12.21.2012

PROJECT REPORT: Special Operations Medical Association

Barefoot Science Verified & Validated

INTRODUCTION & BACKGROUND

Barefoot Science and Noraxon USA had the privilege to attend the 2012 Special Operations Medical Association Annual Conference. Barefoot Science and Noraxon USA are honored to be able to provide solutions that prevent injury, reduce pain, promote health, and provide means to assess human performance to all of the men and women who dedicate their time and lives for our country.

Bare Foot Science (BFS) is a proprioceptive stimulating insole that is designed as a foot strengthening system. Through its unique design BFS introduces a conservative, constant, stimulus that activates biomechanically appropriate muscle firing and proprioceptive signals. To demonstrate the efficacy and efficiency of BFS insoles further objectifying tests were completed.

METHODS

Data was collected from 18 participants, who were attendees at SOMA's 2012 conference in Florida, using Noraxon's Clinical Direct Transmission (CDTS), used to measure changes in muscle activity, symmetry and cooridination, and the Force Distribution Measurement Small (FDM-SX) Platform, which is a pressure measurement platform used to assess balance, underfoot mapping of pressures and other static and dynamic parameters, also available from Noraxon, to measure the dynamic changes that the BFS insoles promote. Participants were given directions to stand, shod,

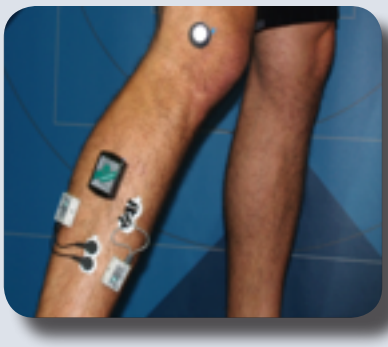

Figure 1: *Noraxon Surface Electromyography Measurement solution with electrode placement set-up*

Figure 2: *Noraxon MyoPressure Analysis for Dynamic measurements – gait, balance, and even static posture assessment. Balance was quantified by the FDM-SX gait platform, before and after wearing BFS for only a short period.*

on the FDM-SX for 10 seconds, parameters including the geometric 95% Confidence Ellipse Parameters and the Center of Pressure Parameters were generated to establish a baseline. This was also done while baseline muscle activation was recorded. Muscle activation of the Peroneus and Anterior Tibialis were additionally examined during dynamic gait.

After the baseline recordings were completed, BFS insoles were fit and put into the participant's shoes. The participants then walked for no less than 500 steps with level 1 BFS (a total of 7 levels are available) in their shoes before the second comparative recording was completed.

Findings from the CDTS and myoMUSCLE Clinical Applications software were analyzed comparing the muscle activation pre and post the use of BFS insoles. myoPRESSURE Analysis software was used to analyzed and compare the changes in center of pressure positioning .

RESULTS

Those who have complaints of foot, knee, and back who have tried BFS insoles have reported a significant decrease in pain as a result of wearing them. Report of pain is subjective and there are already multiple subjective studies showing the significant benefits of using Barefoot Science insoles. Focus on the objective data comparing the difference pre and post the use of BFS was the main goal for this micro study.

The data collected indicated that our 18 participants collectively showed an average of 31% increase in their balance (reduction in the area of the confidence elipse) after wearing the BFS insoles.

The most significant result from the EMG recordings, on the otherhand, was the average increase in muscle activation. With even just the small amount of proprioceptive stimulation the BFS insoles provide at Level 1, muscle firing and fiber recruitment increased significantly, especially considering that pre/post measurements were made within roughly 5 minutes of each other. The increase in the Peroneus and Anterior Tibialis activation was an average of 22%. Numerous other studies discuss this as being beneficial due to improved muscular efficiency and increased circulation which in turn may promote healing of damaged tissues.

