Critical Review:
Is the Shaker exercise effective in rehabilitating swallowing function in individuals with dysphagia due to upper esophageal dysfunction?

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This review examines the published evidence on the efficacy of Shaker exercise in rehabilitating swallowing function in individuals with upper esophageal sphincter (UES) dysfunction. A literature search was completed using multiple electronic databases. The search resulted in three randomized clinical trials that were subsequently critically appraised using a critical appraisal tool (CAT). Overall, the articles analyzed in this review provide suggestive evidence for the Shaker exercise being effective in rehabilitating swallowing function in individuals with dysphagia due to UES dysfunction.

Introduction

Functional swallowing is necessary for survival. Safe and efficient swallowing requires an elaborate coordination of neuromuscular activity to allow for the swallowed material to pass from the oropharynx into the esophagus without aspiration occurring (Shaker et al., 2002). Unfortunately, as a result of aging, chemoradiotherapy for head and neck cancer, neural diseases and cardiovascular accidents, the coordination and strength of this system can be impaired, resulting in swallowing abnormalities (Mishra, Rajappa, Tipton, & Malandraki, 2015). When disruption in this passage occurs, symptoms of dysphagia, coughing, and choking may result, leading to malnutrition, pneumonia and asphyxia (Shaker et al., 2002).

Appropriate suprahyoid muscle strength and functioning is necessary for a functional swallow. This musculature allows for opening of the upper esophageal sphincter (UES), a sphincter that separates the oropharynx and the esophagus and serves as a critical gateway in the coordination of swallowing and breathing (Shaker et al., 2002; Mishra, Rajappa, Tipton, & Malandraki, 2015; Logemann et al., 2009; Mepani et al., 2008). When UES opening is narrowed it acts as a resistor to the swallowed material passing through the pharynx and into the esophagus. This may result in post-swallow residue and aspiration (Shaker et al., 2002).

A non-invasive exercise, the Shaker exercise, was developed in attempts to target and strengthen the muscles required for UES opening (Logemann et al., 2009; Antunes & Lunet, 2012). The exercise potentially provides an alternative to invasive treatment procedures such as the cricopharyngeal myotomy or botulinum toxin injections (Antunes & Lunet, 2012). The exercise method includes isometric and isotonic exercises. For the isometric exercise, patients are required to lie on a bed and raise their heads without lifting their shoulders, look at the ends of their feet for 60 seconds and then lower their head back down to the bed to rest for 60 seconds. For the isotonic Shaker exercise, patients are required to lay on a bed and raise their heads in the same posture and look at their feet 30 consecutive times (Shaker et al., 2002; Kim, Lee, Lee & Rhu, 2015).

The Shaker exercise is currently the most commonly recommended swallowing exercise by speech-language pathologists for the treatment of dysphagia (Jones, Knigge, & McCulloch, 2014). Therefore, it is important to examine the existing literature to determine if the Shaker exercise reduces dysphagic symptoms due to UES dysfunction and if this exercise should continue to be recommended by clinicians.

Objectives

The objective of this paper is to critically review the literature in order to determine if the Shaker exercise is an effective treatment method for the rehabilitation of swallowing function in individuals with UES dysfunction.

Methods

Search Strategy:
Articles related to the topic of interest were found using the following electronic databases: PubMed, Google Scholar and Scopus. Keywords used for the database search were as follows:

'upper esophageal sphincter' AND 'shaker exercise'
Selection Criteria:
To be selected for this critical review, studies had to meet the following criteria: 1) include patients presenting with dysphagia due to UES dysfunction; 2) evaluate the impact of the Shaker exercise on at least

one of the following dysphagic symptoms: aspiration, pharyngeal or pyriform sinus residue, UES opening, hyoid movement, laryngeal movement and/or contractions of muscles responsible for opening the UES, including the thyrohyoid, mylohyoid, geniohyoid and anterior belly of digastric; 3) be written in English and 4) be peer-reviewed.

Data Collection:
Results of this literature search yielded three articles congruent with the aforementioned search criteria. All three studies employed a randomized clinical trial design.

Results

A randomized clinical trial (RCT) design provides a high level of objective evidence and is the appropriate method for testing hypotheses pertaining to the relative effectiveness of the Shaker exercise as an intervention intended to promote rehabilitation of the swallowing mechanism. An RCT design allows for careful manipulation of the independent variable(s) and precise measurement of the dependent variable(s) under controlled conditions. The results of an RCT, however, are only relevant to the populations studied, limiting the generalization of the results.

