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THE EFFECTIVENESS OF THE SLURP SWALLOW EXERCISE

AS A TONGUE STRENGTHENING PROCEDURE

FOR TONGUE THRUST: A CASE STUDY

by

Amy Krause

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science in the Department of

Communication Sciences &

Disorders and Education of the Deaf

Idaho State University

August 2014

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Amy Krause find it satisfactory and recommend that it be accepted.

_____

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April 12, 2013

Tony
Seikel
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RE: Your application dated 4/12/2013 regarding study number 3881M4: The Treatment Efficacy of the Oromyofunctional Exercise in Strengthening the Tongue in Persons with Tongue Thrust

Dear Dr Seikel:

Thank you for your response to requests from a prior review of your application for the new study listed above.

You are granted permission to conduct your study as most recently described effective immediately. The study is participant to continuing review on or before 4/12/2014, unless closed before that date.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

Submit progress reports on your project in six months. You should report how many participant s have participated in the project and verify that you are following the methods and procedures outlined in your approved protocol. Then, report to the Human Participant s Committee when your project has been completed. Reporting forms are available on-line.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Patricia Hunter (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH,
CIP Human Participant s Chair

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THE EFFECTIVENESS OF THE SLURP SWALLOW EXERCISE AS A TONGUE STRENGTHENING PROCEDURE FOR TONGUE THRUST: A CASE STUDY

Thesis Abstract - Idaho State University - 2014

Purpose: The purpose of the present study was to determine the effect of a 10 week oromotor slurp swallow exercise program on tongue thrust by measuring tongue strength on a single participant. **Methods:** A 14 yr old female with documented tongue thrust participated. The participant completed a strength training program. The Iowa Oral Performance Instrument (IOPI) measured tongue tip and dorsum strength. **Results:** Following treatment, superior force by the tongue tip and dorsum increased. Participant self-reports and ratings indicated improved swallow function. Pressure (kPa) changes with treatment were determined to be statistically significant. **Conclusion:** A 10-week exercise program increased force by the tongue, supporting the use of slurp swallow exercise for tongue strengthening.

Key Words: Dysphagia, tongue thrust, slurp swallow maneuver, oromotor exercise

Chapter I - Introduction

Disorders of swallowing can have a significant impact on health and quality of life of a child. The act of swallowing is a highly coordinated process that is required for adequate nutritional intake while simultaneously protecting the structures of respiration. Orofacial myofunctional disorders involve abnormalities of oral structures and corresponding functional deviations in swallowing patterns (Hanson & Mason, 2003). The most common distinct classification of an orofacial myofunctional disorder is tongue thrust. Tongue thrust is a tongue pattern that results from failure "to organize food into a bolus and propel it posteriorly for an efficient swallow" (Arvedson & Brodsky, 2002, p 319*).* The tongue protrudes during the swallow beyond the borders of the gums pushing on the upper and lower anterior teeth. Tongue thrust affects one's ability to control placement of the food in the mouth. Food and liquid are often pushed out of the mouth before the lips can affect a seal, interfering with an infant's ability to suck, chew, and swallow (Arvedson, & Brodsky, 2002).

The American Speech- Language-Hearing Association (ASHA, 2004) published the *Preferred Practice Patterns for the Profession of Speech-Language Pathology* outlining the roles and responsibilities of certified Speech Language Pathologist (SLPs) in the field of communication disorders. Trained SLPs are responsible for the assessment, diagnosis and treatment of orofacial myofunctional disorders. ASHA (2004) claims "consistent with the World Health Organization (WHO) framework, assessment is conducted to identify and describe: (a) underlying strengths and deficits related to orofacial myofunctional factors that affect communication and swallowing performance; (b) effects of orofacial myofunctional impairments on the individual's activities (capacity

and performance in everyday communication and eating contexts) and participation; (c) contextual factors that serve as barriers to or facilitators of successful communication and participation for individuals with orofacial myofunctional impairments" (p. 161-162). ASHA provides expectations for SLPs in diagnosing features and treating clients with orofacial myofunctional disorders. While it is apparent that diagnosis and treatment of orofacial myofunctional disorders are the responsibility of certified SLPs, few studies focus on the most effective and efficient treatment techniques to use with this population. The present study examines one aspect of tongue thrust treatment for determination of effectiveness in remediation.

