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Physical Therapy Exercises for Post-Stroke Swallowing Disorders: A Narrative Review

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Abstract:

Background: A major life-threatening consequence of stroke is dysphagia and swallowing disorders, which can lead to increased risk of morbidity and death rate, due to aspiration, pneumonia and poor nutrition. Physical therapy exercises can help in regaining normal and safe swallowing process, whether these exercises are of compensatory nature or rehabilitative nature.

Objective: This review aims to investigate and discuss the current literature on the effectiveness of physical therapy exercises in post-stroke swallowing disorders.

Methods: A comprehensive search was done at PubMed, PEDro, Science Direct, Google Scholar and Cochrane library databases by using keywords such as bulbar training, dysphagia, swallowing dysfunction, ischemic stroke, hemorrhagic stroke, in addition to searching the reference lists. Only English articles published from January 2015 to December 2024 were included. Unpublished manuscripts, dissertations, conference abstracts or articles published in non-English language were excluded. Physical therapy exercises included head-lift exercises, tongue strengthening exercises, jaw exercises, respiratory muscle training, chin tuck against resistance exercises, and cervical exercises.

Results: The findings suggest that physical therapy exercises have the potentiality for improving swallowing functions in stroke survivors with dysphagia. However, there is a need for conducting large and rigorous studies to confirm these findings and establish an evidence-based clinical practice guideline.

Conclusion: The review of the current literature indicates that physical therapy exercises hold promise in improving swallowing functions in stroke survivors. Additional high-quality studies are required to inaugurate standardized treatment protocols.

Keywords: Dysphagia, Physical therapy exercises, Stroke, Swallowing disorders.

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Introduction:

Stroke is a clinically defined syndrome of sudden, focal neurological deficit caused by vascular damage either ischemic or hemorrhagic at the central nervous system[1]. The incidence of stroke is increasing with age advancement. Acute stroke continues to be a leading cause of disability globally, despite advancements in its treatment[2]. Stroke may affect sensory and motor systems and may cause cognitive impairment as well, which hinder patients ability to participate in the social community and to do self-care tasks[3]. As a consequence for such impairments, acute stroke is often complicated with dysphagia, with prevalence of over than 50% of stroke survivors[4]. Aspiration-related complications from dysphagia include pneumonia, frequent coughing or choking, dehydration, malnourishment, reduced quality of life, and social isolation[5].

Swallowing Process:

It’s believed that normal swallowing process is associated with activated cortical and subcortical networks for sensory integration and motor planning. Thus, lesions in either cortical, subcortical, or brainstem will disrupt these control circuits, resulting in dysphagia[6]. For efficient boluses propelling from the oral cavity to the stomach during deglutition, an intricate sensorimotor process is required to coordinate swallowing muscles to protect the airway and to reduce food residues after swallowing[7]. This intricate physiological process is controlled by integrating more than thirty muscles with the cranial nerves[8].

The mechanism of swallowing requires multiple musculatures, such as oral, pharyngeal, laryngeal, and esophageal muscles[9]. There are four stages to describe a normal swallowing process, which are oral preparatory, oral propulsive, pharyngeal and esophageal stage. Oral preparatory stage at which the bolus is manipulated and shaped into a bolus to be positioned by the tongue against the hard palate with a sealed posterior oral cavity. Oral propulsive stage at which tongue anterior tip is lifted up to the alveolar ridge to squeeze food bolus back into the pharynx. Pharyngeal stage which is a rapid sequential activity of food passage and propelling through the pharynx and Upper Esophageal Sphincter (UES) down to the esophagus; with simultaneous protection of the airway, insulating the laryngotracheal structures from the pharynx to prevent bolus aspiration into the airway. Esophageal stage that is controlled by peristalsis to create a wave that carries the bolus down to the stomach[10].

It is believed that damage in the cortical and subcortical structures is the cause of post-stroke dysphagia. In stroke survivors, swallowing recovery might occur due to the cortical re-organization[5]. Dysphagia after unilateral hemispheric stroke is assumed to be caused by a stroke lesion involving the dominant swallowing hemisphere[11].

