LGJDX Journal Of Liaoning Technical University Natural Science Edition
ISSN No: 1008-0562

COMPARATIVE STUDY TO SEE THE EFFECT OF HOLD RELAX TECHNIQUES WITH OR WITHOUT AFOS IN CHILDREN WITH IDIOPATHIC TOE-WALKING

Uswa Fatima[1], Zanbia Ayoub[1], Asma Khalid[1], Chaman Lal[2] Jeeya Paul[3]

1 Royal Institute of Medical Sciences, Multan, Pakistan.
2 Lincoln University College Malaysia.
3 TIMES Institute Multan, Pakistan.

LGJDX Journal Of Liaoning Technical University
ISSN No: 1008-0562 Natural Science Edition

Abstract

Background: Toe walking is a typical pattern seen in young, healthy children and is a problematic pattern seen in anatomical abnormalities and neuromuscular disorders. Idiopathic toe walking refers to this condition as a singular gait anomaly (ITW). Idiopathic toe walkers are typically developing kids (greater than 3 years old) who are seen to walk on their toes. Anecdotal descriptions of toe walking include "walking on toes" and "bouncy gait," according to referring doctors. Toe walking is described by orthopedic surgeons and physiotherapists as having reduced ankle range of motion and being unable to heel strike at the initial point of stride.

Objective of study: Objective of the study was to explore the combine effect of HRT and AFO's with idiopathic toe walking.

Materials and Methods: A cross sectional experimental study was used in which total 60 patients was included having idiopathic toe walking with the age of 5 or less than 5-year-old. SPSS 26 was used to evaluate the results of this study

Results: This study shows that the combine of effect of AFO's and hold relax technique was more effective than single application of hold relax technique.

Conclusion: Patients treated with AFO's and HRT shows more effective results than HRT.

Keywords: Idiopathic toe walking, Ankle Foot Orthoses (AFOs), Hold-relax techniques.

Introduction:

Neurodevelopmental changes associated with idiopathic point walking, differential diagnosis of neurological and orthopedic diseases. Early neurodevelopmental assessment along with diagnosis can improve patient care and follow-up. The aim of our study was to compare preschool idiopathic finger walkers (ITW) with controls in terms of neurodevelopmental characteristics. We chose randomized controlled trials (RCTs) for this example because it is considered the gold standard and has the highest reliability because it can avoid any kind of bias. Wrist injury does not occur when walking quietly, a bipedal abnormality in which the forefoot bears most of the weight. In infants younger than two years of age, this abnormality may not be a disease, but is often the basis for referral to plastic surgery. Walking on your toes can be the first sign of a serious developmental problem that can result from a variety of neurological and developmental issues. Idiopathic conditions are conditions that do not have a clear explanation. Most children who report walking on their toes require a complete physical examination, a complete medical history, and a good developmental history. Age and degree of abnormality will determine treatment. Observation, stretching, cast, brace, neurasthenia medicine, and surgery are all treatments. (one). Toe walking can be treated with physical therapy, orthosis, plaster cast and Botox. surgery, gastrocnemius/soleus injection, or both; However, little data are available on the long-term effects of treatment. (2) Children with toe walking (ITW) are often treated to reduce ankle dorsiflexion. Randomized controlled studies (RCTs) have not produced sufficient data to determine the effects of ITW. One study provided information on the effects of continuous casting with or without BTX injection prior to casting; however, contradictory and inconclusive evidence can be obtained. Three other trials yielded results with BTX as ITW therapy, shoes, fitness equipment, and various types of tubing or tubing; (3) 204 children with ITW aged 4 to 7 years without medical examination, orthopedic surgery, medical treatment, neurology surgery. or physical therapy (4) 204 ITW children aged 4 to 7 years for diagnosis, orthopedic surgery, medical therapy, neurology, neurology or home physical therapy surgery treatment (4).ITW can be treated by observation alone, but if finger flexion and ankle dorsiflexion are limited and walking persists for more than two to three years, other treatment options should be explored. Physical therapy is often used to treat ITW and includes heel-to-toe exercises, ankle stretches, and teaching balance and coordination. The ability of muscle tissue to absorb elongation and

