

The Handwriting Kinetics of Lateral Tripod Grip vs. Static and Dynamic Tripod Grips in School-Age Children

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Summary

This study investigates the kinetic effects of the Lateral Tripod (LT) Grip compared to the Static and Dynamic Tripod (SDT) Grip in school-aged children. In younger children, using the LT Grip during circle tracing resulted in higher average force (AF) in the index finger but lower AF in the middle finger. The coefficient of variation of force (CVF) at the pen tip was greater with the SDT Grip. In older children, CVF patterns differed: the thumb, index, and middle fingers had higher CVF with the LT Grip, while the pen tip's CVF was lower, and during large-circle tracing, the number of force fluctuations per second (NFFPS) in the thumb and middle finger was higher with the SDT Grip. Most differences were trends, with few reaching significance. These findings suggest that grip type influences handwriting mechanics across age groups.

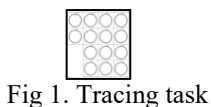
Introduction

Previous studies show that static, dynamic, and lateral tripod grips are mature patterns with no significant effect on handwriting legibility [1] yet differ biomechanically in thumb positioning and web space. Research on their mechanical effects is limited. This study explores them from a kinetic perspective in school-aged children.

Methods

This study recruited children from kindergarten, 2nd, 4th, and 6th grades. The Force Acquisition Pen System [2] measured handwriting biomechanics, recording finger and pen tip forces.

The task involved tracing large (5×5 cm) and small (1.5×1.5 cm) circles (Fig 1). AF is mean force per trial, CVF is force variation ratio, and NFFPS is force fluctuations per second. T-tests and Mann-Whitney U tests analyzed grip differences.



Results and Discussion

Data from 131 children were analyzed. In the younger group, 24 used the SDT Grip (age 6.8 yrs), and 30 used the LT Grip (age 7.1 yrs). In the older group, 30 used the SDT Grip (age 11.1 yrs), and 47 used the LT Grip (age 11.2 yrs). The LT Grip tended to produce higher AF in the index finger but lower AF in the middle finger for younger children, while CVA at the pen tip appeared greater with the SDT Grip. In older children, CVA of the three fingers was generally higher with the LT Grip, while pen tip CVA was lower. During large-circle

tracing, NFFPS in the thumb and middle finger was higher with the SDT Grip. These findings suggest potential differences in force distribution between grips, though they were not statistically significant.

Table 1. Results of Grip Effects.

		Younger			Older		
		M	SD	p	M	SD	p
NFFPS(Thumb)large	SDT	1.23	0.26	0.46	1.36	0.32	0.03*
	LT	1.29	0.31		1.24	0.34	
NFFPS(Index)large	SDT	1.50	0.34	0.45	1.74	0.48	0.91
	LT	1.44	0.21		1.72	0.51	
NFFPS(Middle)large	SDT	1.85	0.65	0.24	2.13	1.25	0.11
	LT	1.63	0.67		1.78	0.83	
NFFPS(Pen tip)large	SDT	1.47	0.23	0.38	1.61	0.20	0.18
	LT	1.53	0.23		1.67	0.19	
AF(Thumb)large	SDT	2.39	0.94	0.99	2.96	1.12	0.77
	LT	2.45	0.99		2.88	1.01	
AF(Index)large	SDT	1.49	0.62	0.10	1.86	0.88	0.52
	LT	1.80	0.69		1.90	0.67	
AF(Middle)large	SDT	0.97	0.53	0.12	1.48	0.86	0.58
	LT	0.76	0.42		1.51	0.85	
AF(Pen tip)large	SDT	0.98	0.26	0.12	1.19	0.38	0.93
	LT	1.12	0.40		1.19	0.36	
AF(Thumb)small	SDT	2.90	0.86	0.32	3.62	1.46	0.28
	LT	2.77	1.25		3.28	1.14	
AF(Index)small	SDT	1.58	0.58	0.07	2.08	0.95	0.78
	LT	1.86	0.66		2.02	0.67	
AF(Middle)small	SDT	1.35	0.60	0.05*	1.85	0.90	0.93
	LT	1.09	0.82		1.87	1.06	
AF(Pen tip)small	SDT	0.89	0.23	0.35	1.10	0.41	0.89
	LT	0.95	0.23		1.09	0.39	
CVF(Thumb)large	SDT	0.40	0.09	0.70	0.30	0.07	0.03*
	LT	0.39	0.11		0.34	0.08	
CVF(Index)large	SDT	0.37	0.10	0.58	0.28	0.07	0.36
	LT	0.35	0.10		0.29	0.07	
CVF(Middle)large	SDT	0.53	0.21	0.21	0.35	0.13	0.07
	LT	0.63	0.31		0.41	0.15	
CVF(Pen tip)large	SDT	0.54	0.12	0.15	0.44	0.06	0.53
	LT	0.50	0.10		0.43	0.05	
CVF(Thumb)small	SDT	0.42	0.06	0.19	0.34	0.07	0.12
	LT	0.39	0.11		0.36	0.08	
CVF(Index)small	SDT	0.34	0.08	0.89	0.28	0.06	0.20
	LT	0.34	0.10		0.30	0.06	
CVF(Middle)small	SDT	0.49	0.12	0.76	0.37	0.09	0.17
	LT	0.50	0.22		0.41	0.12	
CVF(Pen tip)small	SDT	0.61	0.13	0.09	0.52	0.06	0.35
	LT	0.56	0.19		0.51	0.08	

Conclusions

This study examines pencil grip biomechanics across ages and tasks, providing insights for handwriting interventions despite limited statistical significance.

References

- [1] Schwellnus, H et al.(2013). *Am J Occup Ther*, 67(2), 218-227.
- [2] Hsu, HM et al.(2013). *Measurement*, 46(1), 506-513.