

Force Produced By Orthopedic Physical Therapists During Thoracic Spine Joint Mobility Assessment and Manipulation

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Introduction

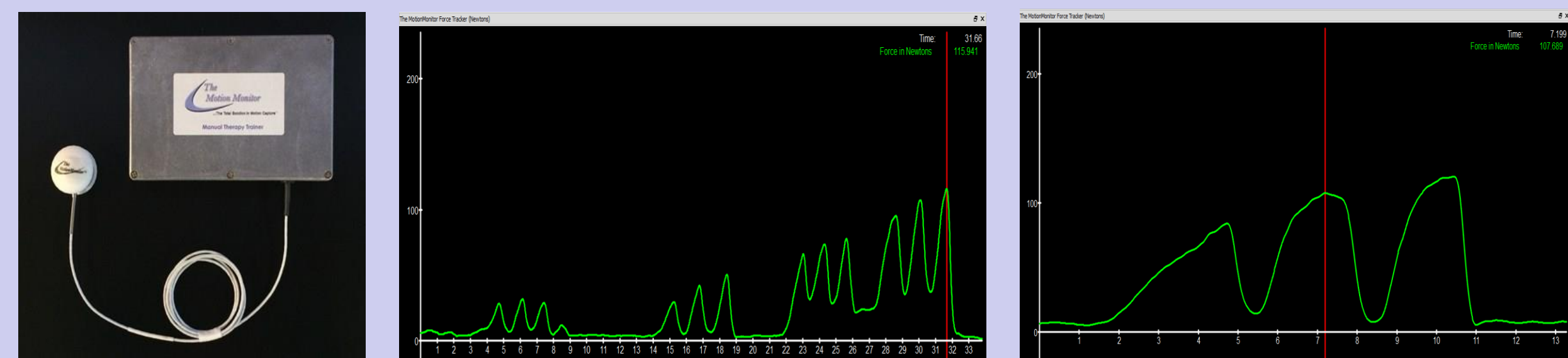
- Joint manipulation is a manual therapy technique commonly used by PTs to improve pain and joint mobility
- Maitland provided a framework for description of various grades of joint manipulation. The framework is based on the depth within the range of motion that the force is applied and the rate of oscillation application, five grades are commonly used
- It is unclear what forces are required to perform joint manipulation and if they are consistent among practitioners
- Lacking is a study analyzing physical therapists and the forces they produce during all grades of joint assessment and manipulation
- Joint manipulation is a component of physical therapy entry level education. Manual therapy is a content area currently required by the Commission on Accreditation in Physical Therapy Education to be included in professional physical therapist education programs
- During spinal manipulation, individual therapists have had limited agreement on a specific location requiring spinal manipulative therapy. The forces applied vary greater from practitioner to practitioner

Objectives

- Determine the amount of force orthopedic physical therapists use to perform joint mobility assessment and grades I to IV of joint manipulation on the thoracic spine
- Help in understanding the forces provided by the physical therapists in joint assessment and manipulation, which may aid in teaching and result in better therapist agreement on joint assessment