reduce myofibril tension is associated with adequate muscle strength. Insufficient hamstring flexibility is associated with poor changes in lower extremity kinematics. Tight hamstrings are associated with many musculoskeletal conditions, including back, hip, and knee injuries and types in athletes and non-athletes. Wearing high-heeled shoes can interfere with toe walking. Using an ankle-foot orthosis (AFO) can interfere with walking on your toes. They are made of durable plastic and fit below the knee as shown in Figure 4. feet and calves). (5) Patients with ankle dorsiflexion or plantar flexor weakness due to conditions such as stroke, cerebral palsy, spinal cord injury and peripheral nerve injury often use ankle splints or flexible tubes (AFO).It's also great for people with broken bones, ankle and foot abnormalities, or arthritis. AFOs assist walking by stabilizing the ankle and foot, maintaining their alignment, and preventing and correcting ankle and foot abnormalities. AFO prevents foot friction, creates a space between the foot and the ground during walking, and balances the body by bringing the heel to the ground during stance. Stretching has been used to improve hamstring elasticity and range of motion (ROM) and improve recovery in sports and physical therapy. Stretching can cause further changes, but the exact mechanism is unknown. According to current theory, stretching increases flexibility by reducing muscle stiffness and stiffness, among other things. According to some research, stretching makes muscles less sticky and increases tissue elasticity. However, findings from other studies detecting changes in muscle mass contradict a decrease in skeletal muscle mass. Long-term endurance after stretching coordinates with ROM changes in addition to soft tissue changes. It is also believed that stretching changes the structure of muscles and other tissues. In fact, long-term adaptations lead to greater working capacity. Toe walking is a common pattern in children under 3 years of age [1] and a pathological pattern in neuromuscular diseases [2] and structural deformities [3].

Methodology

Research technique is an approach that completely addresses research issues. It is a science that examines the methodological aspects of research. Hence, methodology refers to the scientific approach used to undertake a research project (20)
First of all evaluate patients and select those who met inclusion criteria and were divided into two groups by using online randomization generator . Then hold relax techniques were applied

on one group while ankle-foot orthoses were wore by the comparative intervention group along with the hold relax techniques.

3.2 Patients

60 patients were included in our research target, they were divided into two groups as A and B groups, there were 30 patients in each group.

3.3 Study design:

Randomized controlled trials were used as study design. Patients were divided into two groups, intervention and comparison intervention via an online generator. The intervention group received the hold-rest technique and the comparison group received the application of ankle-foot orthoses. An event, comparison, quantitative study, or experiment that uses randomization to assign an intervention to the comparison group is called a randomized controlled trial (21).

3.4 Location:

The study location will be, RIMS Physiotherapy Clinic and Azeem Physiotherapy and Rehabilitation Center Multan.

3.5 Duration (in weeks):

All research and data collection and analysis took four months.

3.6 Intervention and comparison Intervention group:

Intervention group

Intervention group, 30 idiopathic toe walking patients. In this patient group, the hold-rest technique was applied to the patients.

Intervention comparison group.

Thirty patients were included in the intervention control group. Standing system and ankle-foot orthoses (AFO) with HRT were applied to the patients in this group.

3.7 Intervention:

3.7(a) Intervention Group:

Thirty patients with idiopathic point gait were included in the intervention group. Patients in this group were treated with the stay-at-home procedure.PNF stretching is popular in medical practice and is easy to use. PNF stretching is an effective method for strengthening and strengthening. PNF stretching is based on deepening the relationship between the muscles. (22).

3.7(b) Comparison of treatment groups:

Thirty patients with idiopathic toe walking were included in the intervention control group. Fixed technique and ankle-foot orthosis (AFO) with HRT were applied to the patients in this group. An orthotic device called an ankle-foot orthosis (AFO) is fixed to the wearer and rests on the wearer's ankle and foot. The user's neuromusculoskeletal system supports or enables the AFO to perform its functions. To help the weak and paralyzed muscles of the ankle heal the orthopedic wearer, AFO can create an auxiliary force or strength.AFO was developed not only for medicinal purposes, but also to reduce the metabolic cost of human walking. People's daily activities include standing or sitting, walking, going up and down stairs, going up and down mountains, jumping, etc. takes place. Among these, walking is the most important and frequently performed exercise. AFO can help users push forward while walking so that they can move faster and lower their walking metabolic rate to a lower level than normal walking (23).

3.8 Informed Consent:

Informed Consent was used and consent was obtained from the participants to participate in the study.

3.9 Screening and research Population:

Patients selected for analysis based on inclusion and exclusion criteria:

Inclusion criteria:

- Volunteers willing to participate.
- Sex products.
- Idiopathic toe gait.
- Age = <5 years/year.
- The students have some mental retardation.

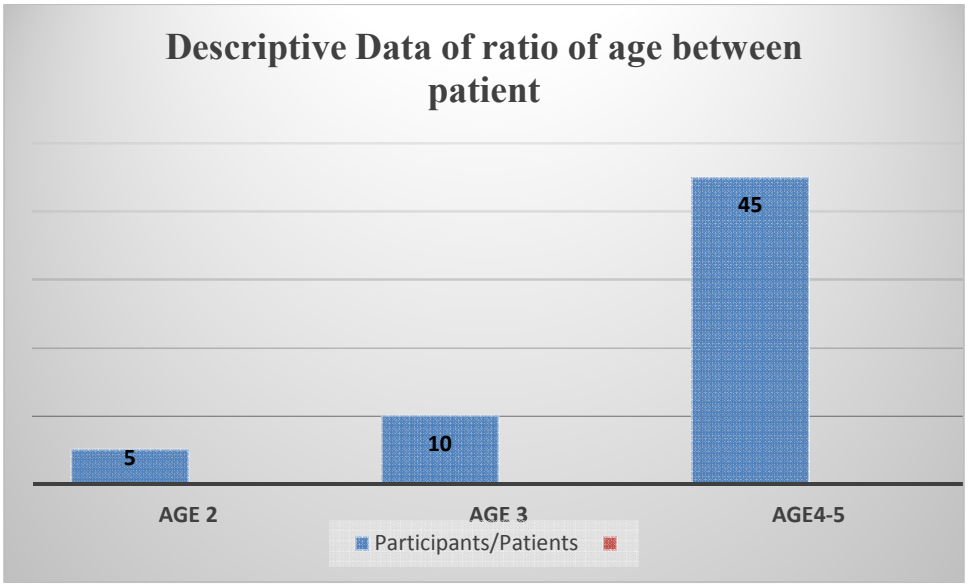
Exclusion Criteria:

