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The Effectiveness Visual Feedback on Postural Control Post Stroke: Literature Review

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Abstract

Stroke often causes disturbances in the sensorimotor system, which can interfere with the sufferer's ability to maintain balance and movement. Visual feedback can provide real-time information regarding the position and movement of a patient's body after a stroke, by adjusting movement adjustments and controlling body posture to maintain balance. The aim of this research is to determine the effect of visual feedback from the exercises given on post-stroke patients' posture control related to muscle activity, center of pressure, balance, gait and functional ability. The method used is a literature review through searching Pubmed and Scopus articles with the keywords "Visual Feedback" AND "Postural Control" OR "Postural Instability" AND Stroke which will be identified and selected using PRISMA guidelines. The research results showed that from 488 search articles, 6 articles were obtained that met the inclusion and exclusion criteria for review, which informed that visual feedback mediated by sit to stand exercises, Dynamic Sitting Sport, Sitting Balance, or visual feedback with a stable surface and bilateral visual feedback can improve muscle activity, center of pressure, balance, gait and functional abilities of post-stroke patients. The conclusion of this research is that there is an influence of visual feedback from the exercises given on posture control in stroke patients.

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INTRODUCTION

Stroke is a rupture or blockage that prevents the flow of blood and oxygen to brain tissue and results in dysfunction related to the location and extent of the injury (Jx et al., 2020). Individuals who experience a stroke will have an impact on reducing activities both physically and socially, which results in the individual no longer being able to carry out their daily activities independently (Insani et al., 2020). The most characteristic symptom is hemiparesis of the body contralateral to the brain lesion, which causes muscle weakness in the upper and lower extremities as well as walking and balance limitations (Abe et al., 2025)

In post-stroke patients, in addition to impaired walking ability, the ability to carry out daily activities can also be impaired and limited (Puntkattalee et al., 2016) After a stroke, patients have difficulty in performing daily independent activities, the quality of life deteriorates due to life changes (Cai et al., 2024) The walking speed of stroke patients decreased by 17-49% compared to normal adults (Komiya et al., 2021). Sit-to-stand and stand-to-sit positions, normal weight-bearing, and walking movements are limited. Body movements in daily life are generally affected Visual integration assists the somatosensory and vestibular senses to stabilize body balance in the sitting position, and contributes to posture control through coordination with somatosensory perception.

Postural control is associated with long-term walking ability (Lyu et al., 2023), activity of daily living ability (Khan & Chevidikunnan, 2021), and depression (Surgent et al., 2019). Loss of lower limb muscle strength due to post-stroke nerve damage and limited balance (Lee et al., 2021). Post-stroke balance cannot improve spontaneously, but can improve with repetitive activities or tasks (Kessner et al., 2019). Interventions recommended to improve balance and postural control in stroke are exercises such as feedback (Arienti et al., 2019). One intervention in the form of visual feedback can improve motor learning (Ghrouz et al., 2024) and increase neural plasticity (Lando et al., 2024) which will reorganize and form new connections in response to injury. This suggests that visual feedback may not only help to improve balance in the short term but may also contribute to the improvement of balance and long term patient stroke. (Youri et al., 2020)

The purpose of this study is to determine the effect of visual feedback from the exercises given on posture control of post-stroke patients related to muscle activity, center of pressure, balance, gait and functional ability. The formulation of this study is whether there is an effect of visual feedback interventions such as sit to stand exercises, Dynamic Sitting Sport, Sitting Balance, and visual feedback with a stable surface and bilateral visual feedback on posture control of post-stroke patients related to muscle activity, center of pressure, balance, gait, functional ability.

Previous research in recent years has reported that physiotherapy can provide functionally related interventions using visual feedback (Abe et al., 2025) Previous research describes feedback interventions can improve postural control with accurate exercises performed together with visual, auditory, tactile, and proprioceptive (Hugues et al., 2017). However, there is RCT literature showing Robot Assisted gait training (RAGT) therapy using Lokomat (Hocoma AG, Volketswil, Switzerland) is more effective than traditional visual feedback (Bergmann et al., 2016) Therefore, this study reviews visual feedback combined with postural training on postural control of stroke patients. However, in previous studies there has been no discussion comparing various visual feedback interventions such as sit to stand exercises, Dynamic Sitting Sport, Sitting Balance, and visual feedback with a stable surface and bilateral visual feedback.

METHODS

This research is a literature review. The article search was conducted using PRISMA guidelines. This research was conducted by searching journal databases in Scopus and Pubmed which were carried out in several stages. In stage 1, researchers searched for articles through Scopus and Pubmed using the keywords "Visual Feedback" AND "Postural Control" OR "Postural Instability" AND Stroke. Then, in the 2nd stage, articles were selected between 2020 and 2025, the titles and abstracts collected will be filtered by removing duplicate articles, articles that use languages other than English and articles that are not related to this research. In stage 3, the researchers read the full text of the articles screened in stage 2, papers that were eligible for inclusion according to the inclusion criteria. Finally, in stage 4, the articles selected from the independent review process were read by other researchers and determined whether the papers should be included/ excluded through discussions conducted by the researchers.

