

EFFECTIVITY OF SQUAT TO STAND TRAINING IN IMPROVING LOWER EXTREMITY MUSCLE POWER ON CHILDREN WITH DOWN SYNDROME

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Abstract

Background: Squat to stand training is one of the core muscle and lower extremity muscle strengthening exercises that aim to improve lower extremity muscle power to prepare foot muscle in the standing process.

Objective: This study aims to find the effectiveness of squat-to-stand training on a down syndrome patient aged 19 months.

Method: This study is single-subject research on a Down Syndrome patient aged 19 months old with walking delay, hypotonia on both legs, unable to stand independently, and muscle weakness on both lower extremities. The subject had received squat-to-stand training for four weeks, twice a week, and a follow-up at each end of the session.

Result: there is an improvement in XOTR assessment, where the baseline result was T that interpreted as the presence of muscle contraction with minimum movement, and after four weeks of intervention, there is an improvement in the muscle tone and movement compared with the baseline though have not met the X value yet, with normal muscle power interpretation.

Conclusion: squat-to-stand training is practical but does not significantly improve lower extremity muscle power in Down Syndrome patients.

Keywords: Down Syndrome, Squat to Stand Training, Strengthening Exercise, Motoric

Introduction

The growth and development of children are an essential part of their lives (Trenggonowatu & Kulsum, 2018). Every child has specific traits in their growth and development, so any kind of problem in each stage will affect the next phase of life. Unfortunately, not all children undergo the average growth and development process, so some of them will need special treatment in their developmental process (Alsakhawi & Elshafey, 2019).

Internal and external factors mainly cause problems in their growth and developmental process. The internal factors are a variety of races, family, age, sex, and genetic and chromosome abnormality. The external or environmental factors are nutrition, stimulation, psychological, and social, economic status (Abo-Zena & Marks, 2015). Meanwhile, the problems that primarily arise in the growth and developmental process are physical growth, motoric development, language, emotions, and behaviour problems. For example, the growth and developmental problem in special needs children caused by internal factors like chromosome abnormality are Down Syndrome (Anam et al., n.d.)

Down syndrome is the most common chromosome abnormality (Rafferty et al., 2021). Children with Down Syndrome have small brain stems and a delay in cerebellum maturity (Maiano et al., 2019). The lack of training program and motoric experience caused motoric disruption and the reduction of balance capacity compared with normal children (J Intellect Disabil Res – 2019 – Ruiz-Gonz Lez – Physical Therapy in Down Syndrome Systematic Review and Meta-analysis.Pdf, n.d.). Children with Down Syndrome have a significant delay in motoric skills development and qualitative difference in movement patterns compared with normal children. This abnormality is caused by an extra copy of chromosome 21 where typically there were two, but it turned out to be 3 in Down Syndrome (Alsakhawi & Elshafey, 2019). This chromosome abnormality disrupted body genetic balance, leading to a change in physical appearance and intellectual ability and functional impairment of body physiology (Kurniawati et al., n.d.)

Based on The American Physical Therapy Association (APTA 2008), the impairments of Down Syndrome children are hypotonic or low tone, muscle power degradation, increased joint laxity, balance problems, inadequate postural control, and delayed development (Alsakhawi & Elshafey, 2019).

The motor impairment mostly found in Down Syndrome children has delayed

development which could impair motor function. Children, where they should generally grow, will face delays in their development, such as the inability to stand, crawl, and walk at the designated time (Sahabuddin et al., 2021).

Physiotherapy had a role in programming training for Down Syndrome children, for example, using squat to stand training that seemed to improving lower extremity muscle power and preparing legs to get ready in the standing phase (Nabilaputri, 2018). Squat-to-stand training will stimulate the proprioceptive stimulation on the neck, trunk, and lower extremity, mainly the mechanoreceptor and activating motor unit recruitment. During the squat-to-stand process, the leg muscle will be well-activated and significantly impact the body's stability in the balanced state (Anam et al., n.d.).

