Therapeutic Interventions for Idiopathic Toe Walking in a Collegiate Basketball Player: A Case Study

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Abstract

Objective: The purpose of this case study is to determine the effect of various therapeutic techniques on idiopathic toe walking in a collegiate basketball player.

Methods: This study discusses interventions used to treat and reverse idiopathic toe walking in an 18-year-old collegiate basketball player with a posterior cruciate deficit knee and pes planus bilaterally. Research regarding effective conservative treatments for this pathology is slim. Therefore, this study investigates the effects of a multi-dimensional clinical approach, including various therapeutic exercises, fascial and muscular release, and joint mobilizations.

Results: The results showed that the athlete's ability to generate a heel strike drastically improved from 5 weeks of daily intervention and treatment. Treatment is ongoing, with weekly interactions with a physical therapist and daily interventions performed by a certified athletic trainer and athletic training student.

Discussion: The evidence in this case study supports the use of a multi-dimensional clinical approach, including various therapeutic exercises, fascial and muscular release, and joint mobilizations for idiopathic toe walking. In this case study, the patient reported a significantly increased range of motion bilaterally. Therefore, further studies of this multidimensional approach are warranted.

Introduction and Background

The patient in this case study presented with idiopathic toe walking bilaterally since childhood. Toe-walking is defined as the inability to generate a heel strike during the initial contact phase of the gait cycle and the absence of complete full foot contact during the entire standing phase (seen in *Figure 2*).[1] This biomechanical pattern is often seen in children under 3. However, it is considered idiopathic toe walking when it persists into childhood and/or adulthood without signs of neurological, orthopedic, or psychiatric diseases such as cerebral palsy, muscular dystrophy, and an autism spectrum disorder.[1] In juxtaposition to normal gait patterns, toe walking results in altered lower-limb biomechanics and muscular engagement. The prolonged plantarflexion needed to maintain position in the stance phase requires more power from both the soleus and gastrocnemius.[2] The quadriceps contribute at higher levels than normal in the loading and mid-stance phases.[2] Moreover, more muscles require higher muscular effort to stabilize the body. Toe walking is also associated with larger muscle forces exerted by the quadriceps to the patella and prolonged force transmission through the Achilles tendon during the stance phase, thus increasing the potential for patellar and Achilles tendon injuries.[2] Therefore, treatment plans should account for the patient's muscular demands and potential overloads from compensatory mechanisms.

Methods

For this study, the patient was treated with a multi-dimensional approach to generate and treat idiopathic toe walking with the primary goal of generating a heel strike and improving ankle dorsiflexion. This approach included muscular and fascial release, joint mobilizations, and therapeutic exercises:

A. **Facial and Muscular Release –** To perform this, the pressure was applied in various locations while the patient actively contracted the muscle or tissue involved. Moreover, the patient was also instructed to use a foam roller and lacrosse ball to roll out the involved muscle or fascia (seen in *Figure 1*).
B. **Joint Mobilizations –** Due to limited dorsiflexion, joint-mobilization techniques were used to increase arthro-kinematic motion within the joint.[3] Proper accessory motion is required to achieve a full range of motion. With normal ankle dorsiflexion, the convex talus glides posteriorly, rolls upward, and rotates externally on the concave surface of the mortise, and the fibula glides superiorly and moves laterally away from the tibia.[3] The joint mobilizations performed include anterior and posterior talocrural mobilizations and posterior distal fibular mobilizations.
C. **Therapeutic Exercises –** The therapeutic exercises prescribed (see *Table 1*) aimed to improve ankle dorsiflexion flexibility, strengthen ankle dorsiflexor muscles, build up the patient's fallen arch bilaterally, and correct muscular imbalanced bilaterally from biomechanical gait issues. Moreover, other exercises were prescribed for strengthening knees to prevent valgus collapse due to past medical history.

