Introduction

Neurotypically developing children who toe walk usually spontaneously resolve by school age, those who do not are considered to have Persistent Idiopathic Toe Walking (ITWp) and may develop ankle contractures and foot skeletal deformities.

Alvarez et al. proposed a classification scheme in 2006. When it was applied to our cohort, it failed to classify many subjects due to ambiguity in the classification scheme definitions.

Methods

- This was a single-center, retrospective record review of 65 neurologically normal children (mean age 11.1, range 6.0-19.4) diagnosed with ITWp, with completed kinematic and kinetic motion analysis.
- Utility (percent classifiable) was determined for the novel Shriners Hospital for Children (SHC-ITWp) and Alvarez classification schemes.
- Intra- and inter-rater reliability were determined for a subset of patients using the SHC-ITWp (30 limbs preand post-op).

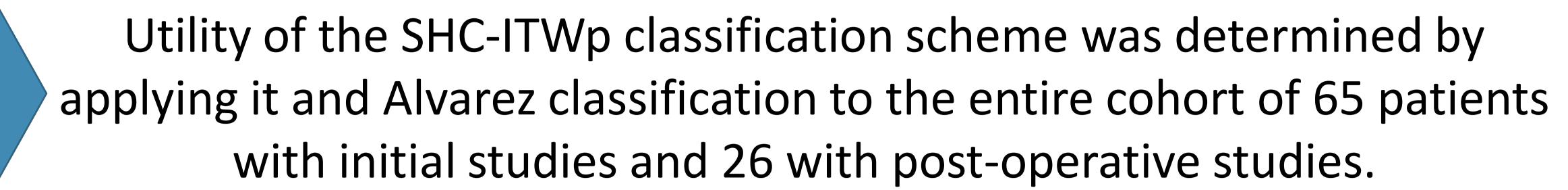
Definitions

	SHC-ITWp Classification Criteria
	Ankle Sagittal Kinematics/ Kinetics
1	Present kinetic 1 st rocker
	Kinematics/kinetics: No abnormalities
2 a	Present kinetic 1 st rocker
	Kinematics/ kinetics: Additional 1 or more abnormality
2b	Absent kinetic 1 st rocker
	Kinematics/ kinetics: No other abnormalities
3	Absent kinetic 1 st rocker
	Kinematics/ kinetics: Additional 1 or more abnormality
4 a	Absent kinetic 1 st rocker
	Kinematics: Plantarflexion bias in stance and swing
	Kinetics: Moment double bump (2 nd peak larger)
4b	Absent kinetic 1 st rocker
	Kinematics: Plantarflexion bias in stance and swing
	Kinetics: Moment double bump (1 st peak larger)

Reliability and Utility of a Novel Classification Scheme for Gait **Deviations in Children with Persistent Idiopathic Toe Walking**

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Ар	plicatio	n of the	SHC-IT	Wp Clas	Application of the Alvarez Classification Sch								
	Туре	Туре	Туре	Туре	Туре	Туре	Uncateg-			Туре	Туре	Туре	Uncateg
	1a	1b	1c	2	3a	3b	orizable			1	2	3	orizable
Initial	3	1	2	9	55	60	0		Initial	3	8	60	59 (45%)
(130 limbs)									(130 limbs)				
Post-Op	20	11	12	8	1	0	0		Post-Op	23	6	0	23 (44%)
(52 limbs)									(52 limbs)				

The SHC-ITWp classification scheme accurately classified 100% of limbs (130 of 130 limbs prior to intervention, 52 of 52 limbs following surgery).

> Reliability of the SHC-ITWp classification scheme was determined by frequency of agreements for intra- and rater-agreement. The shaded fields indicate perfect agreement.

Frequency of Intra-Rater Agreement								Frequency of Inter-Rater Agreement							
Rater 1 2 nd Pass								Rater 2							
Rater 1	1	2A	2B	3	4A	4B		Rater 1	1	2A	2B	3	4A	4B	
1 st Pass															
1	14							1	11	3					
2A		6		1				2A	1	5					
2 B			5					2B			5	1			
3			1	6				3		1		5	1		
4A					14			4A					13	1	
4B						13		4B						13	

Utility of the SHC-ITWp classification scheme was determined by

- The Alvarez classification scheme was only able to classify 61 of 130 limbs (55%) prior to intervention and 29 of 52 limbs (56%) following surgery.

Intra-rater agreement was 96.7% with a weighted kappa of 0.98. Inter-rater agreement was 86.7% with a weighted kappa of 0.93.

Discussion

- The Alvarez classification exhibited marked deficiencies when applied to a large cohort of subjects with ITWp.
- The SHC-ITWp classification scheme resolved the issues presented by Alvarez by modifying the criteria initially presented.
- First, we subdivided the classification groups to more accurately represent disease severity, the variety of type 2's described in Alvarez are now separated out into type 2a, 2b, 3 and distinct from type 1.
- Second, the classification types are now discrete, patients no longer qualify for multiple types.
- Finally, we added classification types (2a and 3) that include 1+ abnormal kinematics and/or kinetics to take into account gait abnormalities observed in children with ITWp.

Conclusion

- The SHC-ITWp exhibited excellent utility and reliability in classifying the limbs of children with ITWp.
- The SHC-ITWp accurately classified 100% of limbs; both prior to intervention and following surgery. In contrast, the Alvarez classification scheme exhibited poor utility, as it was only able to classify 55% prior to intervention and 56% following surgical intervention.
- The SHC-ITWp also exhibited excellent reliability with intra-rater agreement of 97% and inter-rater agreement of 87%.

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