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Effects of a Balance and Strength Training Program on Functional Proprioceptive and Motor Control Abilities in Young Adults with Neurodevelopmental Disorders

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"Effects of a Balance and Strength Training Program on Functional Proprioceptive and Motor Control Abilities in Young Adults with Neurodevelopmental Disorders"

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Abstract

The objective of this study was to determine if young adults, ages 18-22, with neurodevelopmental disorders, including Autism Spectrum Disorder, Intellectual Disabilities, Communication Disorders, Attention-Deficit/Hyperactivity Disorder, Specific Learning Disorder, and Motor Disorders, would benefit by adding a proprioceptive intervention program to an already existing strength training program. Benefits hypothesized from this intervention were in the areas of agility and balance, two of the three components of proprioceptive abilities. Increased agility and balance has been proven to increase functionality and safety as it can decrease fall risks. Subjects were all apart of a transitional program from high school into the adult world and actively seeking the skills needed to live a more fulfilling and functional life as productive members of society. Subjects were assessed on their agility and balance before and after and 8 week intervention period using Timed Get Up and Go Test and the Balance Sway App, from Sway Medical, respectively. Each subject was their own control in this study to eliminate multiple varying factors for each subject. Each subject completed 1 hour per week of weight lifting based strength training and 1 hour per week of proprioceptive interventions that addressed agility, balance, and coordination. Each proprioceptive intervention was logged by the lead researcher and strength training was kept consistent throughout the 8 weeks. The researcher hypothesized that subjects would improve on both measurements for agility and balance in their post test after participating in both the proprioceptive-strength multimodal program. The results of the study showed an overall significant improvement in all subjects in agility and balance after the 8 weeks of proprioception-strength intervention. The implications of this study for the transitional program that the subjects all partake in was to adjust their routine workout program to include more functional activity that is both focused in proprioception and strength training

combined. The application of this study to other transitional programs for this population is to implement workout programs that promote functional independence through a multimodal program that addresses their weaknesses in strength and in balance and agility.

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BOBW Job Coaches
Safety Monitors During Interventions

BOBW Students
Participants

Introduction

In populations with neurodevelopmental disorders (ND), motor skills and balance are often impaired and result in decreased ability to perform functional activities(Giagazoglou, et al. 2013). Neurodevelopmental disorders can cover a wide range of diagnosis and life conditions including Autism Spectrum Disorder, Intellectual Disabilities, Communication Disorders, Attention-Deficit/Hyperactivity Disorder, Specific Learning Disorder, and Motor Disorders(American Psychiatric Association, 2013, p. xiii). It is defined in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) as a set of conditions that onset early in development that produce impairments of personal, social, academic, or occupational functionality (American Psychiatric Association, 2013, p. 36). Many of these impairments are due to decreased motor function, which is manifested as poor visual and motor coordination, limited precision of movements, inhibition, and difficulties in learning new forms of activities (Lee, Lee, Shin, Shin, & Song, 2014). Activities of daily living (ADLs) such as independent feeding, dressing, cooking, cleaning, grooming activities, etc. all present difficulty at times due to disorganized motor control. Current research continues to support the importance of proprioception in the development and implementation of functional motor behaviors (Vidoni, 2008). Proprioception is defined as neuronal feedback from the joint capsules, ligaments, muscles, tendons, and skin, that affects motor control (Blanche, Reinoso, Chang, & Bodison, 2012). Development of proprioception within this population is interrupted early on, causing neural pathways to not be completely and accurately laid down. This inhibits proprioceptive feedback which can lead to poor balance, agility, and coordination. Typically, when a motor plan is selected, commands are sent within the brain based on the goal of the desired movement. Prior to the action being executed, the neural pathways update their plan based on the desired outcome and then re update post-movement based on the success of the outcome (Vindoni, 2008). In those with ND, although they learn functional movement patterns such as walking, reaching, grasping, feeding, and performing multiple other fundamental skills, their movements lack precision and have poor coordination leading to reduced efficiency (Lee, Lee, Shin, Shin, & Song, 2014).

It is vital for rehabilitation science professionals to look at such complications prevalent in specific populations and work to solve the problem or better the situation. In this underrepresented population, young adults are being put in an area of disregard comparatively to other time periods in their lives. When someone is young and diagnosed with a developmental disorder, they are most often in school and placed on an Individualized Education Program (IEP) and regularly see in school specialists. Once graduated, there are many different directions to go whether that be a transitional program, a work placement, a community program, or a lifestyle lacking intervention and socialization. Often, the opportunity to get intervention to help maintain or increase physical function can become limited during this time which will then affect the rest of their adult life up to the point of reaching the geriatric age where intervention is reintroduced more heavily. Fall risks are often a concern in young adults with ND as falls tend to occur at a much younger age than that of the typically developing population (Cox, Clemson, Stancliffe, Durvasula, & Sherrington, 2010). It is important to find interventions that transitional and other types of programs can easily implement to help combat the increased chance of fall risk in this specific population.