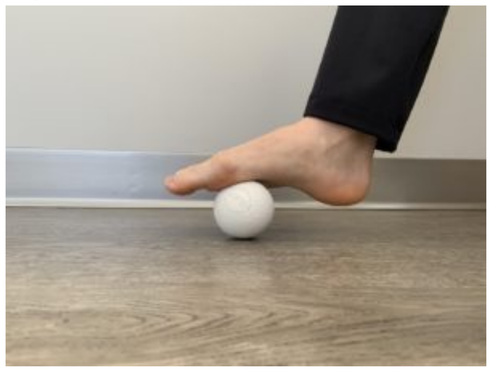
Table 1: Therapeutic Exercise Prescription

Week 1:	Week 2:	Week 3:	Week 4:	Week 5:
Incline Board Calf Stretch	Incline Board Calf Stretch	Incline Board Calf Stretch	Incline Board Calf Stretch	Incline Board Calf Stretch
Leg Lock Bridge	Leg Lock Bridge	Short Foot	Short Foot	Short Foot
Single Leg Leg Press w/ blood flow restriction	Eccentric Heel Touchdowns	Long Stride Steps	Long Stride Steps	Long Stride Steps
BAPS	Stool Scoots	BAPS Board	BAPS Board	BAPS Board
Pilate Heel Taps	Dynamic Hamstring Stretch	Dynamic Hamstring Stretch	Dynamic Hamstring Stretch	Dynamic Hamstring Stretch
	Dynamic Hip Flexor Stretch	Dynamic Hip Flexor Stretch	Dynamic Hip Flexor Stretch	Dynamic Hip Flexor Stretch
		Stool Scoots	Stool Scoots	Stool Scoots
			A- Skips	A- Skips
			Eccentric Heel Touch Downs	Eccentric Heel Touch Downs
				Box Drops

Table 2: Range of Motion [4]

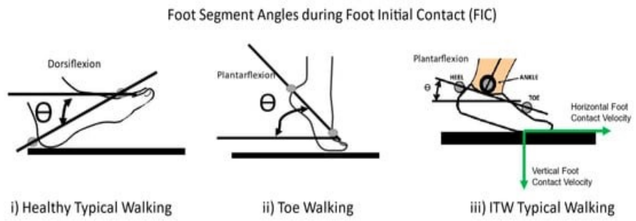
Range of Motion	Normal (Female 9-19)	Pre-Treatment	Post-Treatment
Dorsiflexion	17.3 (15.6 – 19.0) degrees	7.2 degrees	13.7 degrees
Plantarflexion	57.3 (54.8 – 59.8) degrees	95.3 degrees	93.6 degrees

Figure 1: Plantar-fascial Release[5]



Note. From "Plantar-fascial Release" by inertiaphysio, n.d., retrieved from https://inertiaphysio.ca/trigger-point-release-self-treatment-with-a-lacrosse-ball/

Figure 2: Foot Segment Angles during Foot Initial Contact (FIC)[6]



Results and Conclusion

The results show that the multi-dimensional approach is applied to treat the biomechanical gait issue of idiopathic toe walking. As seen in *Figure 2*, the patient displays significant improvement with ankle dorsiflexion from 5 weeks of treatment. However, it is hard to determine which treatment had the most impact on increasing ankle dorsiflexion. By increasing the ability to dorsiflex the ankle, the patient can now generate a heel strike, thus altering her gait. By altering her gait, she aims to decrease the stress placed on her dorsiflexors and knee extensors and strengthen their antagonist muscles, plantar flexors, and knee flexors. As this condition has developed over the past 18 years, rehabilitation for correction will occur gradually. Currently, there is little to no research in conservative management and treatment for idiopathic toe walking. Instead, only drastic surgical treatments such as arch reconstruction, ankle reconstruction, and bilateral ankle booting are considered standard practices.

Future Work

1. Other clinicians can learn from this study and see that more conservative treatment options exist to treat idiopathic toe walking. This study shows clinicians can use a personalized multi-dimensional approach to this pathology. I would want to pair these results and the case series with other trials from more clinicians.
2. Future clinicians can take aspects of the multidimensional approach listed and split them up and perform a controlled trial, thus determining the most effective treatment technique performed.
3. Future clinicians should research the connection between idiopathic toe walking and posterior cruciate ligament sprains, as toe walkers often have overactive quadriceps, thus potentially weakening the PCL.

References and Acknowledgments

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