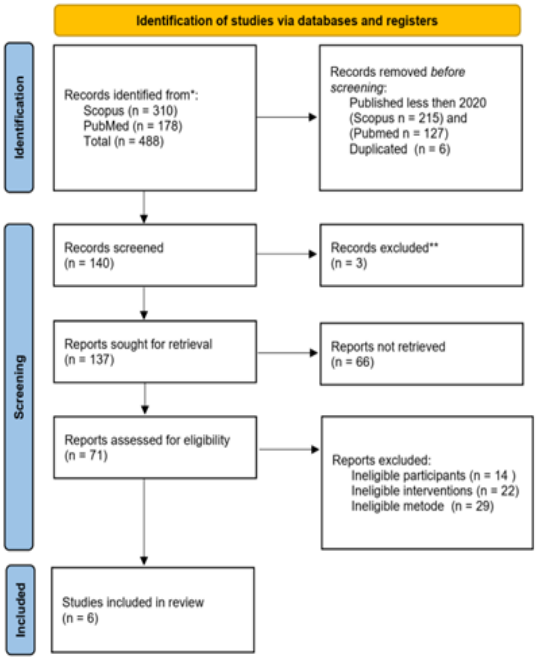

Figure 1. Flowchart for Literature Search.

RESULTS AND DISCUSSION

The search results found regarding visual feedback and postural control stroke obtained a total of 6 articles based on Pubmed and Scopus. Six articles were selected using English language that has been adjusted to the PRISMA Guideline as a theoretical basis. Furthermore, these six articles will be reviewed to determine the effectiveness of exercise-mediated visual feedback training on postural control of stroke patients, the following is a review **Table 1** of the selected articles.

Based on the six articles above, a total of 170 stroke participants were obtained, five of which had participants with chronic stroke and one of which had acute stroke participants. All six articles used the RCT method. The interventions carried out in these six articles were in the form of visual feedback combined with sitting exercises such as sit to stand training, dynamic sitting exercise, sitting balance, or standing visual

Table 1. Review Artikel

Author	Patient	Comparison	Results
(Hyun et al., 2021a)	30 stroke patients after onset between 3 and 6 months	The control group received sit to stand training program and general physical therapy, while the intervention group received sit to stand program with real-time visual feedback.	Sit to stand training combined with real-time, visual feedback is effective in improving lower extremity muscle activity, balance, gait and functional ability after stroke.
(M. Inoue et al., 2022)	27 hemiparesis stroke patients who suffered an attack within the first 30 days	Dynamic seated exercise intervention group with delayed visual feedback and Dynamic sitting control group	Dynamic sitting exercise with delayed visual feedback can improve postural control, balance and functional ability after stroke
(Sawa et al., 2022)	20 stroke patients (in sub acute and chronic phases)	Control group receives real-time visual feedback intervention, intervention group receives delayed visual feedback	Sitting balance training with delayed visual feedback can improve postural control, balance and functional ability after stroke
(Yeo et al., 2023)	39 chronic stroke patients diagnosed > 6 months	Intervention group with visual feedback with unstable surface (n=19) and control group with unstable surface training (n=20).	Visual feedback with unstable surface can improve walking speed, trunk stability and functional ability after stroke
(No et al., 2022)	24 stroke patients with onset >6 months	Intervention group bilateral visual feedback (n=8), unilateral visual feedback (n=8) and control group with squat exercise without visual feedback.	Visual feedback with bilateral visual feedback can improve postural control and balance after stroke
(Pak & Lee, 2020)	40 stroke patients with onset >6 months	Experimental group visual feedback training with visual targets during weight shifting, and control group visual feedback training with weight shifting	Visual feedback with visual targets during weight shifting on the paretic side can improve muscle activation and balance after stroke

feedback with unstable surface and bilateral visual feedback. Based on this, the results of this study found that visual feedback can improve muscle activity, center of pressure, walking ability, and daily activity ability of stroke patients.

