

# Neuromuscular training normalizes plantar pressures in Autism Spectrum Disorder (ASD) subjects

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## Background

Autism Spectrum Disorder (ASD) is a neuro-developmental disorder characterized by impaired social and communication skills, with repetitive behaviors [2]. Impaired locomotor function, balance and muscle strength are also found in ASD, leading to gait asymmetries [1, 4, 5] and increased injury risk due to falls [3]. Previous work in our laboratory has shown significant differences in plantar pressure distribution, static balance and reaction time in ASD subjects v. normal control subjects. There is little research analyzing the effectiveness of interventions to improve gait or fall risk.

This current study assessed the effects of a motor skill development program on static postural balance, plantar pressures, and visual and physical reaction time in subjects with ASD.

## Key Terms

**Plantar Pressure** = The Pressure applied to the ground by the bottom of the foot.

**Plantar Surface Area** = The area of contact of the bottom of the foot with the ground.

**Center of Pressure (COP)** = is the point where the sum of pressures act on a body.

**Body Barycenter** = A two dimensional shape outlining the moving center of mass of the left and right foot.

## Methods

Seventeen subjects (age range: 11-20yrs) participated in a six week program of neuromuscular training sponsored by the Els Center of Excellence, in collaboration with the First Tee of the Palm Beaches and PGA REACH. The individual programs lasted for forty-five minutes, focusing on different core golf skills while previously learned skills were reviewed and integrated.

Before (PRE) and after (POST) the 6 weeks, plantar pressures were recorded during barefoot walking on a P-Walk 480x480mm modular pressure platform (BTS Bioengineering, Italy) along a 5 meter pathway. Static (standing) pressures were measured over 5 seconds in standing position. Dynamic pressures were measured as participants walked at a naturally chosen walking gait speed. Static pressures and values were measured during a 5 second period of silent standing.

Before (PRE) and after (POST) the 6 weeks, gait kinetics were assessed using a G-Walk inertial sensor (BTS Bioengineering, Italy) located on S2 vertebrae while walking back and forth down a 9 meter walkway (1 meter wide). The G-Walk houses a specialized wireless inertial sensor providing data for clinical assessments, such as spatio-temporal data and body kinematics.

A paired-t test was used to assess differences ( $\alpha = 0.05$ ) in means between PRE and POST values of all variables measured. A False Discovery Rate (Benjamin-Hochberg) was calculated and used to limit Type I errors in analysis.

## Conclusion

Following six weeks of neuromuscular training plantar pressures and surface area improved and exhibited more normal distributions. This is in line to previous research done in our Laboratory.

There were no significant changes in static equilibrium measures following six weeks of training.

There were no significant changes in gait kinematics and kinetics following six weeks of training.