The objective of this study is to determine if a multimodal program of strength training and proprioceptive training can increase agility and balance in young adults with neurodevelopmental disorders. It is hypothesized that adding a program that includes balance, agility, and coordination work within a strength based model will increase functional proprioception (balance and agility) for young adults with neurodevelopmental disorders. As a secondary outcome, if this model was found to be effective, we hoped to implement the proprioceptive structure in all of the Best of Both Worlds' (subject group) future fitness programming to help their students functionally as their educational programs work to teach them life and work place skills. Quality of life for young adults with neurodevelopmental disorders is often overlooked compared to pediatric and geriatric populations. The goal is to develop some theories as to how we can begin to adapt and implement the basic research of allied health that is often used in other populations, in order to best serve the ND young adult population.

This study will address deficits in balance, agility, and coordination in individuals within the ND population to increase functionality and safety. With a gained ability to move with more confidence, this population can then increase their independence throughout the lifespan. In review of the literature, there is a gap between ages within the neurodevelopmental population that this study will strive to address. The translation of the skills learned early in life in relation to movement ability and functional skill will decrease the occurrence of injury and dependent lifestyles that will then decrease the need for certain severe interventions that individuals might otherwise need.

Literature Review

Background

In populations with neurodevelopmental disorders (ND), motor skills and balance are often impaired and result in decreased ability to perform functional activities (Giagazoglou, et al. 2013). Neurodevelopmental disorders can cover a wide range of diagnosis and life conditions and is defined in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) as a set of conditions that are often onset early in development and present with deficits that produce impairments of personal, social, academic, or occupational functionality (American Psychiatric Association, 2013, p. 36). Many of these impairments are due to decreased motor function, which is manifested by poor visual and motor coordination, limited precision of movements, inhibition, and difficulties in learning new forms of activities (Lee, Lee, Shin, Shin, & Song, 2014). Activities of daily living (ADLs) such as independent feeding, dressing, cooking, cleaning, grooming activities, etc. all present difficulty at times due to disorganized motor control. Current research continues to support the importance of proprioception in the development and implementation of functional motor behaviors (Vidoni, 2008). Proprioception is defined as neuronal feedback from the joint capsules, ligaments, muscles, tendons, and skin, that affects motor control (Blanche, Reinoso, Chang, & Bodison, 2012). Development of proprioception within this population was interrupted early on, causing neural pathways to not be completely and accurately laid down. This inhibits proprioceptive feedback which can lead to poor balance, agility, and coordination. Typically, when a motor plan is selected, commands are sent within the brain based on the goal of the desired movement. Prior to the action being executed, the neural pathways update their plan based on the desired outcome and then re update post-movement based on the success of the outcome (Vindoni, 2008). In those with ND, although they learn functional movement patterns such as walking, reaching, grasping, feeding, and performing multiple other fundamental skills, their movements lack precision and have poor coordination leading to reduced efficiency (Lee, Lee, Shin, Shin, & Song, 2014).

Allied Research

Individuals with ND often have a sedentary lifestyle and lack physical activity, which could be an additional contributing factor to the loss of functional abilities (Lee, Lee, Shin, Shin, & Song, 2014). As this population increases in age, falls tend to become frequent as a result of poor balance and motor coordination. This is in part caused by inactivity that further limits a person's ability to perform ADLs as basic as walking (Giagazoglou, et al. 2013). Many studies have looked at the benefits that physically engaging programs have on this population. In a previous study it was found that balance performance in persons with intellectual disabilities (ID), a subcategory of ND, could be significantly improved following various physical intervention programs including trampoline exercises, dance fitness programs, obstacle course programs and more (Giagazoglou, et al. 2013). Studies have found that in young adults with ID, balance programs have improved functional gait patterns showing improvements in agility, coordination, and balance.

Postural control, effects of vision on proprioception, and motor anticipation have been improved in ND groups by multimodal programs (Schmit, Riley, Cummins-Sebree, Schmitt, & Shockley, 2015). With learned functional exercises, subjects can adapt to the appropriate motor plan needed in the future. Participants who are required to continuously respond to a constant change of gravity, for example, can result in deep proprioception as well as other sensory inputs (Giagazoglou et al. 2013). Proper sensory feedback is necessary in programs that are attempting to increase proprioceptive abilities.

