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Symmetry of Resting Tone, Alignment, and Strength in the Pelvic Region

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Introduction

Resting muscle tone throughout the axial skeleton is an important contributor to postural stability in standing. Some theorize that specific muscles, such as the gluteus maximus and latissimus dorsi, can contribute to stability and posture through symmetrical pull, providing compression across the sacro-iliac joint (SIJ), and asymmetrical pull in these muscles could cause dysfunction and potential pain in the hips and back. Currently, methods for diagnosing dysfunction in the SIJ rely on bony palpation which has poor sensitivity, specificity, and inter-rater reliability. Current studies on use of the MyotonPro myometer have shown that it can find side-to-side differences in tone in muscles of the appendicular skeleton with high reliability, however no studies have looked at the differences in tone between sides in the axial skeleton.

Purpose of Study:

- Assess side-to-side differences in tone and strength in asymptomatic participants with back or SIJ pain using muscles crossing the pelvis to establish baseline measures of healthy populations.
- Assess side to side differences in iliac crest, ASIS, and PSIS height, as well as pelvic tilt.
- Use measurements of side-to-side differences in tone, strength, and pelvic alignment to establish baseline data to compare with symptomatic participants for low back (LBP) or SIJ pain in future studies.

Methods

Manual muscle tests were conducted with a Lafayette handheld dynamometer following the protocols from “Muscle Testing and Function with Posture and Pain” by Kendall. Tone, elasticity, stiffness, creep, and relaxation were measured for each muscle with the MyotonPro following protocols determined by the manufacturer, with placement determined by surface EMG studies and previous MyotonPro studies. Pelvic symmetry was measured with a Palpation Meter (PALM) in the frontal and sagittal planes, using the ASIS, PSIS and iliac crests. Each device was used by a single rater, and intra-rater reliability was determined with Cronbach’s alpha in SPSS using 10 participants over two sessions, one week apart. Mean and standard deviation were calculated in Microsoft Excel, and percent differential was calculated with [(left-right)/left], with a negative percent differential indicating a lower value on the left side. Examples of measurements using the MyotonPro, dynamometer, and PALM can be seen in images 1-3.

Results

Table 1: Left and right muscle tone and elasticity averages reported from MyotonPro with side-to-side difference (negative value indicates left side had less tone or elasticity)

Muscle	Measure	Left	Right	Percent Differential
Gluteus Maximus	T*	13.86 ± 1.80	14.34 ± 2.13	-3.46%
	E*	184.87 ± 42.50	200.17 ± 52.37	-8.28%
Latissimus Dorsi	T	17.46 ± 2.97	17.97 ± 2.55	-2.92%
	E	296.1 ± 104.54	333.40 ± 91.05	-12.60%
Gluteus Medius	T	12.50 ± 1.34	12.67 ± 1.68	-1.36%
	E	163.37 ± 42.08	169.57 ± 68.27	-3.80%
Adductor Magnus	T	14.06 ± 2.61	14.02 ± 1.84	0.28%
	E	223.43 ± 63.79	222.60 ± 45.01	0.37%
Rectus Femoris	T	13.66 ± 1.05	13.67 ± 0.91	-0.07%
	E	233.10 ± 31.21	233.77 ± 26.36	-0.29%
Biceps Femoris	T	15.53 ± 1.71	15.96 ± 2.62	-2.77%
	E	270.57 ± 35.45	273.30 ± 47.94	-1.01%

*T = Tone (Hz); E = Elasticity (Logarithmic Decrement)

Table 2: Left and right muscle strength averages reported using a Lafayette handheld dynamometer in Kendall’s MMT positions with side-to-side differences (negative value indicates that left side was weaker)

Muscle	Left Resistance (lbs.)	Right Resistance (lbs.)	Percent Differential
Gluteus Maximus	69.53 ± 7.28	68.40 ± 8.11	1.63%
Latissimus Dorsi	29.51 ± 8.40	29.30 ± 7.60	0.71%
Gluteus Medius	51.23 ± 10.46	51.76 ± 11.58	-1.03%
Hip Adduction	72.10 ± 10.68	75.42 ± 14.49	-4.59%
Quadriceps	72.20 ±7.36	75.82 ±8.74	-5.01%
Hip Flexion	65.26 ± 8.27	69.77 ± 10.51	-6.91%
Hamstrings	54.43 ± 7.53	53.96 ± 7.65	0.86%
Iliopsoas	64.12 ± 9.25	61.50 ± 10.34	4.09%

Table 3: Measurements of pelvic symmetry and alignment as reported using PALM (negative value indicates that left was lower than right)

Pelvic Alignment Measures	Average (Range)
Iliac Crest Symmetry	-0.23° ± 1.56°
PSIS Symmetry	-0.7° ± 1.58°
ASIS Symmetry	-0.13° ± 1.33°
Left Pelvic Tilt	8.33° ± 3.46°
Right Pelvic Tilt	8.0° ± 3.53°

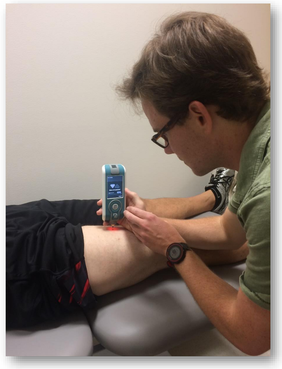

Image 1: Use of MyotonPro to measure tone in rectus femoris

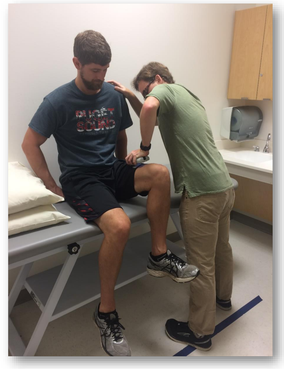

Image 2: Use of Lafayette dynamometer to measure hip flexion strength

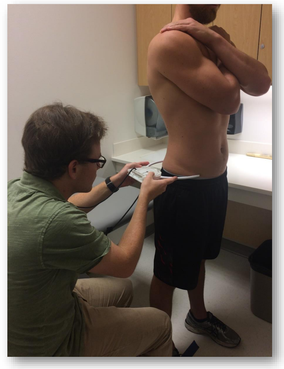

Image 3: Use of PALM to measure right pelvic tilt using ASIS and PSIS as landmarks

Conclusion

Overall small side-to-side differences in resting tone, elasticity, strength, and pelvic symmetry were noted in participants who were asymptomatic for SIJ pain or LBP. This data could assist in finding cutoff points to identify symptomatic individuals who could benefit from interventions utilizing treatment techniques aimed at improving symmetry of tone and strength.

Discussion

- The data here can be used with future results on symptomatic participants to identify the range of norms for bony landmarks and SIJ muscle tone, in order to determine if either landmark palpation or muscle tone asymmetries can be properly used to assess pelvic dysfunction as it relates to pain.
- Based on pelvic alignment measurements, it would be expected that there would be higher tone on the left side creating a greater inferior pull, however the findings on resting tone did not support this.
- Rectus femoris had the highest intra-rater reliability for the MyotonPro and lowest percent differential for tone, which supports previous study findings of the MyotonPro’s high reliability for the rectus femoris, suggesting the need for further studies of the MyotonPro’s effectiveness on other axial skeleton musculature.
- While this study collected normative data for tone as well as strength for individual muscles, it is important to not assume a relationship considering that resting tone could be different than maximum strength during muscle contraction.

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