Based on the explanation above, the author is interested in studying, understanding, and conducting research about the effect squat to stand training on children with Down Syndrome through a case report titled "Effectivity of Squat to Stand Training in Improving Lower Extremity Muscle Power on Children With Down Syndrome".

Research Method

The method in this study is single-subject research with an ABA approach design. This design is aimed to find the effect of squat-to-stand training on children with Down Syndrome (Indra, 2021).



Figure 1. Research Chartflow

There are two basic controls in this Single Subject Research, baseline condition and intervention condition. A baseline condition is a pre-treatment condition which is aimed to see or find the data when an independent or intervention variable was implemented, and this condition is identified as A. Intervention condition is when the intervention is implemented, identified as B. Intervention condition is aimed to see how an intervention is effecting the research subject (Indra, 2021).

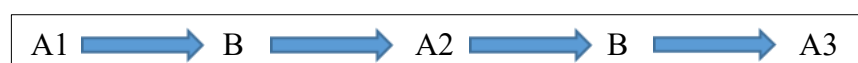


Figure 2. Research Method

A-B-A design is a development from A-B basic design where there is baseline condition repetition after the intervention. The conclusion based on the functional correlation between dependent and independent variables is more substantial in this basic design than in the A-B design. The subject's behaviour was assessed numerous times in three stages: the first stage is baseline condition (A); the second is intervention condition (B); the third is a condition when the intervention is taken and back to the initial condition or baseline (A2). The measurement was done continuously in these three stages until the data was considered stable. The logic of this design is that if the desired response or subject's condition is back to baseline (A2) when the intervention is drawn back, it can be concluded that there possibly the implemented intervention is affecting the initial condition or that there was a functional correlation between a dependent and independent variable (Indra, 2021).

Description:

A1 : baseline 1. Muscle power measurement using XOTR scale. Growth and developmental status using DDST, and functional measurement using GMFM.

B : Implementing squat-to-stand training for four weeks and evaluated at the end of the intervention.

A2 : Follow-up, a re-assessment using XOTR, DDST, and GMFM. The follow-up is done at each end of the intervention.

The research was held at Atik Hidayati Physiotherapy Clinic Dusun 2, Desa Jemawan, Kec. Jatinom, Kab. Klaten, Center Java. The research started with baseline data collection and the first intervention meeting on Monday, January 31st 2022, until February 23rd 2022. The subject is a 19 months old Down Syndrome patient with walking development delay, hypotonia on both legs, unable to stand independently, and muscle weakness on both lower extremities with medical treatment history along his growth and development process. At first, he could only roll, but after eight months of therapy at Atik Hidayati Physiotherapy Clinic, he can now stand by grabbing subjects around him. Besides, he got another medical diagnosis, hypothyroid, based on his medical report.

Before getting the treatment, the patient was getting physiotherapy assessment, such as developmental delay using DDST, the lower extremity muscle tone using XOTR, and functional activity limitation using GMFM. The operational definition of this study consists of:

a. Independent variable

The independent variable of this case is squat-to-stand training, which aims to improve lower extremity muscle power to get the patient ready for his standing phase. Below are the steps in squat-to-stand training:

1. Tools
 - a) Mattress
 - b) Toys

2. Procedures

Squat-to-stand training was given after joint mobilization and proprioceptive training of the upper and lower extremity. This intervention aims to get the muscles ready before the actual intervention and improve proprioceptive ability. Hereafter, squat-to-stand training was repeated 30 times.

Table 1 shows the training program using AGA and AGB mobilization, proprioceptive and squat-to-stand training. The program was given for four weeks with static principle and the same dose in every session.