Critical Research

In previous studies, training programs have included eyes-open and eyes-closed walking in the form of sideways, backwards, and toe-to-heel in addition to tandem standing (Lee, Lee, Shin, Shin, & Song, 2014). Other studies have looked at programs that include more functional exercises such as rolling a ball, pushing and pulling objects, lifting objects, and kicking, catching, and throwing a ball (Carmeli, Zinger-Vaknin, & Morad, 2005). It has been suggested that studies in the future add more emphasis on using more functionally applied ADLs in these programs (DeBolt & McCubbin, 2004). Other studies have focused more on strengthening exercises to improve proprioception such as trampoline programs (Giagazoglou, et al. 2013), cycling work, and more basic tasks like heel raises and leg extensions (Blomqvist, Olsson, Wallin, Wester, A. & Rehn, 2013). One study talked in depth about the importance of developing a highly engaging and entertaining program for this population with an emphasis to assure compliance (Giagazoglou, et al. 2013). Exercises need to be not only entertaining but also comprehensive and functional. Typical tasks need to be broken down for simplicity and some tests need modification. In developing a program, all of these components must be taken into consideration.

It is also important to find ways to document balance and proprioception in order to judge the effects of a program. Balance can be measured by Sway Balance technology where it will examine force platform and mean sway for each trial of different stances (Sway Medical, 2016). Agility can be tested by the Timed Get Up and Go test as this test has been used to evaluate functional mobility. It measures the time taken by a person to stand up from a chair, walk a distance of 3 meters , turn, walk back to the chair, and sit down again. This test has been used in both those diagnosed with multiple disabilities as well as typically developing adults and has been found as a reliable and valid measurement tool of functional mobility (DeBolt & McCubbin, 2004). The operationalized components of these two dependent variables, Balance Sway and Timed Get Up and Go represent two of the three components of proprioception, balance and agility. Combining these two tests can give a good reading on proprioceptive ability before and after a multimodal program of proprioception and strength training has been implemented.

Literature Review Summary

Literature omits evaluation of a combined program of proprioceptive and strength training in the population with neurodevelopmental disorders. The intent of this study is to measure balance, agility, and coordination changes within a treatment group of ND young adult students before and after proprioceptive and strength training. With the combination of both proprioception training and strength training of stabilizer muscles,it is hypothesized that proprioceptive abilities will increase. From the research we can conclude that with increased proprioceptive abilities, functionality and ability to perform ADLs increase and fall risks decrease. The goal is to develop a training program of basic and comprehensible exercises that will be appropriate for this population that is also effective in improving functional motor skills to enhance independence and life satisfaction.

Methods

This study used seven subjects, ages 18 - 21, who have been diagnosed with at least one neurodevelopmental disorder. All subjects are a part of a transitional program that works on life skills to increase independence and life satisfaction post-high school graduation. This research took place in the late summer and fall semester of 2016. In this program, all seven students participate in a strength training workout created by a Otterbein University health professional faculty members one time a week for a duration of one hour and a group fitness workout one time a week for a duration of one hour. This strength based portion was carried out starting 2 weeks before proprioceptive baseline testing began and persisted throughout and beyond the post-testing. In addition to their strength based workouts, this study added in a proprioceptive workout for one time a week for eight weeks. This study used two determining tests to measure the impact of our intervention program. Both a functional skill analysing test and a static variable measuring test were used to analyze the impacts of our proprioceptive program. The functional test that was used is the Timed Get Up and Go Test. This test has been proven valid for developmentally disabled populations and therefore is valid for our population. It is important to note that it has not been well tested in young adults but most often tested in geriatric populations (DeBolt & McCubbin, 2004). The static variable measurement test used was, Balance Sway, created by Sway Medical. This is an application that uses a mobile device connected to the subject's chest via a harness, to measure center of gravity, postural sway, and righting abilities. Individual scores are recorded and compared for combined balance with eyes closed, tandem stance on left and right side with eyes closed, and single leg stance on left and right side with eyes closed (Sway Medical, 2016).This test has been proven reliable for many populations including subjects with Parkinson's Disease, concussions, adults 50 - 74 years-of-age, collegiate athletes, high school athletes, and youth gymnasts, but has not been tested in the neurodevelopmental population (Research - Sway, 2014).

These pre and post tests were administered the week before and the week after intervention was administered. All pre and post tests were administered by the lead research only to eliminate inter rater reliability limitation. Before test results were recorded, trial runs were administered to allow for subjects to learn the test and feel more comfortable. The intervention process took place over an 8 week period in which four levels of balance, coordination, and agility intervention were implemented in addition to an hour long strength training program conducted by a separate initiative that works with the students year-long. Intervention of the proprioceptive portion was administered by the lead researcher and assistant researcher only to assure consistency. All 7 subjects attended proprioceptive intervention sessions on Wednesdays of each week (appendix B). The setting was consistent in the biomechanical research lab and classroom of the HSS department. Each level of intervention was a duration of 2 weeks, meaning that there was one day a week where participants receive the proprioceptive intervention where they did the same level two weeks in a row before moving on to the next level. The study's interventions used basic physical exercise equipment including tennis balls, airex pads, cones, and weighted balls. Intervention levels by week are described below. Each level of intervention was performed once a week for two weeks before subjects moved on to the next level. This is to eliminate learning curve effects and establish correctness in movements before advancing to the next level of difficulty. Each week there were three types of activities that subjects performed;

those in balance, agility, and coordination.

