Transverse Plane Kinematics Between Walking and Running Change Frequently for Children with Idiopathic In-Toeing or Out-Toeing

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INTRODUCTION: Idiopathic in-toeing and out-toeing are common orthopedic conditions that are sometimes treated via surgical intervention. Motion analysis can be an important tool for determining the change in rotation of the lower limb when running versus walking. Past studies have focused on rotational analysis of the pelvis, but do not consider those of the foot and hip in the transverse plane. This study aims to quantify rotational changes that occur in participants with idiopathic in-toeing and out-toeing when running versus walking of the pelvis, hip, and foot relating to the transverse plane.

METHODS: A retrospective study of participants with idiopathic in-toeing and out-toeing were selected based on running and walking kinematic data obtained from instrumented gait analysis. Using a 5th to 95th percentile calculation as a control, a change in rotation of over ten degrees in the transverse plane was considered significant and was used to determine the prevalence of participants that adjusted their gait appreciably when running versus walking.

RESULTS: There were 328 participants that completed a gait analysis study. 145/328 (44.2%) displayed a change in gait (in at least one level of pelvis, hip or foot) when running, greater than ten degrees. In regard to foot progression and hip rotation, participants with an in-toeing diagnosis displayed an outward change when running. The opposite held true for out-toeing participants; they displayed a more inward change when running. When measuring pelvic rotation, participants that exhibited a change in gait showed a more pronounced external change, regardless of diagnosis.

DISCUSSION AND CONCLUSION: Adolescents with idiopathic in-toeing and out-toeing that have an ability to alter their transverse plane gait angles tend to change them more often in the opposite direction of their respective diagnosis. An adolescent with in-toeing may change more outward when running and the reverse is true for adolescents with out-toeing.

Independent Variables	Dependent Variables	
Diagnosis (Petwees subjects), 6 levels: Pensonal seriovenion Femoral extravenion Internal tribuil tension Internal tribuil tension Into and tribuil tension In-toning (not otherwise specified) Out-toning fact otherwise specified) Speed (withing subjects), 2 levels Walking	Fost progression His rationa Pelvic progression	

Diagnosis	Significant change	No significant change	
Femoral anteversion (n=116)	44%	56%	Diagnosis
Femoral retroversion (n=41)	56%	44%	Femoral aut
Internal tibial torsion (n=63)	42%	58%	Femoral rev
External tibial torsion (n=64)	38%	62%	Internal tibe
In-toning (n=19)	42%	58%	External tib
Out-toeing (n=20)	50%	50%	In-toeing (n

	Foot Progression				Hip Retation	
socis	More Internal Regaring	More External Regarding	No Charge	Diaznosis	More Internal Running	
ral autevenion (n=116)	65	28%	66%	Femoral anteversion (n=116)	3%	
ral retroversion (n=41)	39%	10%	51%	Femoral serroversion (n=41)	37%	
nd tibial torsion (n=68)	6%	24%	70%	Internal tibial tension (n=63)	6%	
nal tibial tenion (n=64)	17%	11%	72%	External tibial tenion (s=64)	19%	
ning (n=19)	0%	26%	74%	In-toeing (n=19)	0%	
oning (n=20)	30%	20%	50%	Out-toeing (n=20)	15%	П

	Pelvic Rotation				
Diagnosis	More Internal Running	More External Renning	No Change		
Femoral anteversion (n=116)	1%	22%	77%		
Femoral retraversion (n=41)	2%	12%	86%		
Internal tibial torsion (n=68)	0%	13%	87%		
External tibial tonsion (n=64)	3%	17%	80%		
In-toeing (n=19)	5%	32%	63%		
Out-toring (n=20)	0%	25%	75%		