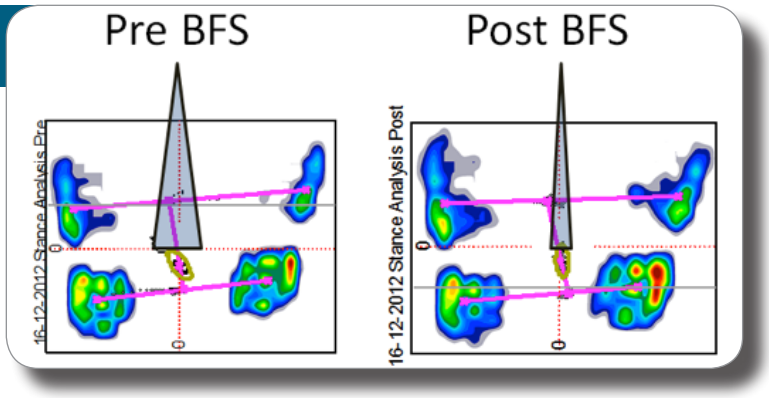

Figure 3: *The grey triangle represents the Confidence Ellipse which encompasses 95% of the subjects' center of pressure movement. Note the diminished area of the COP course and area during the "post BFS" analysis.*

Noraxon's analysis software, MR3, simultaneously controls the recordings of the pressure, EMG and video. This allowed results to be played back frame by frame synchronized with video, allowing us to look at the progressive changes in the muscle activity through dynamic movement as well.

Figure 4:
Since the Kinematic Chain links the entire body, stimulation in one key location resonates throughout the entire body.

This slow motion analysis highlighted not only the increased firing, but also the synchronization of Peroneus and Anterior Tibialis occurring at pre heel strike. Muscles that play this important role in the preparation for contact are also controlling what happens throughout the rest of the body prior to impact (e.g. controlling and limiting excessive pronation in the first segment of gait). Additionally, the muscles involved in the toe off segment of gait can be contributors to more balance and control elsewhere in the body. This synchronization in firing throughout the kinetic chain is a benefit that no other insole can claim. Additionaly, this whole body synchronization potentially acts as a benefit to the economy of locomotion. Even with a weak foot these larger extrinsics (Peroneus and Anterior Tibialis) are getting plenty of work due to the inefficiencies of gait, and the corrections they are making. Overtime ithese muscles, which are measured to be immediately more balanced, may also not have to work as hard, and would have less recruitment demands, ultimately leading to less fatigue and reducing the chance for injury.

As we make gait more efficient there is often a decrease in EMG amplitude that would be the result of better synchronization and greater efficiencies. It is also likely postural control will improve as well as balance to the rest of the frame.

Fatigue and asymmetrical muscle activation are predictors of potential forthcoming injuries. It is further known and now objectively measured that stronger feet and their corresponding muscles are better able to manage forces, assist in stabilization, and improve the synchronization of events that might otherwise quickly fatigue the body in high complaint areas like the hip, knee, and back. With this being the case, results match the claims and subjective findings already published.

Figure 5: *After more long term rehabilitation more obvious biomechanical changes might be expected. When long terms changes like an improved Center of Mass shown here are measured, more efficient bone and muscle alignment in the foot, ankle and lower leg are occuring. Proper allignment encourages redistributing stress more equally to reduce strain on the hip muscles. It provides a strong foundation that is able to more efficiently maintain alignment in or out of shoes.*

DISCUSSION

There were a few cases where results showed more unstable tracings and greater path lengths after the 500 steps comparison. These results were documented alongside annotations of respective orthotic usage prior to testing. In cases where confidence ellipse area increased post BFS, most subjects were noted as being heavily braced. Once the orthotics were removed for the tests, programmed muscle contractions and firing patterns were disrupted, and subjects were given greater ranges of movement and activation allowances. Retesting 48 hours later resulting in an average 31% increase in muscle firing and 44 increase in balance. With these isolated cases accounted for, 100% of the participants saw an increase in muscle firing and an increase in balance post BFS.