Table 1 Training Program

Week	Frequency	Intensity	Time & Repetition	Type
I	Twice a week	1 Set	5 minutes & 10 x	Joint mobilization
		1 Set	5 minutes	Proprioceptive training
		1 Set	20 minutes & 30x	Squat-to-stand training
II	Twice a week	1 Set	5 minutes & 10 x	Joint mobilization
		1 Set	5 minutes	Proprioceptive training
		1 Set	20 minutes & 30x	Squat to stand training
III	Twice a week	1 Set	5 minutes & 10 x	Joint mobilization
		1 Set	5 minutes	Proprioceptive training
		1 Set	20 minutes & 30x	Squat to stand training
IV	Twice a week	1 Set	5 minutes & 10 x	Joint mobilization
		1 Set	5 minutes	Proprioceptive training
		1 Set	20 minutes & 30x	Squat to stand training

b. Dependent Variable

The subject's development was screened using Denver Developmental Screening Test (DDST). DDST is an assessment method showing children's developmental ability based on age (Jasri & Karim, 2020). DSST aims to assess children's developmental status according to their age and monitor if there was a delay in their growth and development, so it will be a massive help in screening for any development abnormality in children. Motoric

development that causes growth and developmental delay in children is primarily found in the form of delays in some aspects such as crawling, sitting, standing, and walking. Assessment using DDST will be done at each end of the intervention (Soetjningsih & IGN, 2015).

The subject's functional ability was assessed using Gross Motor Function Measure (GMFM) scale. GMFM is a standard observational instrument designed and validated to measure the change in gross motor function from time to time (Deutz et al., 2018). The abnormality in functional ability can be in the form of a patient's inability to stand independently and need help from other people or objects around him. GMFM assessment was done at each end of the intervention.

Lower extremity muscle power improvement was measured using the XOTR instrument. XOTR instrument is used to screen all limbs, both upper and lower, with rating criteria as below (Mahendra, 2015):

X : average muscle power

O : no muscle contraction at all

T : detected muscle contraction with minimum movement

R : detected reflex

This XOTR assessment is done at each end of treatment or intervention.

The data in this study was analyzed and proceeded using the descriptive statistical approach in the form of improvement visualization after the intervention was carried out for four weeks. The outcome of this research is muscle power improvement. This study is presented in the form of a table. The process of data analysis was needed in each condition.

A baseline measurement was conducted using XOTR screening to get stable data, and this session was done for a week to see the muscle endurance of the legs before initiating the intervention for four weeks. The follow-up at each end of the research intervention aims to see the progress. The next step is evaluating whether the goal is achieved using the XOTR instrument.

Result

After conducting a study on a patient diagnosed with Down Syndrome by giving intervention of joint mobilization, proprioception and squat-to-stand training for eight sessions in four weeks, the result showed improvement in XOTR assessment. At the

baseline, the XOTR assessment resulted in T, meaning muscle contraction was detected with minimum movement. After four weeks of physiotherapy intervention, there was an improvement in muscle tone and movement compared with baseline, even though not up to X, which is interpreted as average muscle power. On the T1, the patient needed help standing by grabbing objects or people around, but on the T8 or last evaluation, the patient could stand independently. The evaluation of XOTR screening is described in table 2 below.

Table 1 XOTR Assessment Result

REGION	T1	T2	T3	T4	T5	T6	T7	T8
Hip	T	T	T	T	T	T	T	T
Knee	T	T	T	T	T	T	T	T
Ankle	T	T	T	T	T	T	T	T
Date	31-01-22	3-02-22	7-02-22	10-02-22	14-02-22	17-02-22	21-02-22	24-02-22

Meanwhile, the evaluation of the DDST showed a minimum improvement. In T1, a 19-month-old patient should typically achieve 23 aspects of gross motor, but he can only achieve 12 aspects. After eight physiotherapy sessions, the evaluation showed minor improvement where the patient could only achieve 13 aspects of the gross motor, but this still can be considered meaningful progress in his growth and development process. The evaluation of DDST is explained in table 3.

Table 2 DDST Assessment Result

Date	Gross Motor	Language	Fine Motor	Social Personal
T1	12 Aspects	3 Aspects	Abnormal	Normal
T2	12 Aspects	3 Aspects	Abnormal	Normal
T3	12 Aspects	3 Aspects	Abnormal	Normal
T4	12 Aspects	3 Aspects	Abnormal	Normal
T5	13 Aspects	3 Aspects	Abnormal	Normal
T5	13 Aspects	3 Aspects	Abnormal	Normal
T7	13 Aspects	3 Aspects	Abnormal	Normal
T8	13 Aspects	3 Aspects	Abnormal	Normal

The result of functional assessment using GMFM is that there was no significant improvement after eight sessions of intervention on standing and walking dimensions. The result GMFM assessment is explained in figure 3.