Week 1 & 2 Intervention

level 1

Balance: Subjects were instructed to pass a ball with researcher in bilateral stance. Researcher and subject stood 5 ft apart. Researcher tossed ball keeping it within the subject's base of support. Repeated five times.

Agility: Subject walk/jogged 3 M (10ft) straight down and around one cone, picked up a ball out of a bucket on the ground, brought it back and drop it in bucket. Repeated two times.

This was set up like a competition for two subjects to go at a time. Subjects were instructed to go as fast as they can and feel comfortable with without falling.

Coordination: Subjects were instructed to assume a bilateral stance. They were to reach for one item within base of support and ipsilaterally using one hand and bring item to side to dispose of in a bucket. This was repeated this five times with the right extremity and five times with the left extremity.

Week 3 & 4 Intervention

level 2

Balance: Subjects were instructed to pass a ball with researcher in tandem stance. Researcher and subject stood 5 ft apart. Researcher tosses ball keeping it within the subject's base of support. This action was repeated five times.

Agility: Subject will walk/jog 3 M (10ft) in a cross pattern in between 2 cones, around 3rd, pick up a ball out of a bucket on the ground, bring it back and drop it in bucket. This action was repeated two times. This was set up like a competition for two subjects to go at a time. Subjects were instructed to go as fast as they can and feel comfortable with without falling.

Coordination: Subjects instructed to assume a bilateral stance. They are to reach for item outside base of support and contralaterally using one hand and bring item to side to dispose of in a bucket. This action was repeat this five times with the right extremity and five times with the left extremity.

Week 5 & 6 Intervention

level 3

Balance: Subjects were instructed to pass a ball with researcher in bilateral stance on an Airex Pad. Researcher and subject stood 5 ft apart. Researcher tosses ball keeping it within the subject's base of support. Repeat five times.

Agility: Subject will walk/jog 3 M (10ft) in a cross pattern in between 3 cones, around 4th, pick up a ball out of a bucket on the ground, bring it back and drop it in bucket. Repeat three times. This was set up like a competition for two subjects to go at a time. Subjects were instructed to go as fast as they can and feel comfortable with without falling.

Coordination: Subjects instructed to assume a tandem stance. They are to reach for item outside base of support and contralaterally using one hand and bring item to side to dispose of in a bucket. Repeat this five times with right extremity and five times with left extremity.

Week 7 & 8 Intervention

level 4

Balance: Subjects were instructed to pass a ball with researcher in tandem stance on an Airex Pad. Researcher and subject stood 5 ft apart. Researcher tosses ball slightly outside of base of support. Repeat five times.

Agility: Subject will walk/jog 3 M (10ft) in a cross pattern in between 4 cones, around 5th, pick up a ball out of a bucket on the ground, bring it back and drop it in bucket. Repeat three times. This was set up like a competition for two subjects to go at a time. Subjects were instructed to go as fast as they can and feel comfortable with without falling.

Coordination: Subjects instructed to assume a single leg stance (SLS). They are to reach for item outside base of support and contralaterally using one hand and bring item to side to dispose of in a bucket. Repeat this five times with right extremity and five times with left extremity.

Each session, the researcher instructed the subject on each activity to their cognitive level and assured that they fully understood before any attempt was begun. The researcher demonstrated if necessary and provided prompts throughout activities. Record of each subject completing each week of intervention was kept by the researcher on a uniform data collection sheet (appendix A).

In analyzing results, the study looked for a change in dependent variables as a result of the intervention. To do this, descriptive statistics were derived from the Statistical Package for the Social Sciences (SPSS). The explore procedure was used to to gather mean values for each variable that was assessed (all values from Balance Sway and the Timed Get up and Go). Due to the low number of participants in this study, inferential statistics were looked at to determine if balance interventions were beneficial to this group. Data were analyzed for a difference in "mean" values between pre- and post-tests for each variable, using a paired t-test.

Results

All values from pre and post-testing were entered into the Statistical Package for the Social Sciences (SPSS). The explore procedure was then used to gather mean values for each variable that was assessed (all values from Balance Sway and the Timed Get up and Go). Descriptive statistics for each sub variable includes Timed Get up and Go time, overall balance sway, sway feet together eyes closed (ec), tandem stance right ec, tandem stance left ec, single leg stance right ec, and single leg stance left ec. All but two (feet together ec and tandem stance right ec) showed statistically significant improvements over initial values. Significant P values are as follows: Timed Get up and Go time P = .017, overall balance sway P = .014, tandem stance left ec P = .035, single leg stance right ec P = .023, and single leg stance left ec P = .004. Insignificant P values are as follows: sway feet together ec P = .229 , tandem stance right ec P = .678 (table 1).