The following review of the literature will examine the swallow in detail. The nature of swallowing, anatomy and physiology, and the normal stages of swallow will be discussed in order to set the context for understanding of the abnormalities that occur during a disordered swallow. An analysis of problems with orofacial myofunctional disorders will then be examined. It will also describe historical treatment methodologies. The current study intends to provide evidence into the effectiveness of the slurp swallow maneuver in increasing superior tongue force in treating tongue thrust.

Chapter II - Review of the Literature

Nature of Swallowing

Understanding the normal anatomy and physiology of the swallowing process is critical for providing adequate assessment and treatment. Deglutition, or the act of swallowing, begins at the lips and ends inside the stomach (Arvedson, & Brodsky, 2002). This basic human function is crucial for survival and health. Mastication refers to chewing and deglutition refers to swallowing. The act of swallowing is critical for adequate nutrition, and the processes of mastication and deglutition require organized function of numerous muscles and physical systems (Seikel, King, & Drumright, 2010). Mastication and deglutition serve as major processes needed to sustain life.

In addition to the movement of food in the digestive tract during deglutition, the act of swallowing also serves to protect the airway. In humans, the respiratory and digestive systems share space, and protection of the airway involves complex physiological processes. Typically, when food or liquid is swallowed, respiratory structures (ie., the larynx) close off the pathway to the lungs, preventing foreign objects from entering the airway. An atypical swallow due to a compromised swallowing mechanism can result in aspiration of foreign material entering the airway or lungs (Arvedson & Brodsky, 2002). A closer look at the anatomy and physiology of swallowing as well as the stages that typically occur will increase understanding of the process of swallowing and help aid identifying potential indicators of a compromised swallowing system.

Anatomy and Physiology of the Swallow

The act of swallowing affects multiple systematic processes and numerous anatomical structures. These structures include the labia (lips), mandible, maxillae, dentition, tongue, hard palate, vellum, pharynx, epiglottis, larynx, esophagus and trachea. The systems of deglutition, respiration, and phonation intersect at the structures of the pharynx and larynx. This is the space in which airway protection occurs as food is bypassed into the esophagus averting entrance into the trachea and lungs.

The structures of swallow can be found in various cavities of the vocal tract. These cavities include the buccal cavity, oral cavity, and the pharyngeal cavity. The cavities can be used to help identify structures and aid in describing the swallowing process. Following the flow of nutrition, food first enters the oral cavity. This includes the space between the lips and the third molar (Seikel, King, & Drumright, 2010). The oral cavity houses the tongue and extends back to the area of the faucial pillars. The faucial pillars are significant as they serve as the trigger point of the swallow. Although not part of the swallowing system, the nasal cavity is responsible for respiration. Disfunction of the swallow could cause leakage of food into this cavity. The pharyngeal cavity is the space that extends behind the nasal and oral cavities and superior to the larnyx (Seikel, King, & Drumright, 2010). The pharyngeal cavity can be subdivided into the oropharnygeal and nasopharnygeal cavities. The oropharynx serves as the entrance way of food into the larynx and includes the structures of the velum, soft palate, hyoid bone, and anterior border of the faucial pillars (Seikel, King, & Drumright, 2010). The nasopharnynx is the pathway for respiration that connects the nasal cavity to the pharynx, and this area is normally protected during the swallow. In order to understand the

complex processes occurring during the swallow, a review of the normal stages of the swallow is necessary.

Normal Stages of Swallow

The coordinated acts of the swallow can be broken down into four stages. These "stages of swallow" help to form a shared description of what is occurring during deglutition. It also aids in diagnosing differences that occur in the swallowing process. The four stages of swallow are: the oral preparatory phase, oral phase, pharyngeal phase, and esophageal phase (Logemann, 1998; Seikel, King, & Drumright, 2010).

The first step in the stages of swallow is the oral preparatory phase. This phase is the anticipatory process that occurs as the oral cavity prepares to accept nutrition. Oral preparation begins with the visual, olfactory, or tactile sensory recognition of food (Logeman, 1998) Stimulation of the olfactory system elicits a response from the salivary glands of the oral cavity. The muscles of the tongue and the lips respond by moving out of their resting position, the tongue dips slightly in anticipation of accepting food. As food passes into the mouth, the lips and dentition are used to aid in entrance, the lips then close in order to seal in the nutrition. This seal not only prevents food from escaping out of the oral cavity, but also helps to build pressure needed for the swallow (Logemann, 1998). If the food requires mastication, highly coordinated movements of the tongue move the food to the molars where it can be manipulated into a bolus. The food is then pushed back to the tongue to be checked for consistency. This cycle continues as the tongue uses a spatualting motion to form the bolus while mixing it with saliva (Seikel, King, & Drumright, 2010). The amount of time spent in this step varies, depending on the consistency of the food and the person who is eating. Once the food has been crushed

and manipulated into the right consistency it is returned to the tongue and held in this position by the hard palate, ending the oral preparatory stage.