- Persons with bone or orthopedic problems.
- Students refuse to participate.
- Subjects with all kinds of differences.

3.10 Approach to Service:

Treatment of ITW facilities to improve ankle dorsiflexion range of motion depending on pain severity and child's age. Treatment includes a variety of techniques including conservative therapy such as passive or plantar exercises, dorsiflexor strengthening exercises, motor control and inhibition of plantar flexion procedures such as Botox injections or casts and orthoses that cover the ankle and foot (AFO) or foot only (FO). It should also be considered that there may be negative and side effects: Health care should be followed by children; some children complain of abdominal pain after Botox type A injection; Seeing AFO and casting can be devastating for children and families. Therefore, for now, the choice of orthotic system may be influenced by its feasibility and ability to reduce side effects while reducing tip-toe walking and restricting daily work. One of the best treatments, FO encourages the child to correct toe walking instead of restricting it like tight AFOs and casts. They also have fewer flaws than these options. Previous studies of FO have often examined the spatio-temporal aspect of gait, revealing nothing about ankle function. There are no studies on the joint biomechanical properties of ITW children walking with an orthosis (8).

Results:



Test of Normality (Kolmogorov-Smirnov)	
Variable	**P-value**

FFI pre in intervention group	0.2
FFI post in intervention group	0.03
FFI pre in intervention comparison group	0.24
FFI post in intervention comparison group	0.034
LEFS pre in intervention group	0.4
LEFS post in intervention group	0.03
LEFS pre in intervention comparison group	0.2
LEFS post in intervention comparison group	0.03
FADI pre in intervention group	0.24
FADI post in intervention group	0.034
FADI pre in intervention comparison group	0.4
FADI post in intervention comparison group	0.03

Variables including FFI, LEFS. FADI shows the p-value of pre and post intervention group

Test of Normality (Shapiro-Wilk test)	
Variable	**P-value**
FFI pre in intervention group	.6
FFI pre in intervention comparison group	.9
LEFS pre in intervention group	.1
LEFS pre in intervention comparison group	.008

FADI pre in intervention group	.007
FADI pre in intervention comparison group	.002

Variables including in all scale above was subjected to a normalcy test. It was used to determine whether or not data was dispersed properly. The Shapiro-Wilk test was used to provide both parametric and non-parametric results. If the p-value is more than 0.05, the data is non-parametric, and the Wilcoxon and Mann Whitney u tests are used to compare the variables before and after treatment, as well as between two groups. If the p-value is more than 0.05, the data is parametric, and we use independent t-tests and paired tests to compare two groups, as well as pre and post assessments in the same group

Table 1 Means and standard Deviation of age in both groups

Descriptive Statistics(age in both groups)						
Group		N	Minimum	Maximum	Mean	Std. Deviation
Intervention	age	30	2.0	5.0	3.50	0.44
	Valid N	30				
Intervention comparison	Age	30	2.0	5.0	3.50	0.44
	Valid N	30				

Means and standard Deviation of age in both groups

Descriptive Statistics (➔ Group A)

Descriptive Statistics(➔ Group A)						
Group A		N	Minimum	Maximum	Mean	Std. Deviation
Intervention	FFI pre in intervention group	30	2	5	3.5	0.11
	FFI post in intervention group	30	2	5	3.5	0.11
	FFI pre in intervention comparison group	30	3.6	5	3.6	0.21
	FFI post in intervention comparison group	30	3.5	5	4.25	0.32

	LEFS pre in intervention group	30	4	5	4.5	0.34
	LEFS post in intervention group	30	4	5	4.5	0.34
	LEFS pre in intervention comparison group	30	3	5	4	0.22
	LEFS post in intervention comparison group	30	2	5	3.5	0.23
	FADI pre in intervention group	30	2	5	3.5	0.23
	FADI post in intervention group	30	2	5	3.5	0.23
	FADI pre in intervention comparison group	30	1.5	5	3.25	0.213