Table 1. Paired T-Test Results

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Overall1 - Overall2	-20.90571	16.07175	6.07455	-35.76960	-6.04183	-3.442	6	.014
Pair 2	TUG1 - TUG2	1.24571	1.00659	.38046	.31477	2.17666	3.274	6	.017
Pair 3	FeetTogether1 - FeetTogether2	-.97571	1.92607	.72798	-2.75703	.80560	-1.340	6	.229
Pair 4	TandemR1 - TandemR2	-8.10714	49.12637	18.56802	-53.54145	37.32717	-.437	6	.678
Pair 5	TandemL1 - TandemL2	-26.24429	25.56345	9.66207	-49.88653	-2.60204	-2.716	6	.035
Pair 6	SLright1 - SLright2	-34.98000	30.58549	11.56023	-63.26686	-6.69314	-3.026	6	.023
Pair 7	SLleft1 - SLleft2	-34.18429	20.35071	7.69185	-53.00555	-15.36302	-4.444	6	.004

Descriptive statistics also illustrate that the standard deviations in participants scores decreased after the intervention as shown in the graphs in appendix C.

Discussion

Results support the hypothesis that combining a proprioceptive intervention plan with strength training can increase balance and agility which can lead to decreased fall risks in the young adult population of those with neurodevelopmental disabilities. Overall, agility times got faster and balance improved after an 8-week proprioceptive intervention. In looking at the inferential statistics, the sample does raise some questions. Due to the small sample size of seven, the random variation is limited. In limiting the sample to students enrolled in a transitional program who all have ND, results may not be representative of the population. Different ND create different deficits in balance and motor speed creating results with considerable variation. However, results showed that the sample group decreased variability post intervention. This can conclude that, variation in diagnoses aside, the general ND young adult population can all improve with a proprioceptive-strength-training program.

There were data collection tools used that are not proven to be for the specific population at hand due to the lack of literature and testing with this group. The Balance Sway application test has not been tested for reliability in the ND and, therefore, may lead to unforeseen differences in how the application accurately represents performance and ability. Subjects of our particular study present a different component to understanding the directions of the test that could hinder the results. It is assumed that there can be a learning curve for the subjects of this study that could have affected performance during interventions as well as testing results.

Results could have been altered by the cognitive understanding and concentration of this specific population that could have put implication on their motor abilities that were not completely accurate. Outliers were present in results but were not consistent with one subject. This alteration in accurate results could be due to inattentiveness in subjects when performing tests. If they are not completely focused and begin to laugh, wiggle, or a variety of other things, their balance scores can be altered or their agility time slowed.

As a result to this study's findings and to the limitations found further research should be conducted to find specific proprioceptive activities that best fit the population as a whole to maximize the effectiveness of the program on balance and agility with the overarching goal of decreasing fall risks. Research should be done to test the validity and reliability of the Balance Sway application test to the ND population. Research should also look at the implication differences in more specific diagnostic subcategories of neurodevelopmental disorders to better understand how specific programs could be better adapted per the diagnoses. Although those specific subcategories should be looked into with further research, this study begins to fill the gap in literature that specifically focus on proprioception and strength training effects on this specific population with ND.

As a result of our significant findings in this research program, there will now be changes made to the Best of Both Worlds training program, the program in which subjects for this study were taken, to better fit their needs. Changes will be made to the strength training portion of their program to add more functional work to the routines. The goal of these changes is to provide a routine that promotes healthy daily exercises that the young adults with neurodevelopmental disorders can do to enhance their functionality and decrease their risk for falls.

Transitional programs for young adults are becoming more recognized as a beneficial next step for graduating students going into the workforce and society. High functioning young adults with ND are looking for these programs to help guide them into a healthy and self sustaining life and programs like this proprioceptive-strength training program can help them achieve that goal. Transitional programs should be encouraged to implement physical training programs that incorporate proprioception and strengthening in order to help their students create sustainable healthy habits and decrease fall risks.

Conclusions

Variation in diagnoses aside, we can conclude from our results and from previous literature that a proprioceptive-strength-training intervention program can lead to decreased fall risks in the young adult population of those with neurodevelopmental disabilities.This can then lead to a more independent lifestyle able to be held by individuals partaking in this intervention which aligns with goals of transitional programs like the BOBW program.

As a result of our significant findings in this research program, there will now be changes made to the Best of Both Worlds training program to better fit their needs. Changes will be made to the strength training portion of their program to add more functional work to the routines. The goal of these changes is to provide a routine that promotes healthy daily exercises that the young adults with neurodevelopmental disorders can do to enhance their functionality and increase their safety.

