on the day after the first examination and continued for three sessions in the week. At each session, the NDT were applied on his involved leg four times for a 30 seconds period with a 1 minute pause between each application. The NDT movements carried in supine position were as follows in [Table/Fig-5].

<table>
<thead>
<tr>
<th>Week</th>
<th>Exercise Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Passive one-end proximal sliding exercise to the peroneal nerve-knee flexion &amp; extension movement performed by maintaining plantar-flexion of the ankle.</td>
</tr>
<tr>
<td>2</td>
<td>Passive one-end distal sliding exercise to the peroneal nerve-ankle dorsiflexion to plantar flexion movement performed by maintaining hip &amp; knee in flexed position.</td>
</tr>
<tr>
<td>3</td>
<td>Passive two-end proximal tension exercise to the peroneal nerve-knee extension and neck flexion movement performed by maintaining the plantar-flexion of the ankle.</td>
</tr>
<tr>
<td>4, 5 &amp; 6</td>
<td>In sitting position, active two end peroneal nerves sliding exercise to the peroneal nerve- instructed to do plantar flexion and inversion of ankle with simultaneous neck extension x 2 times. The patient was also instructed to do active tension techniques by doing plantar flexion and inversion of the ankle with neck flexion movement respectively x 2 times.</td>
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DISCUSSION

Inversion Ankle injuries (IAS) are the most common musculoskeletal injuries in sports and the rate of IAS accounts for 85% of ankle injuries with 10-30% of athletes, developing chronic ankle instability.
The six week neurodynamic technique, post intervention assessment exhibited an improvement in the participant pain score biomechanical aspects; dynamic balance, knee range of motion, peroneal muscle activation response, and increase in the percentage of gait parameters in repeated functional ankle instability for medium pace cricket bowl. From the future perspective, by including NDT with standard physiotherapy management would speed up the progress of rehabilitation and reduce the recurrence rate of ankle injury. Further research is needed to address this problem with a larger sample and using motion capture system with force plate to predict the joint load and muscle force before and after the neurodynamic technique.

CONCLUSION

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REFERENCES


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<th>Pre intervention</th>
<th>Post intervention</th>
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<tr>
<td></td>
<td>Stance phase (%)</td>
<td>Loading response (%)</td>
</tr>
<tr>
<td>Injured</td>
<td>69.4</td>
<td>17.6</td>
</tr>
<tr>
<td>Non-injured</td>
<td>68.1</td>
<td>19.6</td>
</tr>
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</table>

[Table/Fig-9]: Gait Spatial and Force Parameters.