Logemann et al, 2009 evaluated the effect of the Shaker exercise on improving swallowing function and reducing aspiration in 19 patients with dysphagia involving UES dysfunction. Participants were recruited from seven institutions in the United States of America. Participants were randomized into two groups, stratified by etiology. All participants met with a speech-language pathologist twice per week for swallowing therapy. The control group was composed of 11 participants who practiced traditional therapy involving the completion of the Super-Supraglottic exercise, the Mendelsohn Maneuver, and tongue base exercises for 5 minutes ten times a day for 6 weeks. The second group, the experimental group, was composed of 8 participants who practiced the Shaker exercise 3 times a day for 6 weeks. Compliance with exercise completion was documented in participant diaries, which recorded the number of minutes of practice per day. Outcome measures included anterior and superior hyoid movement, anterior and superior laryngeal movement and the maximum width of UES opening. These were assessed by two blinded assessors viewing videofluoroscopic (VFS) evaluations of the patients' swallow of 3 mL liquid, 5 mL liquid and 3 mL paste, immediately before and after receiving treatment. Researcher blinding was also employed as data management and randomization was completed by the Communication Sciences and Disorders Research Group within the American Speech Language and Hearing Association.

An appropriate statistical analysis, a two-factor repeated-measures analysis of variance (ANOVA), was chosen to analyze the videofluorographic data. No significant differences existed between the groups in regards to age, gender, race, ethnicity, education and etiology of swallowing disorder at baseline. The authors documented no significant difference in practice time at home between groups. Despite only 14 of 19 participants completing all key measures, Logemann et al, 2009 provided a full account of participant attrition and did not identify this a factor responsible for systematic bias. The results of this study indicate that relative to the control group, the Shaker exercise group exhibited significantly greater superior laryngeal movement, superior hyoid movement on 3-mL paste swallows and anterior laryngeal movement on 3-mL liquid swallows. After both traditional therapy and Shaker therapy there was a significant increase from pre- to post- therapy in the width of the UES opening on 3-mL paste swallows.
The researchers did not modify the methods *post hoc* and no nuisance variables were identified that could account for the results.

Shaker et al, 2002 evaluated the effect of the Shaker exercise on restoring swallowing function in individuals with dysphagia caused by abnormal UES opening resulting in postswallow residue and aspiration requiring percutaneous tube feeding. The authors employed a randomized clinical trial design with crossover. 11 patients were randomized to the experimental group that practiced the Shaker exercise treatment while seven patients were randomized to the sham exercise program that practiced tongue-lateralization exercises prior to entering a tested real exercise program. Participants in this study were selected from three different hospitals and were randomized into exercise group by selecting an envelope that gave them written directions on how to perform an exercise that was to be performed three times a day for six weeks. Participants were also provided with a log to record exercise practice. Outcome measures included the anteroposterior and lateral diameters of the UES opening during 5-mL liquid swallows, maximum superior and anterior movement of the hyoid bone and larynx during 5-mL liquid swallows, height and width of pyriform sinus residue and presence or absence of aspiration. These were assessed using VFS before and after the exercise period by two assessors blinded to group identity and treatment status. A speech pathologist performed the functional outcome assessment of swallowing (FOAMS) of each patient before and after therapy,

where a numerical value between one and seven was assigned to each participant's swallowing competency.

Appropriate parametric and non-parametric tests were employed within this research, including a 2-way analysis of variance (ANOVA) and the Wilcoxon signed rank test. No significant differences between the participants in both groups were present at baseline in regards to gender, age, etiology (hemispheric CVA, brainstem CVA, pharyngeal radiation and other) and duration of dysphagia. Following the six week period of treatment, patients in the real exercise group exhibited significant increases in the diameter of the UES opening and maximum anterior laryngeal movement, and a higher score on the FOAMS. When patients from the sham group were crossed over to the real exercise group, all patients exhibited a significant increase in the diameter of the UES opening and maximum anterior laryngeal movement and a better score on the FOAMS. All participants in this study were able to resume oral feeding following the completion of the real exercise. All key outcomes were obtained from 100% of the subjects that were initially allocated to the two groups. No *post hoc* modifications were employed and no nuisance variables were identified.

Mepani et al, 2009 compared the effectiveness of the Shaker exercise program with that of a traditional therapy program on thyrohyoid muscle shortening of 11 dysphagic patients with UES dysfunction. Six participants were randomized to traditional therapy involving the completion of laryngeal and tongue range of motion exercises, the Super-Suraglottic Swallow, the Mendelsohn Maneuver and the effortful swallow exercises three times a day for six weeks. Five participants were randomized to the Shaker exercise that was completed three times a day for six weeks. The only outcome measure included in this study was the average percent change in thyrohyoid distance before and after therapy, which was evaluated by an assessor blinded to group and exercise status viewing VFS of the participants' 5 mL liquid swallow.