Appendix

Appendix A

Weekly Data Collection

Name: Subject 1 Date: Level: Agility Balance Coordination Notes:	Name: Subject 5 Date: Level: Agility Balance Coordination Notes:
Name: Subject 2 Date: Level: Agility Balance Coordination Notes:	Name: Subject 6 Date: Level: Agility Balance Coordination Notes:
Name: Subject 3 Date: Level: Agility Balance Coordination Notes:	Name: Subject 7 Date: Level: Agility Balance Coordination Notes:
Name: Subject 4 Date: Level: Agility Balance Coordination Notes:	

Appendix B

Timeline															
	8/31	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	11/2	11/9	11/16	11/23	11/30	12/12-12/16
week	consent collection	consent collection	initial eval week	1	2	3	4	5	6	7	8	final evals	thanksgiving week		
notes		9/5 no classes	9/16: distinction app due										flex week		12/6 -9 finals
Activity level			eval	level 1	level 1	level 2	level 2	level 3	level 3	level 4	level 4	eval			

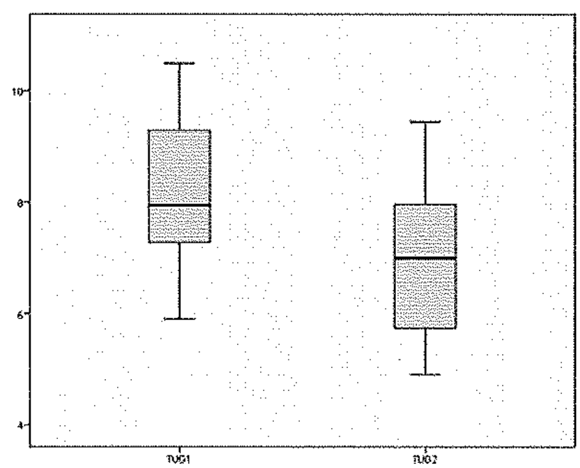
Timeline broken down by week with each level of intervention for each category of proprioception.

Appendix C

Descriptive stats for the Timed Get up and Go

Descriptives

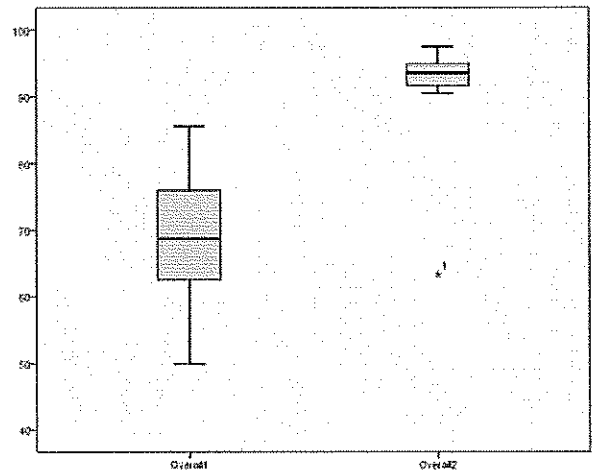
			Statistic	Std. Error
TUG1	Mean		8.2129	.59481
	95% Confidence Interval for Mean	Lower Bound	6.7574	
		Upper Bound	9.6683	
	5% Trimmed Mean		8.2143	
	Median		7.9500	
	Variance		2.477	
	Std. Deviation		1.57371	
	Minimum		5.90	
	Maximum		10.50	
	Range		4.60	
	Interquartile Range		2.32	
	Skewness		.055	.794
	Kurtosis		-.741	1.587
TUG2	Mean		6.9571	.61444
	95% Confidence Interval for Mean	Lower Bound	5.4637	
		Upper Bound	8.4706	
	5% Trimmed Mean		6.9440	
	Median		7.0000	
	Variance		2.643	
	Std. Deviation		1.62565	
	Minimum		4.90	
	Maximum		9.45	
	Range		4.55	
	Interquartile Range		2.85	
	Skewness		.276	.794
	Kurtosis		-1.013	1.587



Descriptive stats for the Overall Balance Sway

Descriptives

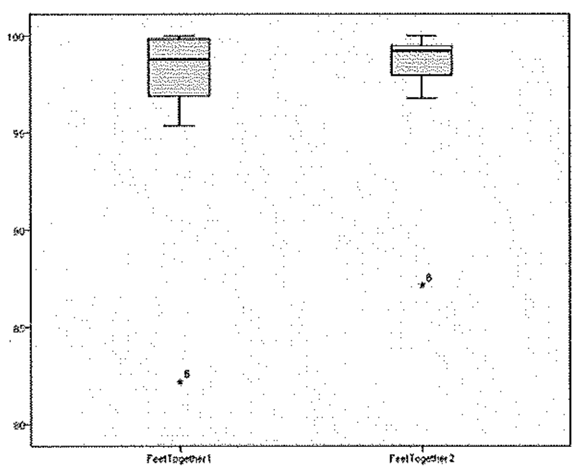
			Statistic	Std. Error
Overall1	Mean		68.7343	4.61647
	95% Confidence Interval for Mean	Lower Bound	57.4382	
		Upper Bound	80.0304	
	5% Trimmed Mean		68.8475	
	Median		68.6900	
	Variance		149.182	
	Std. Deviation		12.21402	
	Minimum		49.87	
	Maximum		85.56	
	Range		35.69	
	Interquartile Range		21.29	
	Skewness		-.054	.794
	Kurtosis		-.368	1.587
Overall2	Mean		89.6400	4.46907
	95% Confidence Interval for Mean	Lower Bound	78.7046	
		Upper Bound	100.5754	
	5% Trimmed Mean		90.6661	
	Median		93.5700	
	Variance		139.808	
	Std. Deviation		11.82404	
	Minimum		63.30	
	Maximum		97.51	
	Range		34.21	
	Interquartile Range		5.22	
	Skewness		-2.453	.794
	Kurtosis		6.234	1.587