## Bibliography

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## Results

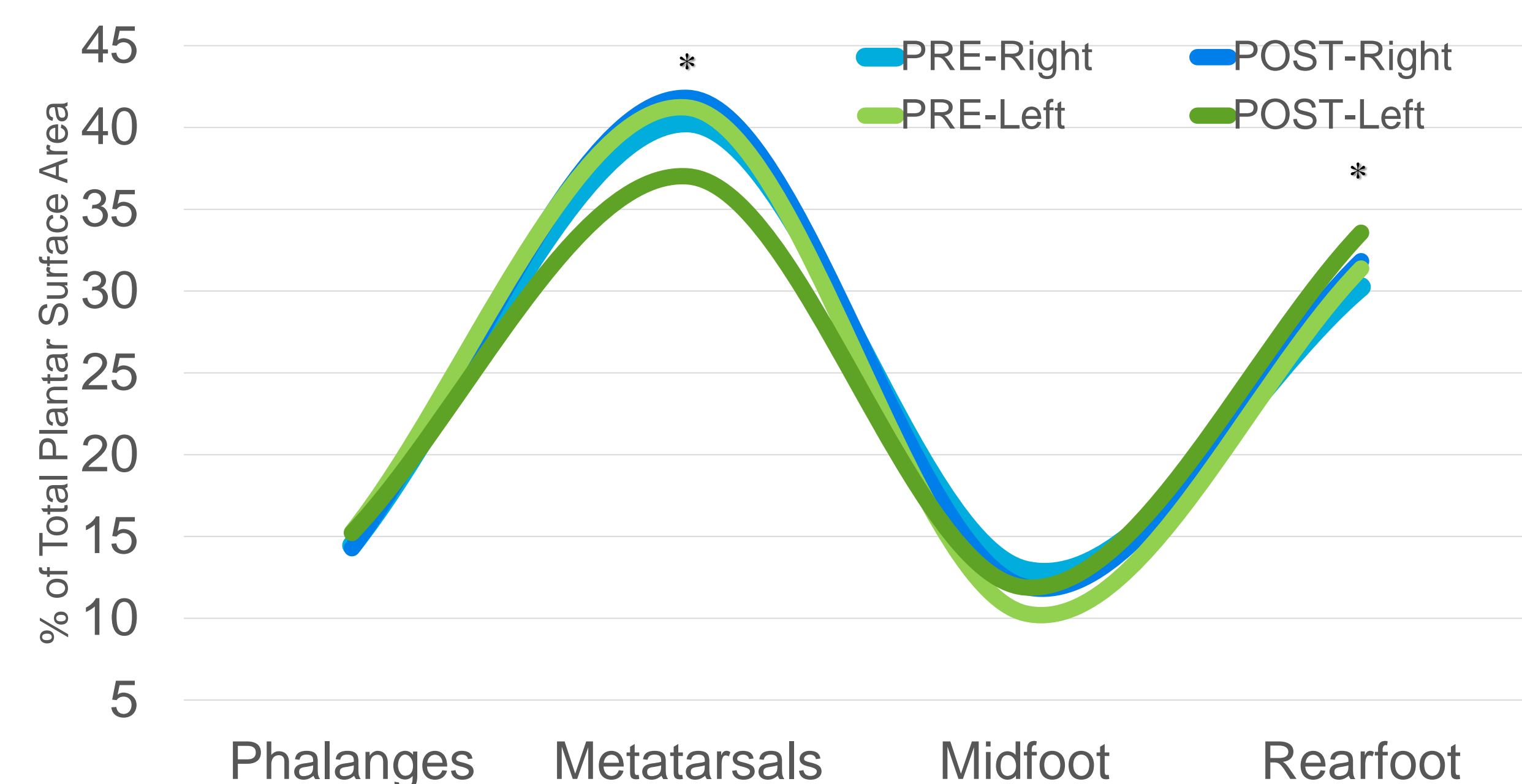
### Subject Characteristics & Static Equilibrium Measurements (PRE v POST)

(n=17)	PRE	POST
Height (in)	65.77 ( $\pm 4.45$ )	65.89 ( $\pm 4.34$ )
Weight (lb)	158.02 ( $\pm 40.00$ )	160.22 ( $\pm 38.68$ )
Body Mass Index (kg/m <sup>2</sup> )	25.30 ( $\pm 4.39$ )	25.59 ( $\pm 4.22$ )
C.O.P. Distance (mm)	139.63 ( $\pm 190.01$ )	74.94 ( $\pm 56.99$ )
Avg Speed (mm/sec)	.028 ( $\pm 0.038$ )	.015 ( $\pm 0.011$ )
Dist/Surf LSF	0.736 ( $\pm 0.900$ )	.353 ( $\pm 0.218$ )
Body Barycenter (mm <sup>2</sup> )	2903.28 ( $\pm 6367.31$ )	410.14 ( $\pm 472.68$ )