	FADI post in intervention comparison group	30	2	5	3.5	0.23

Descriptive statistics between group A

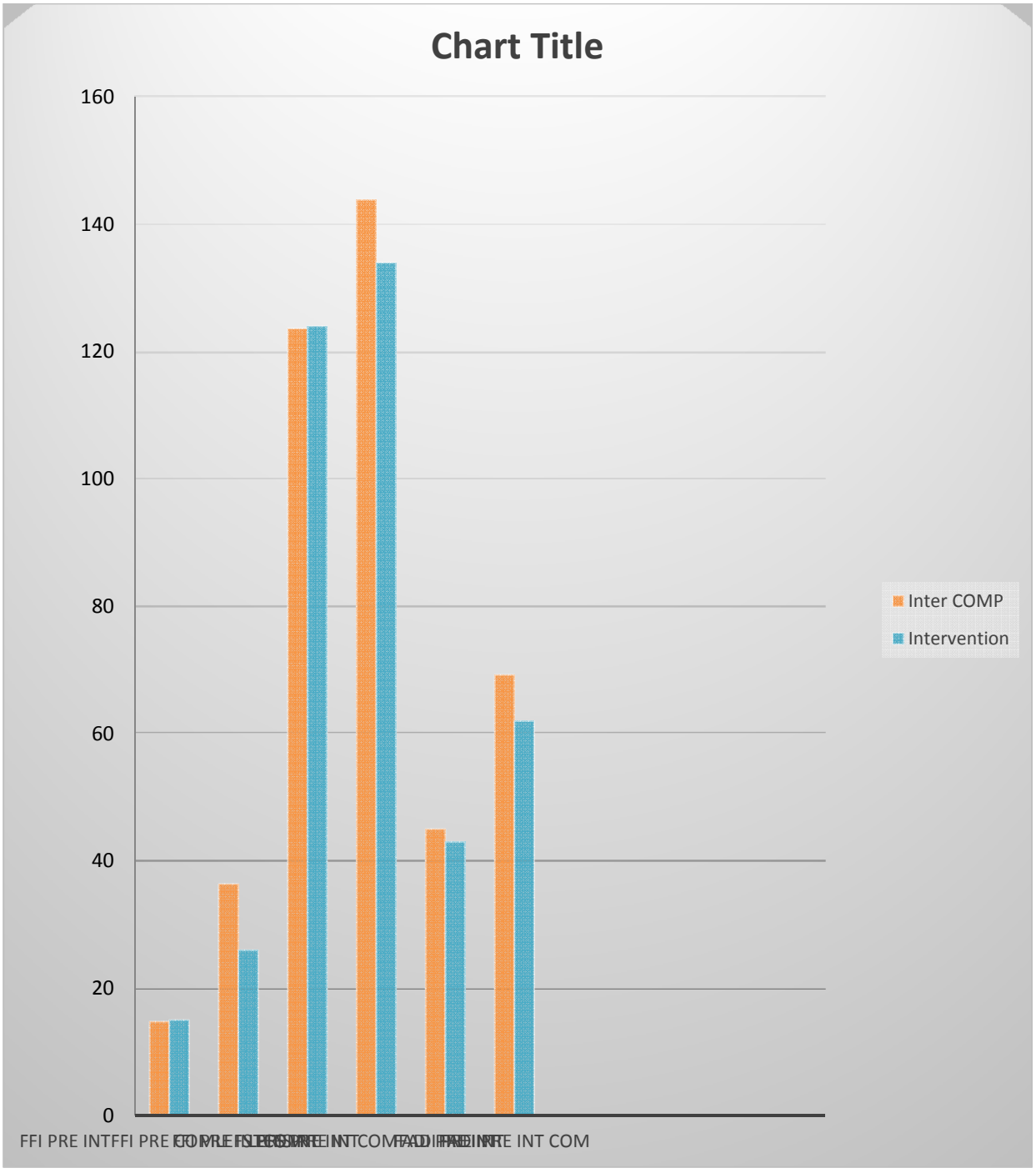
Descriptive Statistics (➔ Group B)

Descriptive Statistics(➔ Group B)						
Group B		N	Minimum	Maximum	Mean	Std. Deviation
Intervention comparison	FFI pre in intervention group	30	2	5	3.5	0.11
	FFI post in intervention group	30	2	5	3.5	0.11
	FFI pre in intervention comparison group	30	3.6	5	3.6	0.21
	FFI post in intervention comparison group	30	3.5	5	4.25	0.32