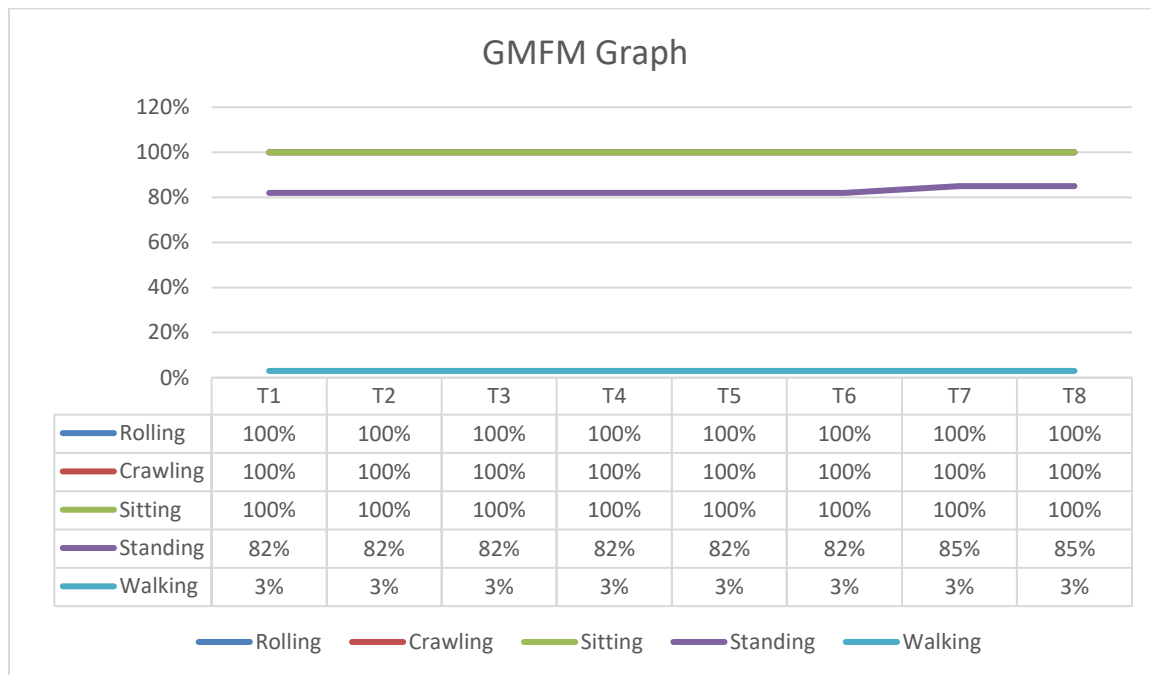


Figure 2. GMFM Graph

Discussion

Squat-to-stand training is one of the various core muscle and lower extremity muscle strengthening exercises that are not only applicable for special needs children such as Down Syndrome but also can be used for normal populations such as athletes and other normal children, developed in plentiful movement options and customizable with individual's necessity and goals. Squat-to-stand training that is implemented regularly with an appropriate dose for special needs children with Down Syndrome will be beneficial and be a great help in improving their growth, and developmental process, including strengthening their postural, pelvic, and legs muscle as these hold essential roles in walking phase (Alsakhawi & Elshafey, 2019). However, not only squat to stand training, warming-ups before also needed. For example, joint mobilization to get the child ready and proprioceptive training to improve patients' proprioceptive function to stimulate the sensory function and endurance (Harbourne et al., 2021). This study showed that squat-to-stand training has an influential impact but not significantly.

Conclusion

Based on the study result, squat-to-stand training in a Down Syndrome subject aged 19 months is effective in strengthening lower extremity muscle power, but further research with a longer duration should give more maximum results.

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