### Pelvic Kinematic Measurements (PRE v POST)

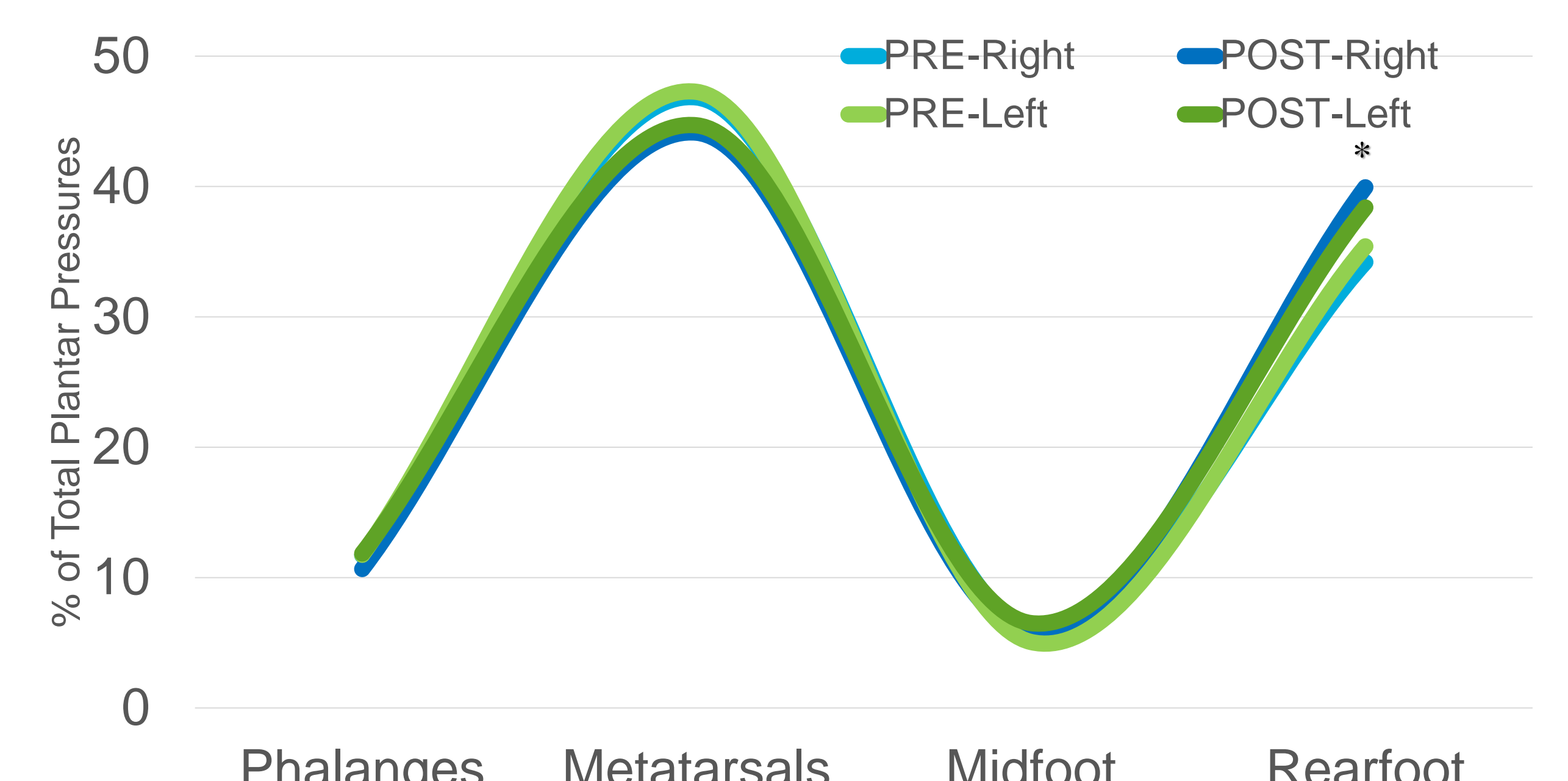
(n=17)	PRE	POST
Left Leg Quality Index	93.73 ( $\pm 3.25$ )	93.49 ( $\pm 4.75$ )
Right Leg Quality Index	95.00 ( $\pm 5.80$ )	95.07 ( $\pm 3.44$ )
Symmetry Index	25.30 ( $\pm 4.39$ )	25.59 ( $\pm 4.22$ )
Tilt Symmetry	68.53 ( $\pm 17.46$ )	66.73 ( $\pm 22.28$ )
Obliquity Symmetry	91.33 ( $\pm 7.61$ )	91.20 ( $\pm 10.88$ )
Rotation Symmetry	86.20 ( $\pm 16.31$ )	80.33 ( $\pm 23.76$ )