Descriptive stats for the Feet Together

Descriptives

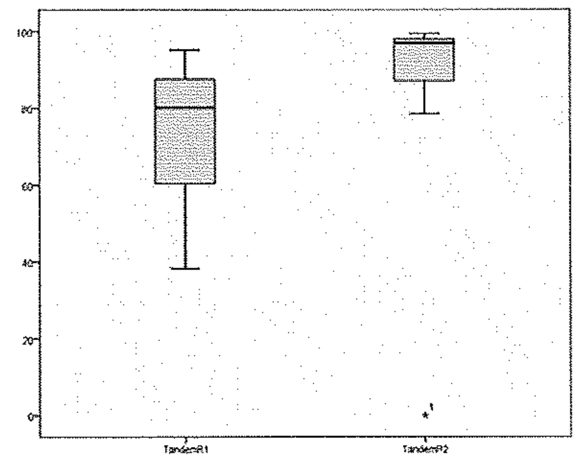
			Statistic	Std. Error
FeetTogether1	Mean		96.3471	2.43820
	95% Confidence Interval for Mean	Lower Bound	90.3809	
		Upper Bound	102.3134	
	5% Trimmed Mean		96.9313	
	Median		98.7900	
	Variance		41.610	
	Std. Deviation		6.45106	
	Minimum		82.18	
	Maximum		100.00	
	Range		17.82	
	Interquartile Range		4.61	
	Skewness		-2.315	.794
	Kurtosis		5.590	1.587
FeetTogether2	Mean		97.3229	1.74260
	95% Confidence Interval for Mean	Lower Bound	93.0589	
		Upper Bound	101.5868	
	5% Trimmed Mean		97.7398	
	Median		99.2100	
	Variance		21.257	
	Std. Deviation		4.61049	
	Minimum		87.14	
	Maximum		100.00	
	Range		12.86	
	Interquartile Range		2.93	
	Skewness		-2.308	.794
	Kurtosis		5.831	1.587



Descriptive stats for the Tandem Stance Right

Descriptives

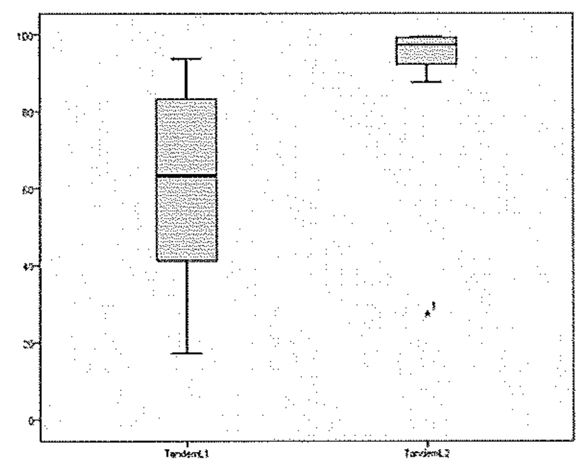
			Statistic	Std. Error
TandemR1	Mean		72.7914	8.51286
	95% Confidence Interval for Mean	Lower Bound	51.9612	
		Upper Bound	93.6216	
	5% Trimmed Mean		73.4688	
	Median		80.1700	
	Variance		507.282	
	Std. Deviation		22.52291	
	Minimum		38.29	
	Maximum		95.10	
	Range		56.81	
	Interquartile Range		48.92	
	Skewness		-.839	.794
	Kurtosis		-.919	1.587
TandemR2	Mean		80.8986	13.75504
	95% Confidence Interval for Mean	Lower Bound	47.2412	
		Upper Bound	114.5559	
	5% Trimmed Mean		84.3679	
	Median		96.8400	
	Variance		1324.408	
	Std. Deviation		36.39241	
	Minimum		.00	
	Maximum		99.35	
	Range		99.35	
	Interquartile Range		19.80	
	Skewness		-2.449	.794
	Kurtosis		6.101	1.587