Stroke is a rupture or blockage of blood flow in the brain that can prevent the flow of blood and oxygen to brain tissue (Morone et al., 2020; Rethnam et al., 2021). The most characteristic symptom of stroke is hemiparesis of the body contralateral to the brain lesion, which causes muscle weakness in the upper and lower extremities as well as walking and balance limitations (Abe et al., 2025). Individuals who experience a stroke will have an impact on reducing activities both physically and socially, which results in the individual no longer being able to carry out functional activities (Insani et al., 2020)

Postural control is essential for performing functional activities that are the basis of daily life (Kannan et al., 2019) However, stroke patients experience sensory and motor impairments such as decreased prereceptive, visual input, decreased muscle activation, and performance of the trunk (Ghorbanpour et al., 2021). trunk performance is directly related to walking and physical function and balance capacity, in people after stroke (Karthikbabu & Verheyden, 2021)

Decreased balance capacity is one of the common occurrences in post-stroke patients, and will be associated with worsening physical activity, disability, and low quality of life. In addition, balance disorders often lead to high fall rates (Li et al., 2019). Research conducted by (Hyun et al., 2021a; S. Inoue et al., 2022; Pak & Lee, 2020; Sawa et al., 2022) that visual feedback can improve post-stroke balance.

Decreased balance ability of stroke patients results in abnormal muscle mobilization on the non-paralyzed side due to decreased muscle strength on the paralyzed side, decreased motion (Dai et al., 2021) Research conducted by Hyun et al., (2021) by comparing sit to stand training interventions with a combination of visual feedback and sit to stand hip flexors, hip abductors, knee extensors. The muscles that are activated when walking are Gluteus Medius (GM), rectus femoris (RF) and Tensor Fascia Latae (TFL). GM is the main muscle used during walking and provides body stability to the left and right when standing on one leg. In a study conducted by Pak & Lee (2020) RF and TFL there were significant differences between intervention groups with visual feedback by targeting visual, Rectus Femoris (RF), Gluteus Medius (GM), and Tensor Fascia Latae (TFL).

In stroke patients tend to move less on the side of the body that is lesioned Visual feedback interventions show an increase in the center of pressure. However, according to (S. Inoue et al., 2022) this increase if with delay visual feedback there is an increase in shifting weight laterally to the paretic and non-paretic side, but there is no significant difference in shifting weight to the anterior side when compared to real-time visual feedback. However, in research (Hyun et al., 2021b) found that the center of pressure in real-time and delay visual feedback interventions had a significant increase. However, another study conducted by (Kotadia et al., 2021) that real-time visual feedback is more effective in maintaining and increasing the center of pressure.

Walking ability is also an important aspect besides center of pressure in stroke patients. The walking speed of stroke patients decreased by 17-49% compared to normal adults (Komiya et al., 2021). Therefore, walking rehabilitation of patients with stroke is an important goal to improve activity function (Youri et al., 2020) Recent publications show consistent results by confirming impairments in several parameters of post-stroke gait characteristics such as reductions in walking speed, step length, and walking time on the injured side, and asymmetric walking patterns (Kaźmierczak et al., 2022) Real-time visual feedback can improve patients' walking ability, when measured using the Timed Up and Go Test (TUG) and 10 Minute Walking Test (10MWT) (Hyun et al., 2021a). However, in a study conducted by Pak & Lee (2020) 10MWT did not show a significant difference between the control and intervention groups, where the intervention group was visual feedback with visual targets and the control group with visual feedback intervention without visual targets.

The visually assessed walking ability scale, namely the Functional Ambulatory Category (FAC) also shows stroke patients who are given visual feedback show an increase in walking ability (S. Inoue et al., 2022) and movement distance (Pak & Lee, 2020). Visual feedback intervention combined with unstable surface balance training has increased walking speed and stride length. However, in cadance, stride time, and degree of knee extension (Yeo et al., 2023) Bilateral visual feedback can increase TUG in hemiparesis stroke compared to unilateral visual feedback (No et al., 2022).

In stroke patients, in addition to impaired walking ability, the ability to carry out daily activities can also be impaired and limited (Puntkattalee et al., 2016). After a stroke, patients have

difficulty in performing independent daily activities, the quality of life deteriorates due to life changes (Cai et al., 2024). So that the patient's daily ability is also important to be evaluated. Previous articles explain that sit to stand training and a combination of real-time visual feedback performed for 20 minutes per day for 5 days a week for 6 weeks can improve lower limb muscle strength, balance, walking patterns, and quality of life for stroke patients (Hyun et al., 2021a) Bilateral visual feedback can improve Berg Balance Scale (BBS) scores (No et al., 2022). Another study conducted by (M. Inoue et al., 2022) visual feedback intervention with delay has an effect on Postural Assessment Scale for Scale (PASS) and five times sit to stand scores compared to visual feedback intervention with real time. The study has limitations where there is no measurement of the degree of loading on the paretic and non-paretic sides so that there is no significant increase in the ability to shift body weight forward for both groups.

CONCLUSION

Visual feedback can improve the center of pressure, walking ability, and daily activity ability of stroke patients. There are limitations in this study that have not been compared with appropriate interventions for acute or chronic phases, and related to the location of damage to the patient's brain. Another limitation is that it cannot identify improvements in stability and control the effects of rehabilitation other than this intervention. so further research is recommended to conduct research by comparing interventions given to stroke patients in the acute phase or in the chronic phase and the location of damage to the brain.

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