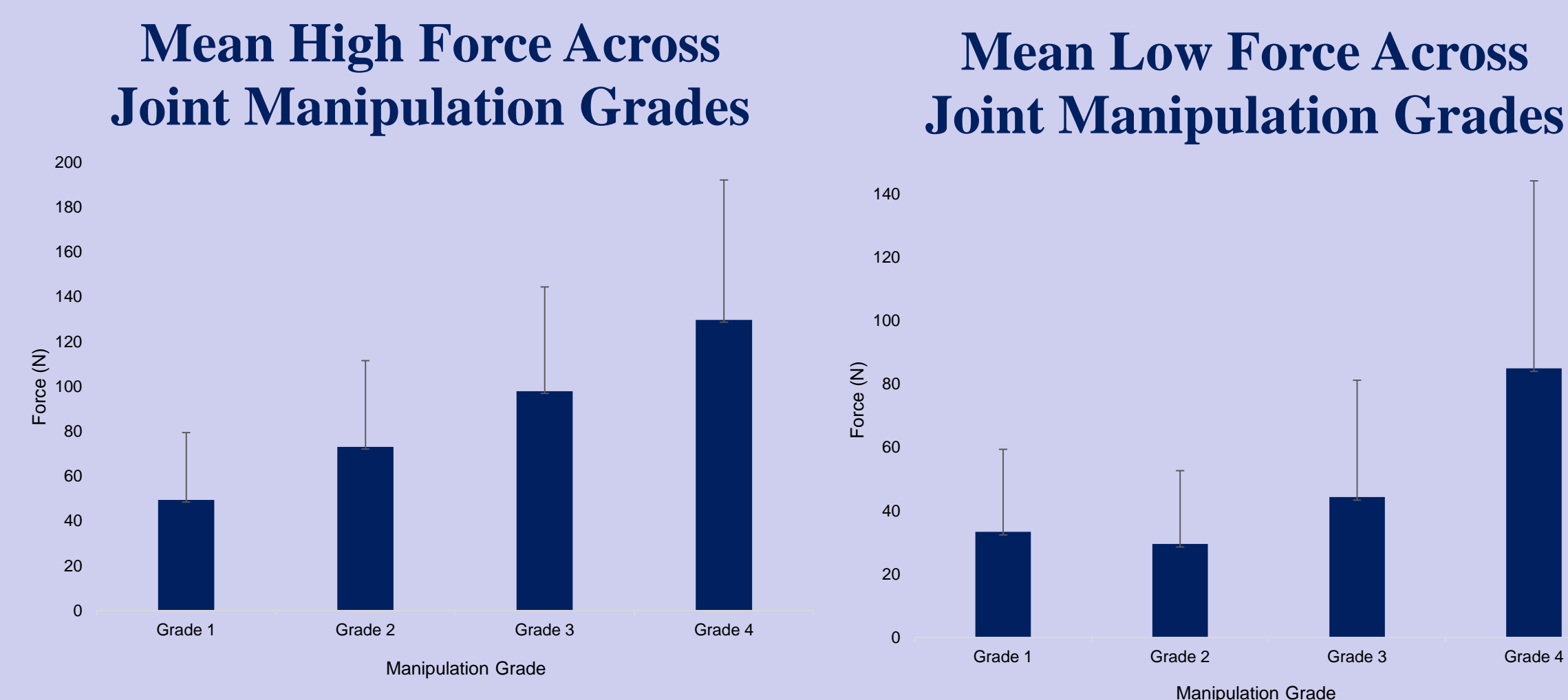
Methods

- 19 physical therapists in the southwest Florida area working in the outpatient orthopedic setting were recruited to participate
- The PTs were asked to perform joint mobility assessment in a posterior-anterior direction on the thoracic spine at the level of the inferior border of the scapula and one spinal level above and below on one of the researchers
- Following the assessment, grades I-IV of joint manipulation on the transverse processes of the thoracic spine in a posterior to anterior direction were performed at the three levels. Each grade of joint manipulation was performed three times and averaged
- The forces exerted by the physical therapists was measured with the MotionMonitor® Manual Therapy system, a device designed to track force and impulse data during real-time exercises



Results

- The forces used to assess joint mobility of the thoracic spine showed a large amount of variability. The mean high force during assessment was 104.93 N and the mean low force was 63.20 N, with a standard deviation of 33.80 N and 33.35 N, respectively. The range was measured to be 137.33 N for high force, and 104.64 N for low force
- A large variability between subjects was also observed in the mean high and low forces for grades I-IV of joint manipulation
- There was a statistically significant difference in force (N) between grades I-IV of joint manipulation for both mean high force (p=.000) and mean low force (p=.000). There was also a statistically significant difference (p=.019) in time (s) between oscillations in grades I-IV of joint manipulation
- For pairwise comparisons of mean high force, there were significant differences (p=.000) between all grades of joint manipulation
- For the pairwise comparisons of mean low force during joint manipulation, there were significant differences (p<.05) between grades I and IV, grades II and III, grades II and IV, and grades III and IV of joint manipulation
- For the pairwise comparisons of mean time between joint manipulations, there were significant differences (p=.000) between grades I and II of joint manipulation



Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Assessment Mean High Force	19	137.33	45.78	183.10	104.93	33.80
Assessment Mean Low Force	19	104.64	6.50	111.14	63.20	33.35
Valid N (listwise)	19					

	Mean	Std. Deviation	N		Mean	Std. Deviation	N
Grade 1 Mean Low Force	33.3330	26.06724	19	Grade 1 Mean High Force	49.3802	30.04724	19
Grade 2 Mean Low Force	29.5130	23.13035	19	Grade 2 Mean High Force	73.0313	38.52201	19
Grade 3 Mean Low Force	44.3185	36.89186	19	Grade 3 Mean High Force	97.8796	46.53694	19
Grade 4 Mean Low Force	84.9492	59.21100	19	Grade 4 Mean High Force	129.7135	62.36692	19

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	Sig.
Mean_Time	.454	4.436 ^b	3.000	16.000	.019
Pillai's Trace	.546	4.436 ^b	3.000	16.000	.019
Wilks' Lambda	.832	4.436 ^b	3.000	16.000	.019
Hotelling's Trace	.832	4.436 ^b	3.000	16.000	.019
Roy's Largest Root	.832	4.436 ^b	3.000	16.000	.019

Effect	Value	F	Hypothesis df	Error df	Sig.
Mean_Low_Force	.675	11.095 ^b	3.000	16.000	.000
Pillai's Trace	.325	11.095 ^b	3.000	16.000	.000
Wilks' Lambda	2.080	11.095 ^b	3.000	16.000	.000
Hotelling's Trace	2.080	11.095 ^b	3.000	16.000	.000
Roy's Largest Root	2.080	11.095 ^b	3.000	16.000	.000