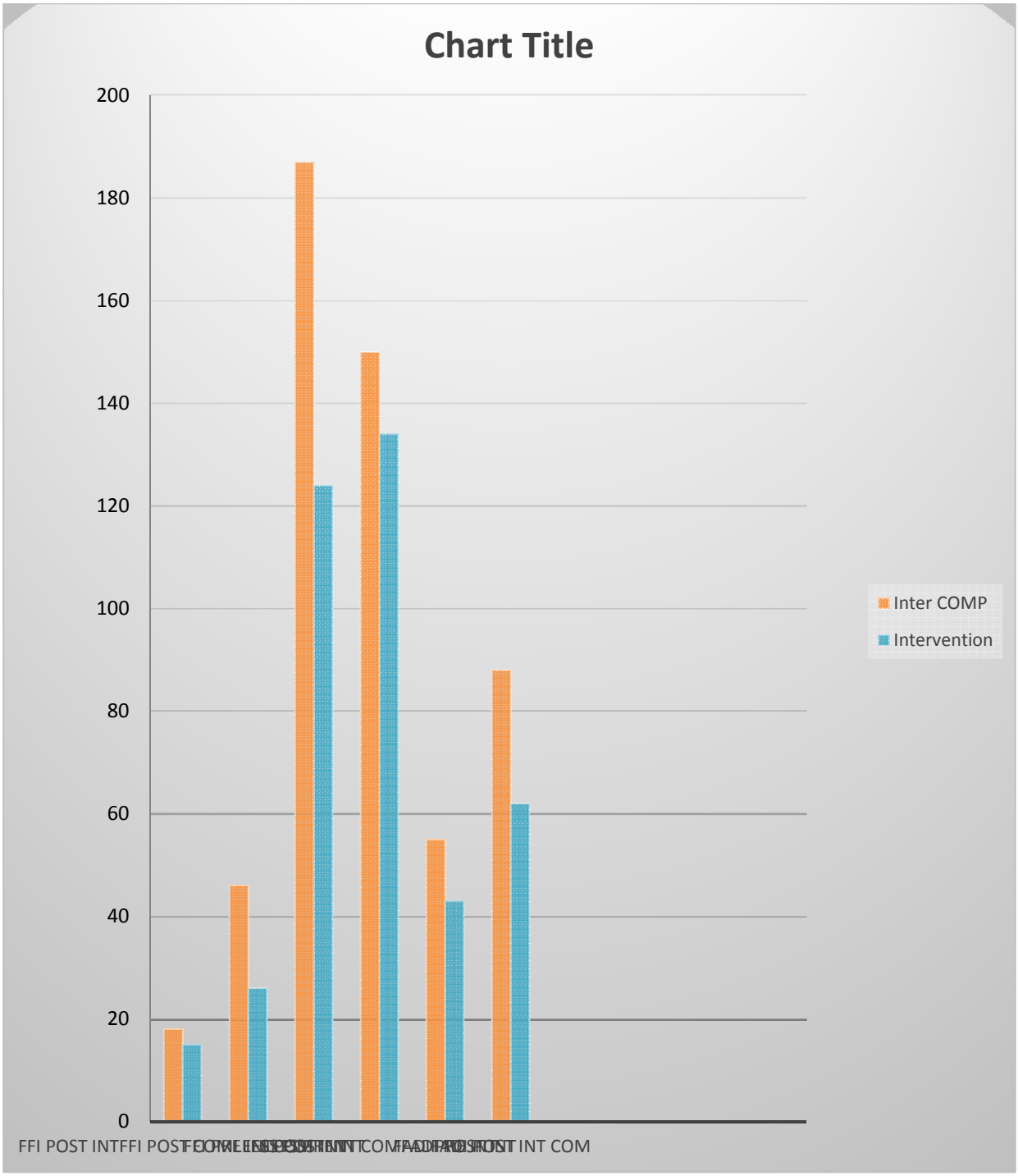
	LEFS pre in intervention group	30	4	5	4.5	0.34
	LEFS post in intervention group	30	4	5	4.5	0.34
	LEFS pre in intervention comparison group	30	3	5	4	0.22
	LEFS post in intervention comparison group	30	2	5	3.5	0.23
	FADI pre in intervention group	30	2	5	3.5	0.23
	FADI post in intervention group	30	2	5	3.5	0.23

Descriptive statistics between group B

LGJDX Journal Of Liaoning Technical University Natural Science Edition
ISSN No: 1008-0562