Overview of physical therapy exercises for post-stroke swallowing disorders:

Restoring a normal and safe swallowing process after stroke requires neurorehabilitation. It's a crucial step to address interventions like facilitatory exercises, swallowing reflex stimulation, breathing exercises, strategies that include compensatory swallowing positions, facial muscle exercises, in addition to patient education regarding safe swallowing and selecting proper food consistencies to enhance the swallowing phases and raise patient consciousness and participation during the course of rehabilitation[12].

Tongue strengthening exercises:

Reduced maximum isometric tongue pressures < 300 mmHg and inadequate tongue driving force are two indicators linked to an increased risk of aspiration[13]. Tongue is one of the muscles that can be targeted by exercises, as it plays an important role in forming, controlling, and propelling boluses during swallowing[14]. Studies in the literature[15-18] provided tongue exercises using Iowa Oral Performance Instrument (IOPI) for tongue pressures training, accuracy, and strengthening. For the anterior part of the tongue, the air-filled bulb was positioned at the tongue tip to be pushed against the alveolar arch, furthermore, the bulb is positioned at the middle portion of the tongue to be pushed against the mid-part of the hard palate for the posterior part of the tongue[15]. Kim et al. described the procedure at which the back part of the tongue was positioned at the rear edge of the hard palate, whereas the front part of the tongue was positioned longitudinally along the hard palate[16].

Kim and others found that there is evidence to support that tongue-to-palate resistance training is effective in tongue strengthening as well as in enhancing swallowing performance in post-stroke dysphagic patients[16]. There is also some evidence supporting that tongue pressure strength and accuracy training may significantly enhance swallowing functions in sub-acute stroke survivors[15].

Head-lift exercises (HLE) and Chin-Tuck Against Resistance exercises (CTAR) and Jaw exercises:

The suprahyoid musculature is linked to the hyoid bone, it attaches the hyoid bone to the skull and mandibular base. With a stable insertional base at the mandible, the suprahyoid muscles elevate the hyoid bone to elevate the base of the oral cavity for efficient swallowing[19]. This can increase forward laryngeal excursion and opening of the UES, and minimize residue post-swallowing[20].

Exercises that target suprahyoid muscles are subclassified into; head-lift exercises (HLE) which is also called shaker exercise, chin-tuck against resistance exercise (CTAR), and modified jaw opening exercise (MJOE). All these exercises address the hyoid complex involving the suprahyoid muscles, which can be targeted by either tucking the chin in supine/sitting or by jaw-opening movements.

CTAR exercise requires patient's in sitting position while compressing an inflatable rubber ball against the tucked chin, to strengthen suprahyoid and thyrohyoid muscles to facilitate the motion of UES[8]. On the other hand, head-lift exercise involves repeatedly raising and lowering the head from supine position[21]. While MJOE is done by providing manual resistance at the patient's chin applied in an upward vertical direction against mouth opening.

Three studies[8,22,23] evaluated the efficacy of CTAR on swallowing ability in post-stroke dysphagic patients. The exercise was done in seated position, by using PhagiaFLEX-HF device (Alternative Speech and Swallowing Solutions, Inc), or a game-based CTAR with (LES 100, Cybermedic Inc., Iksan in South Korea) with a 10-inch tablet, or by using an inflatable rubber ball for chin compression respectively. Another study[24] provided the exercise in the form of manual given upward vertical resistance against mandibular opening while keeping the mouth closed with the tongue placed in tipper swallow position. Other study[25] provided the intervention in the form of HLE from supine position.

There is evidence validating the effectiveness of CTAR exercises in minimizing aspiration risk and enhancing oral intake in stroke survivors with dysphagia, particularly those with restricted hand/upper limb power and range of motion[22]. Also, there is proof on the effectiveness of HLE in improving hyoid excursion and minimizing aspiration in post-stroke dysphagia[25]. Gao and Zhang stated that CTAR exercise has an equivalent impact on enhancing swallowing ability as HLE[8]. However, Park and others found that game-based CTAR exercise not only does it have the same impact as HLE on swallowing function, but is also a less rigorous and more appealing method of exercising[23]. Koyama and others found that MJOE is applicable with no adverse outcomes in stroke patients and that it enhances anterior hyoid excursions during swallowing[24].