Descriptive stats for the Tandem Stance Left

Descriptives

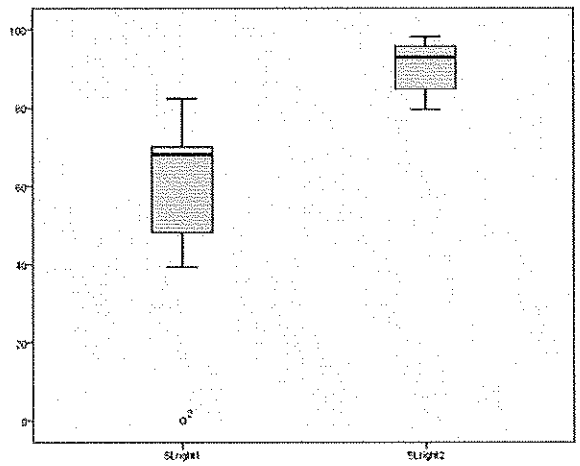
			Statistic	Std. Error
TandemL1	Mean		60.4671	11.66341
	95% Confidence Interval for Mean	Lower Bound	31.9278	
		Upper Bound	89.0065	
	5% Trimmed Mean		61.0213	
	Median		63.3600	
	Variance		952.247	
	Std. Deviation		30.85849	
	Minimum		17.21	
	Maximum		93.75	
	Range		76.54	
	Interquartile Range		71.42	
	Skewness		-.503	.794
	Kurtosis		-1.219	1.587
TandemL2	Mean		86.7114	10.01933
	95% Confidence Interval for Mean	Lower Bound	62.1950	
		Upper Bound	111.2278	
	5% Trimmed Mean		89.2994	
	Median		97.2700	
	Variance		702.709	
	Std. Deviation		26.50866	
	Minimum		27.33	
	Maximum		99.51	
	Range		72.18	
	Interquartile Range		11.59	
	Skewness		-2.520	.794
	Kurtosis		6.443	1.587



Descriptive stats for the Single Leg Right

Descriptives

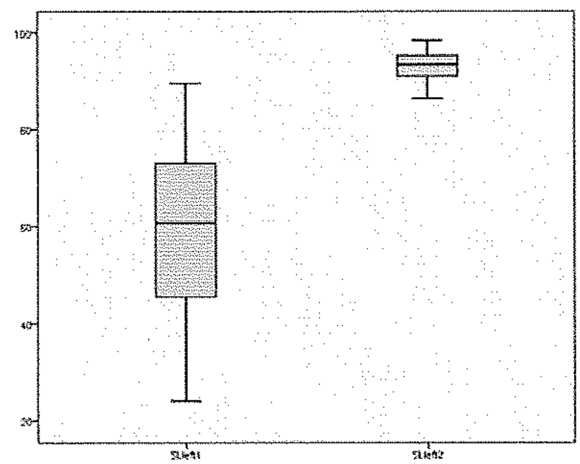
			Statistic	Std. Error
SLright1	Mean		55.3029	10.52591
	95% Confidence Interval for Mean	Lower Bound	29.5469	
		Upper Bound	81.0588	
	5% Trimmed Mean		56.8593	
	Median		68.1700	
	Variance		775.564	
	Std. Deviation		27.84895	
	Minimum		.00	
	Maximum		82.41	
	Range		82.41	
	Interquartile Range		31.30	
	Skewness		-1.562	.794
	Kurtosis		2.422	1.587
SLright2	Mean		90.2829	2.83573
	95% Confidence Interval for Mean	Lower Bound	83.3441	
		Upper Bound	97.2216	
	5% Trimmed Mean		90.4387	
	Median		92.8600	
	Variance		56.289	
	Std. Deviation		7.50263	
	Minimum		79.62	
	Maximum		98.14	
	Range		18.52	
	Interquartile Range		16.31	
	Skewness		-.621	.794
	Kurtosis		-1.413	1.587



Descriptive stats for the Single Leg Left

Descriptives

			Statistic	Std. Error
SLleft1	Mean		58.7929	8.46398
	95% Confidence Interval for Mean	Lower Bound	38.0827	
		Upper Bound	79.5030	
	5% Trimmed Mean		59.0121	
	Median		60.7300	
	Variance		501.452	
	Std. Deviation		22.39312	
	Minimum		24.11	
	Maximum		89.53	
	Range		65.42	
	Interquartile Range		37.32	
	Skewness		-.214	.794
	Kurtosis		-.574	1.587
SLleft2	Mean		92.9771	1.48995
	95% Confidence Interval for Mean	Lower Bound	89.3314	
		Upper Bound	96.6229	
	5% Trimmed Mean		93.0356	
	Median		93.3900	
	Variance		15.540	
	Std. Deviation		3.94203	
	Minimum		86.43	
	Maximum		98.40	
	Range		11.97	
	Interquartile Range		5.78	
	Skewness		-.435	.794
	Kurtosis		.111	1.587



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