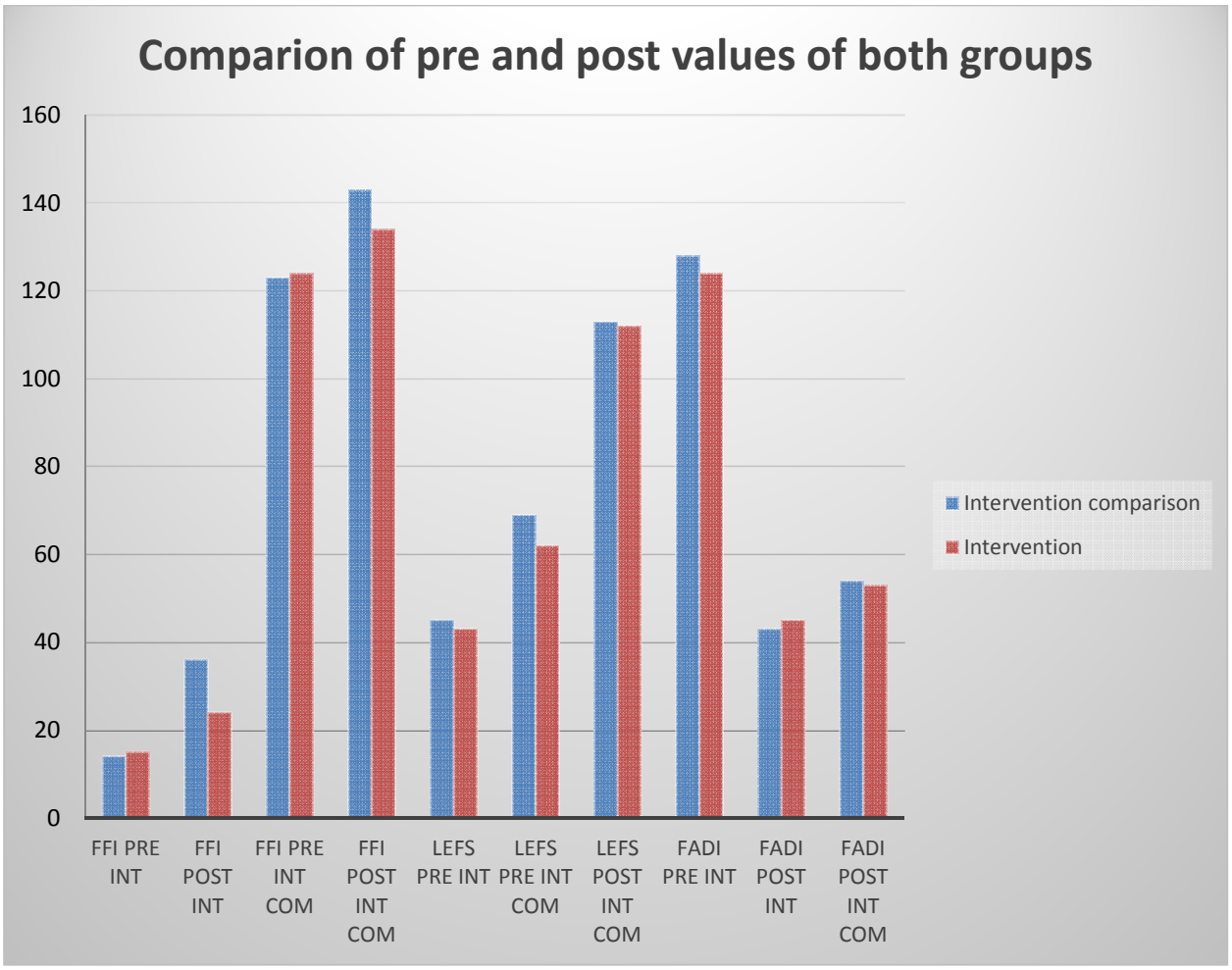


Pre values of both groups



Post values of both groups

LGJDX Journal Of Liaoning Technical University Natural Science Edition
ISSN No: 1008-0562



Discussion:

There are many theories about the causes of ITW, including neurological, biomechanical, and behavioral. Some researchers believe that ITW may be related to underlying mental health issues. Many studies have reported higher rates of ITW in children with conditions such as cerebral palsy, autism spectrum disorder, and developmental delay (Chin et al., 2013; Romkes et al., 2006; Williams et al., 2006)., 2006). Behavior: Finally, some researchers suggest that ITW may be a behavior that results from a habit or preference. For example, some children may start walking on their toes because they find it easier or more fun than walking on their heels. At the same time, this behavior can become a habit and lead to ITW. Evaluation of ITW includes a comprehensive assessment of the child's medical history, physical examination, and gait assessment.Medical history: In the medical history, the doctor should ask about the child's developmental history, family history, and previous illnesses or surgeries. Physical Examination: The physical examination should include measurements of muscle strength, range of motion, and joint function. Physicians should be alert for signs of neurological disease or other musculoskeletal abnormalities. Gait Analysis: Gait analysis is an important part of the ITW assessment. It involves observing the child's gait and looking for abnormalities.Gait assessment can be done using video analysis or special equipment Idiopathic toe walking (ITW) is a gait in which a child continues to walk on toes without an underlying condition or disorder of the nervous system. This is a common problem, affecting 7 percent of children. While children usually develop the condition, some continue into adolescence and adulthood. While the exact cause of ITW is unknown, it is believed to be multifactorial, with a combination of genetic, neurological, and environmental factors contributing to its development. The following are some of the known risks associated with ITW: 1.Family history: There is evidence that ITW may have a genetic component. Studies have shown that children with a history of ITW are more likely to be affected themselves. 2. Premature birth: Premature babies are at high risk of ITW. Premature birth can impair the development of muscles and tendons, which can lead to toe walking.3. Muscle weakness: Weakness of muscle tone can cause ITW. This can be due to many causes, such as physical inactivity, neurological disease or muscular dystrophy. 4. Tight Achilles tendon: The Achilles tendon connects the tendon to the bone.If this muscle is tight, it can limit the ankle's range of motion, making it difficult for the child to walk from heel to toe. 5.