Respiratory muscle training:

With regard to stroke survivors with dysphagia, respiratory muscle training should be explored as a therapeutic method. As ineffective and impaired cough is linked to respiratory muscle weakness in stroke survivors[26]. Swallowing and breathing functions require a highly coordinated physiological control, as these functions cannot be performed simultaneously. During the acute post-stroke stage, dysphagia occurs due to muscular dysfunction and incoordination caused by the central nervous system lesions[27]. Thus, interventions that strengthen respiratory muscles may increase the effectiveness of coughs and lower the incidences of aspiration[28].

On reviewing the literature, Moon et al. studied the effect of expiratory muscle strengthening on swallowing ability in acute post-stroke dysphagia. The intervention was provided by using the expiratory muscle strength training device EMST 150 (Aspire Products LLC., USA), at which the participants were instructed to blow through a mouth-piece while sealing the nasal cavity[29]. On the other hand, two studies[28,30] targeted both the inspiratory and expiratory muscles by using Dofin Breathing Trainer (DT 11 or DT 14 GaleMed Corporation) and (Orygen Dual Valve®, Forumed SL, Barcelona, Catalonia, Spain) respectively.

There is some evidence supporting the effectiveness of respiratory muscle training on the swallowing ability in stroke survivors during the acute phase[29], and in enhancing improvements of oral intake[30], and in improving swallowing security in subacute post-stroke dysphagia after three-week intervention, however, no differences were detected at three-month follow-up in swallowing security when compared to conventional treatment[28].

Cervical exercises:

Stroke survivors may suffer from hemiparesis following a stroke, such hemiparesis can result in scoliotic, kyphotic, or hyperlordotic cervical spine malalignments, and it’s believed that these aberrant cervical alignments can exacerbate dysphagia[31]. Cervical spine malalignment can impede individuals' swallowing abilities by deviating from the typical swallowing pathway, such as constricting the pharynx or/ and the esophageal vestibule, or resulting in inadequate laryngeal elevation causing swallowing muscles dysfunction and oropharyngeal dysphagia[32,33]. Therefore, it’s believed that strengthening cervical musculature could enhance posture by maintain the head erect and the shoulders horizontal, as well as facilitating muscles of mastication[34].

Jeon et al investigated the impact of incorporating upper cervical spine mobilization with neuromuscular electrical stimulation (NMES) on swallowing functions and forward head posture in post-stroke dysphagia, the intervention was provided in the form of upper cervical spine mobilization in the direction of suboccipital flexion[35]. While an another research study done by Ploumis et al investigated the effectiveness of cervical isometric exercises in improving dysphagia following stroke with hemiparesis, the exercises were provided in the form cervical isometric exercises done in four directions (forward-backward-sidewards)[31].

Jeon et al. found out that combining NMES with upper cervical spine mobilization is an intriguing potential to enhance swallowing functions and forward head posture in post-stroke dysphagic patients[35]. It was also found that adding cervical isometric exercises to the rehabilitation program of hemiparetic post-stroke dysphagic patients resulted in greater improvements in their swallowing functions compared to patients who were subjected to speech therapy only[31].

Conclusion:

Physical therapy exercises show promise in improving swallowing functions in stroke survivors, by improving tongue strength, control and propulsion, and by targeting suprahyoid muscles that helps in improving forward laryngeal excusrion and upper oesophageal sphincter opening for safe swallowing process, in addition to reinforcing the coordination between swallowing and breathing for effective protection of the airway, and also for improving cervical alignment and proper posture required for safe swallowing. Despite these findings, further high-quality studies are needed to inaugurate standardized treatment protocols, and to establish an evidence-based clinical practice guideline.

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