Appropriate statistical tests, paired and unpaired t-tests, were chosen by the researchers to compare the average percent change in thyrohyoid distance before and after therapy and the average percent change in thyrohyoid distance between groups. No significant differences between the groups were present at baseline in regards to gender, age, and etiology (CVA or chemoradiotherapy). Despite only 11 of 19 participants completing all key measures, Mepani et al, 2009, accounted for the attrition of each patient and did not identify this as a factor responsible for systematic bias. The results of this study indicate that relative to the traditional therapy group, the percent change in the thyrohyoid distance after exercise was significantly greater in the Shaker exercise group. There was no significant difference in thyrohyoid distance before and after the Shaker Exercise. No *post hoc* modifications were employed and no nuisance variables were identified.

Critique:

In all three of the aforementioned studies, like many RCTs examining therapy interventions, the authors of the studies were unable to blind the therapists to the type of treatment each patient received. This increases the likelihood for therapist bias whereby the therapist might treat patients differently based on the exercise group the patient is assigned to. All three studies did however, apply assessor blinding to the assessment of the VFS recordings. Mepain et al, 2009 included one blinded assessor while Shaker et al, 2002 and Logemann et al, 2009 included two blinded assessors. These methods of concealment reduced the potential for bias in the assessment of outcome. In the research conducted by Shaker et al, 2002, the authors only reported on the participation of 18 of the 27 participants enrolled. It was not reported whether or not the remaining 9 participants were exposed to a treatment.

In all three RCTs, the small number of participants included is a serious limitation to the generalization of the research. The statistical power in each of these studies was therefore insufficient. An additional limitation of these studies involves the lack of supervision provided over the participants while completing the exercises assigned to them during the treatment periods. Daily differences in participant compliance and effort might have influenced the results of these studies.

Discussion

Overall, the RCT design of the research conducted by Logemann et al, 2009, Shaker et al, 2002 and Mepani et al, 2009, provides a strong level of evidence for the Shaker exercise in rehabilitating swallowing function in individuals with UES dysfunction. However, when the limitations of the research are considered, including the small number of participants and the lack of control over subject participation, the strength of the evidence is considered suggestive rather than compelling. Logemann et al, 2009 provides suggestive evidence for the Shaker exercise improving superior and anterior laryngeal movement, superior hyoidal movement and an increase in UES opening. Shaker et al, 2002 provides suggestive evidence for the Shaker exercise increasing anterior laryngeal movement and UES diameter and also enabling tube-fed individuals to return to oral feeding. Finally, Mepani et al, 2009 found suggestive

evidence for the Shaker exercise improving thyrohyoid muscle shortening, a muscle contraction required for UES opening.

All of these studies provide information that is of high importance to the clinical field of speech-language pathology. In a study conducted by Jones, Knigge and McCulloch, 2014, 206 speech language pathologists completed a survey in which they were asked to indicate the type of management they most commonly recommended. Respondents were divided into two groups. 73% of the first group and 84% of the second group indicated that the Shaker exercise was the exercise that they most commonly recommended for the treatment of dysphagia. Therefore, the results of this survey reflect the need for best practice guidelines for clinicians working with patients that have dysphagia.

The evidence within this research is suggestive of a moderate grade in recommendation. While the level of evidence is strong based on the RCT designs being employed, the sample size and participant control limitations decrease the grading of recommending the Shaker exercise in clinical practice. There is positive evidence for the use of the Shaver exercise in rehabilitating swallowing function in individuals with dysphagia due to UES dysfunction, however due to the limitations within these studies, it is recommended that further research be performed that includes more participants and a higher level of control over exercise completion.

Conclusion

The studies reviewed suggest that the Shaker exercise can rehabilitate swallowing function in those with dysphagia due to UES dysfunction. Positive results have been found for the Shaker exercise improving hyoid and laryngeal movement, UES opening, thyrohyoid muscle shortening and reducing postswallow residue as well as enabling tube-fed patients to return to oral feeding. However further research is needed involving an RCT design with a larger sample size and more control over the patient's completion of the exercise.

Clinical Implications

Rehabilitating swallowing function is important to the health and ultimately the survival of patients with dysphagia. Therefore, it is essential that speech language pthologists provide individuals with effective intervention that will rehabilitate their swallowing function. Although additional research is needed that involves more participants and a higher level of control over subject participation, the Shaker exercise may be an effective approach in rehabilitating swallowing function in individuals with dysphagia due to UES dysfunction.

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