Psychological problems: Children with hearing problems may have problems processing information from the feet and legs, which may cause a tendency to walk on their toes. 6. Autism Spectrum Disorder: Studies have shown that children with autism spectrum disorder (ASD) are more likely to walk on their own feet than older children.The cause is unknown, but it may be related to hearing problems or motor planning problems. 7. Developmental Coordination Disorder: Children with developmental coordination disorder (DDD) may experience balance and coordination problems that lead to toe walking. 8. Behavioral habits: ITW children will develop behavioral habits on their journey.For example, some children may tiptoe out of habit or as a coping mechanism. 9. Joint laxity: Children with joint laxity may have joint laxity, which can make it easier for them to walk on their toes. However, integration can also lead to unstable integration and other problems. 10.Other medical conditions: Some conditions, such as cerebral palsy, muscular dystrophy, or spinal muscular atrophy, can cause toe walking. It is important to remember that many tip-toe children have none of these risks. Also, not all children with these risk factors will develop ITW. The presence of the conditions can increase the risk of ITW, but the truth is often difficult to determine. Persistent ITW has several consequences.These may include: 1. Tension in the calf muscles and Achilles tendon: Children tiptoeing will feel the tension of their muscles and Achilles tendon. This can limit their ankle's range of motion and make it difficult for them to walk from heel to toe. 2. Gross motor delay: It delays the development of gross motor skills such as toe walking, running and jumping.3. Balance and coordination difficulties: Children walking on tiptoe may experience balance and coordination problems that can affect their ability to do physical activity. 4. Foot and ankle pain: Walking on toes puts too much pressure on the feet, causing foot and ankle pain. 5.Depression and Emotions: Children who walk persistently on their toes may experience social and emotional problems Toe walking is a model in which a person walks on the toes or ball of the foot without the heel touching the ground. It is a disease seen in children and its incidence in children is between 4% and 24%. Idiopathic toe walking (ITW) is a type of toe walking disorder with no known cause. Walking on toes can lead to restriction of activities of daily living, reduced participation in sports and social isolation. Therefore, early intervention is necessary to correct gait patterns and prevent long-term consequences.One intervention used for toe walking is the hold-and-rest technique (HR). HR is a muscular effort used to reduce muscle tension, increase movement

coordination, and improve neuromuscular control. In this process, the doctor passively stretches a tense muscle to its limit, then the doctor asks the patient to hold the tense position while using it. After a few seconds, the patient relaxes and the doctor brings the limb to the end of the movement. This process is repeated several times to further increase the convergence.Another intervention used for toe walking is the ankle orthosis (AFO). AFOs are devices that are worn around the ankle and foot to provide support, prevent or correct foot deformities, and improve gait patterns. AFO has been shown to be effective in improving gait patterns in children with cerebral palsy and other neurological conditions. However, evidence for AFO use in ITW children is limited. A literature search was conducted using electronic databases such as PubMed, Cochrane Library and CINAHL.A.I.T), Gillette Gait Index (GGI) or Edinburgh Visual Gait Scale (EVGS). 3. Education covers children aged 3 to 18 years.Studies that were case reports, reviews, or studies involving children with neurological or musculoskeletal disorders other than ITW were excluded. A total of six studies met the inclusion criteria and were included in this review. The sample ranged from 12 to 80 children and a total of 245 children were included in the analysis. These studies have been carried out in many countries, especially in the USA, Turkey and Iran. All studies included in this review show significant improvements in gait patterns in ITW children receiving HR procedures or AFO.However, studies comparing the two interventions reported better outcomes for children who received AFO in addition to HR procedures. A study by De Piazza et al. (2017) compared the results of HR procedures with and without AFO in 16 ITW children. The study found that both interventions improved gait patterns, but the group that received the AFO plus HR procedure had better outcomes than the group that received the HR procedure alone. Another study by Özgirgin and Bumin (2013) compared the results of HR procedures with and without AFO in 24 ITW children.The study revealed that both interventions improved walking patterns with idiopathic toe walking, a condition in which children walk on their toes without an underlying disease. Stay Relaxed Technique (HRT) and Ankle Orthosis (AFO) are two interventions applied to relieve this pain. A comparative study was conducted to evaluate the effects of HRT with and without AFO in children with idiopathic toe walking, and the results showed that the use of AFOs and HRT alone as HRT is more beneficial. The study included children ages 4 to 12 diagnosed with idiopathic clubfoot. Participants were divided into two groups that received HRT with AFO and

those who received HRT alone.The HRT program includes exercises to stretch and strengthen the muscles involved in walking, while the AFO is used to correct the heel of the foot and prevent silent walking. The results of the study showed an improvement in walking patterns, muscle length and muscle strength in both groups after the intervention. However, the group receiving AFO HRT showed significant improvements in gait, muscle length and muscle strength compared to the group receiving HRT alone. The results of this study suggest that the combination of AFO and HRT may be an effective intervention for children with idiopathic toe walking problems. AFO helps maintain the relationship between the heel and foot, which increases the strength and stretch provided by HRT.This combination may help improve gait patterns and muscle function in idiopathic quiet walking children. It is important to remember that every child is unique and treatment for idiopathic pointe gait should be tailored to the unique needs of the individual. Therefore, evaluation and evaluation by a specialist doctor should be done before sany intervention.