Effect	Value	F	Hypothesis df	Error df	Sig.
Mean_High_Force	.805	22.004 ^b	3.000	16.000	.000
Pillai's Trace	.195	22.004 ^b	3.000	16.000	.000
Wilks' Lambda	4.126	22.004 ^b	3.000	16.000	.000
Hotelling's Trace	4.126	22.004 ^b	3.000	16.000	.000
Roy's Largest Root	4.126	22.004 ^b	3.000	16.000	.000

Pairwise Comparisons

(I) MeanTime	(J) MeanTime	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
1	2	-.104 [*]	.027	.007	-.183	-.024
	3	-.242	.096	.132	-.528	.044
	4	-.084	.062	1.000	-.267	.100
2	1	.104 [*]	.027	.007	.024	.183
	3	-.138	.081	.620	-.377	.100
	4	.020	.058	1.000	-.153	.193
3	1	.242	.096	.132	-.044	.528
	2	.138	.081	.620	-.100	.377
	4	.158	.096	.714	-.128	.444
4	1	.084	.062	1.000	-.100	.267
	2	-.020	.058	1.000	-.193	.153
	3	-.158	.096	.714	-.444	.128

(I) MeanHighForce	(J) MeanHighForce	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
1	2	-23.651 [*]	3.029	.000	-32.625	-14.677
	3	-48.499 [*]	6.425	.000	-67.534	-29.465
	4	-80.333 [*]	9.455	.000	-108.345	-52.322
2	1	23.651 [*]	3.029	.000	14.677	32.625
	3	-24.848 [*]	4.425	.000	-37.959	-11.738
	4	-56.682 [*]	7.005	.000	-77.437	-35.927
3	1	48.499 [*]	6.425	.000	29.465	67.534
	2	24.848 [*]	4.425	.000	11.738	37.959
	4	-31.834 [*]	4.102	.000	-43.988	-19.680
4	1	80.333 [*]	9.455	.000	52.322	108.345
	2	56.682 [*]	7.005	.000	35.927	77.437
	3	31.834 [*]	4.102	.000	19.680	43.988

(I) MeanLowForce	(J) MeanLowForce	Mean Difference (I-J)	Std. Error	Sig. ^b	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
1	2	3.820	1.358	.009	-.205	7.845
	3	-10.985	4.008	.081	-22.860	.889
	4	-51.616 [*]	8.761	.000	-77.572	-25.661
2	1	-3.820	1.358	.009	-7.845	.205
	3	-14.806 [*]	4.183	.014	-27.198	-2.413
	4	-55.436 [*]	9.285	.000	-82.945	-27.927
3	1	10.985	4.008	.081	-.889	22.860
	2	14.806 [*]	4.183	.014	2.413	27.198
	4	-40.631 [*]	6.782	.000	-60.723	-20.539
4	1	51.616 [*]	8.761	.000	25.661	77.572
	2	55.436 [*]	9.285	.000	27.927	82.945
	3	40.631 [*]	6.782	.000	20.539	60.723

Data Analysis

- Data was analyzed using descriptive statistics to quantify the mean high and low forces for thoracic joint mobility assessment and grade I-IV manipulation, and mean time between oscillations for grade I-IV manipulation.
- Two repeated measures analyses of variance (ANOVAs) were performed to determine if significant differences occur in mean high force and mean low force (N) between manipulation grades I-IV.
- A third repeated measures ANOVA was performed to determine if significant differences occur in time between oscillations (s) in grades I-IV manipulation.

Discussion

- The forces observed during joint mobility assessment showed a high amount of variability with a standard deviation of close to 33 N for both high and low mean forces, suggesting a potential difference in assessment technique between physical therapists.
- A large standard deviation was observed between the grades of joint manipulation with high and low mean forces, especially grade IV with a standard deviation of 62.37 N for mean high force and 59.21 N for mean low force.
- Statistically significant differences (p=.000) were found between grades I-IV of joint manipulation for both mean high force and mean low force, indicating physical therapists are able to significantly modify their application of force based on grade of manipulation they intended to apply.
- In pairwise comparisons, significant differences were found in mean high force between all four grades of joint manipulation (p=.000), suggesting that PTs apply high forces for each grade of manipulation that are significantly different from one another.
- In pairwise comparisons, the only significant difference in time between oscillations occurred between grade I and II (p=.007).

Conclusions

- There is a high amount of variability between orthopedic physical therapists for both high and low mean forces used to perform thoracic joint mobility assessment, and Maitland grades I-IV of joint manipulation
- The applied manual forces measured during P-A spinal manipulation vary markedly among practitioners when applying the same technique
- Due to the high variability among subjects and the lack of literature on joint manipulation forces applied by PTs, future research is needed to improve standardization of forces utilized for joint mobility assessment