### Distribution of Plantar Surface Area (PRE v POST)



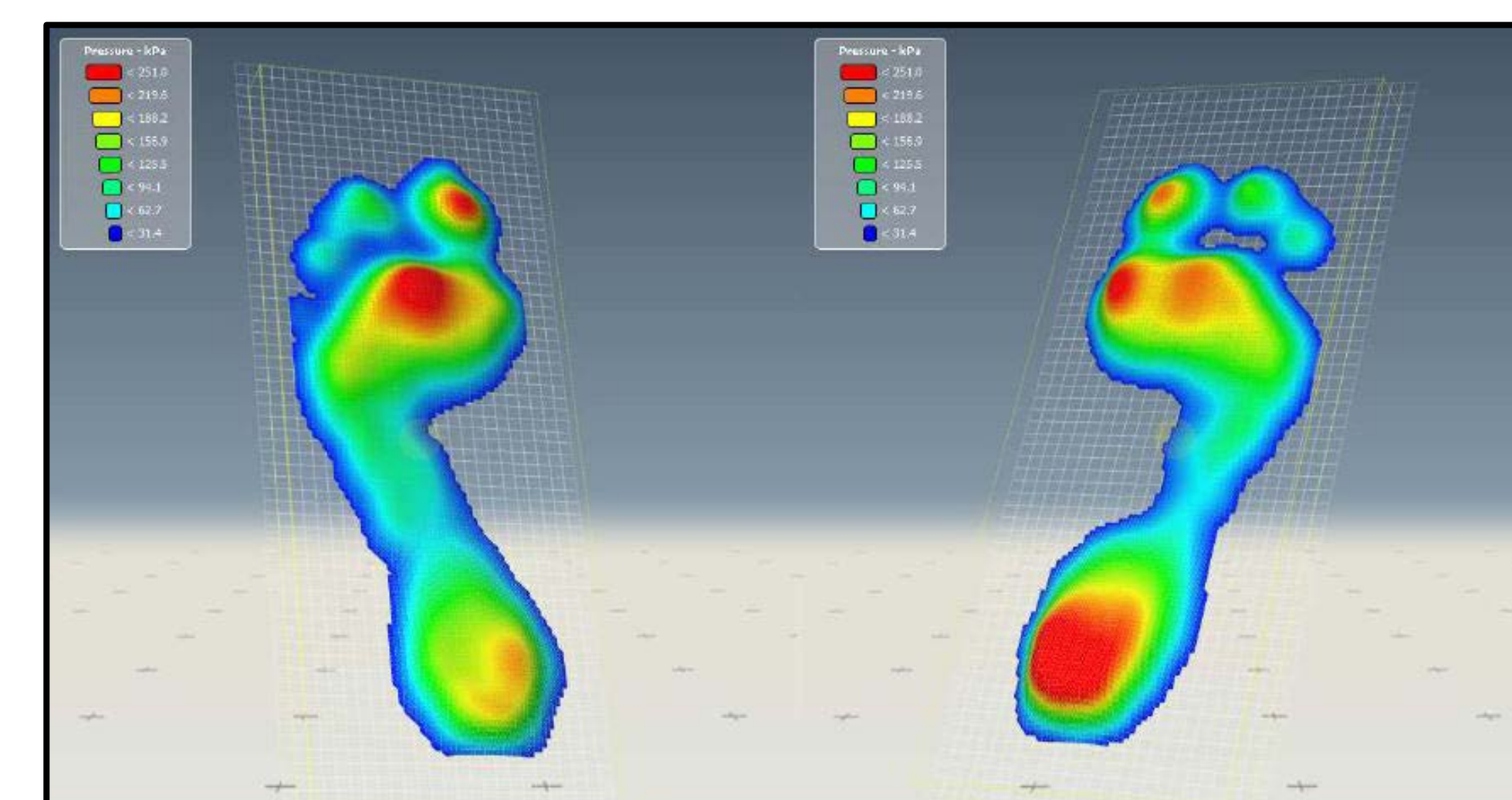
\* Differences between PRE-Left and POST-Left are statistically significant ( $p < 0.05$ )

### Distribution of Plantar Pressures (PRE v POST)



\* Differences between PRE-Left and POST-Left are statistically significant ( $p = 0.05$ )

	p value
Left Surface Area % M1	0.041
Left Surface Area % M2	0.007
Left Surface Area % M3	0.029
Left Surface Area % LH	0.024
Left Pressure % M2	0.050
Left Pressure % LH	0.051



This project was partially supported by a Palm Beach Atlantic University Qualitative Initiative grant (2019-20), in conjunction with the Learning Academy at the Els Center of Excellence for Autism & Els for Autism Foundation (Jupiter, FL)