References

1. Oetgen ME, Peden S. Idiopathic toe walking. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2012;20(5):292-300.

2. Davies K, Black A, Hunt M, Holsti L. Long-term gait outcomes following conservative management of idiopathic toe walking. Gait & posture. 2018;62:214-9.

3. Caserta AJ, Pacey V, Fahey MC, Gray K, Engelbert RH, Williams CM. Interventions for idiopathic toe walking. Cochrane Database of Systematic Reviews. 2019(10).

4. Bartoletta J, Tsao E, Bouchard M. A retrospective analysis of nonoperative treatment techniques for idiopathic toe walking in children: Outcomes and predictors of success. PM&R. 2021;13(10):1127-35.

5. Potts M. Idiopathic Toe Walking. 2018.

6. Alvarez C, De Vera M, Beauchamp R, Ward V, Black A. Classification of idiopathic toe walking based on gait analysis: development and application of the ITW severity classification. Gait & posture. 2007;26(3):428-35.

7. Michalitsis J, Murphy AT, Rawicki B, Haines TP, Williams C. Full length foot orthoses have an immediate treatment effect and modify gait of children with idiopathic toe walking. Gait & posture. 2019;68:227-31.

8. Brasiliano P, Alvini M, Di Stanislao E, Vannozzi G, Di Rosa G, Camomilla V. Effects of wearing a foot orthosis on ankle function in children with idiopathic toe walking during gait. Heliyon. 2022;8(10):e11021.

9. Engström P, Tedroff K. The prevalence and course of idiopathic toe-walking in 5-year-old children. Pediatrics. 2012;130(2):279-84.

10. Engström P, Tedroff K. Idiopathic toe-walking: prevalence and natural history from birth to ten years of age. JBJS. 2018;100(8):640-7.

11. Reinker KA. Does Idiopathic Toe-Walking Spontaneously Correct?: Commentary on an article by Pähr Engström, MD, PhD, and Kristina Tedroff, MD, PhD:"Idiopathic Toe-Walking: Prevalence and Natural History from Birth to Ten Years of Age". JBJS. 2018;100(8):e53.

12. Herrin K, Geil M. A comparison of orthoses in the treatment of idiopathic toe walking: a randomized controlled trial. Prosthetics and orthotics international. 2016;40(2):262-9.

13. Baber S, Michalitsis J, Fahey M, Rawicki B, Haines T, Williams C. A comparison of the birth characteristics of idiopathic toe walking and toe walking gait due to medical reasons. The Journal of pediatrics. 2016;171:290-3.

14. Martín-Casas P, Ballestero-Pérez R, Meneses-Monroy A, Beneit-Montesinos J, Atín-Arratibel M, Portellano-Pérez J. Neurodevelopment in preschool idiopathic toe-walkers. Neurología (English Edition). 2017;32(7):446-54.

15. Williams CM, Tinley P, Curtin M. The Toe Walking Tool: a novel method for assessing idiopathic toe walking children. Gait & posture. 2010;32(4):508-11.

16. Kellis E. Intra-and inter-muscular variations in hamstring architecture and mechanics and their implications for injury: a narrative review. Sports Medicine. 2018;48(10):2271-83.

17. Medina McKeon JM, Hoch MC. The ankle-joint complex: a kinesiologic approach to lateral ankle sprains. Journal of athletic training. 2019;54(6):589-602.

18. Manganaro D, Dollinger B, Nezwek TA, Sadiq NM. Anatomy, Bony Pelvis and Lower Limb, Foot Joints. 2019.

19. Lorentzen J, Willerslev-Olsen M, Hüche Larsen H, Farmer SF, Nielsen JB. Maturation of feedforward toe walking motor program is impaired in children with cerebral palsy. Brain. 2019;142(3):526-41.

20. Mishra SB, Alok S. Handbook of research methodology. Educreation publishing; 2022.

21. Bhide A, Shah PS, Acharya G. A simplified guide to randomized controlled trials. Acta obstetricia et gynecologica Scandinavica. 2018;97(4):380-7

22. Park S, Lim W. Effects of proprioceptive neuromuscular facilitation stretching at low-intensities with standing toe touch on developing and maintaining hamstring flexibility. Journal of Bodywork and Movement Therapies. 2020;24(4):561-7.

23. Chen B, Zi B, Zeng Y, Qin L, Liao W-H. Ankle-foot orthoses for rehabilitation and reducing metabolic cost of walking: Possibilities and challenges. Mechatronics. 2018;53:241-50.

24. Choo YJ, Chang MC, editors. Commonly used types and recent development of ankle-foot orthosis: A narrative review. Healthcare; 2021: MDPI.

25. Rethlefsen SA, Blumstein G, Kay RM. Idiopathic Toe Walking (ITW): Treatment Options. Curr Treat Options Neurol. 2016 Nov;18(11):49. doi: 10.1007/s11940-016-0439-9. PMID: 27613096.