When the consistency of the bolus is adequate for swallow the oral stage volitionally begins. Superior and posterior pressure is exerted by the tongue against the hard palate. The pressure created by the tongue propels the food through the oral cavity towards the oropharynx until the pharyngeal swallow is triggered (Logemann, 1998). The propelling movements of the tongue can be characterized as "an anterior to posterior rolling action of the midline of the tongue, with tongue elevation progressing sequentially more posteriorly to push the bolus backward" (Logemann, 1998, p. 27). The tongue serves as the major propulsive force in pushing the bolus through the oral cavity, through the pharynx, and into the esophagus. The oral stage of swallow in typically swallowing adults lasts less than 1 to 1.5 seconds and can increase depending on the velocity of the food (Logemann, 1998).

The pharyngeal stage occurs when the bolus is propelled posteriorly to the depressed velum and the anterior faucial pillars, triggering the pharyngeal swallow. A palatal reflex occurs to protect the airways from aspirating food or liquid. The larynx and hyoid begin to move anteriorly causing the epiglottis to drop and cover the laryngeal vestibule, the false and true vocal folds then adduct to protect the airways (Logeman, 1998). The tongue serves to seal off the anterior aspects of the pharyngeal space creating an increase in the air pressure inside the pharynx. The mandible then becomes stabilized and the pharyngeal-esophageal (P.E.) segment opens pushing the bolus down through the structures of the larynx and into the epiglottis. Respiration is briefly cut off as the bolus

passes over the laryngeal vestibule. In typically swallowing adults the pharyngeal stage usually takes 1 second or less to complete (Logemann, 1998).

The esophageal phase is the final stage of the swallow and completes the swallowing process. The upper esophageal sphincter (UES) opens and allows the bolus to enter. The bolus then moves through the esophagus by a true peristaltic wave of smooth and striated muscle contractions until it reaches the lower esophageal sphincter (LES) (Logemann, 1998). Once the bolus passes through the LES and into the stomach the sphincter immediately closes to prevent the contents of the stomach from re-entering the esophagus. The transportation of the bolus from the UES to the LES in typically swallowing adults occurs between 8 to 20 seconds.

Each stage of swallow is interdependent on the other stages. The stages need to be critically assessed in order to understand and treat swallowing disorders that occur.

Disorders of Swallowing

Swallowing disorders can affect a person at any age. Disorders of swallow arise from congenital abnormalities, structural damage, and medical conditions. They can also arise as secondary conditions of traumatic brain injury (TBI), aphasia, neurodegenerative diseases, or may be functional in nature. Oromyofunctional disorders are abnormal patterns of the oral and facial structures that negatively impact dentition, deglutition, and articulation (Hanson & Mason, 2003). The most common oromyofunctional disorder is tongue thrust.

Tongue thrust is defined by a forward tongue posture and tongue thrusting action during the swallow. Tongue thrust occurs when the tongue improperly rests against the teeth or protrudes between the teeth at rest or during swallow (Hanson & Barrett, 1988).

The swallowing pattern of tongue thrust is common in children younger than 4-years-old and often referred to as infantile swallowing. Tongue thrust becomes a disorder when still seen in older children continuing into adolescence and adulthood (Peng, Jost-Brinkmann, Yoshida, Chou, & Lin, 2004). Tongue thrust occurs when a child fails to develop a more mature swallowing pattern.

Tongue thrust is typically associated with low the resting posture of the tongue as well as the oral preparatory and oral phases of the swallow. The tongue's resting posture when the oral preparatory stage begins may be low and forward with the tip pressing against or between the upper and lower teeth. Many children with tongue thrust habitually breathe through their mouths causing the lips to be slightly open at rest (Hanson & Mason, 2003). During the oral preparatory stage sensory stimulation indicates that food is present, and a child who tongue thrusts will often protrude the tongue to meet the food instead of using the lips or teeth to remove food from utensils (Seikel, King, & Drumright, 2010). The lips remain open as uncoordinated tongue movements attempt to move food to the molars in preparation for the oral phase (Hanson & Barrett, 1988). Difficultly manipulating the bolus can be observed in the forward thrusting of the tongue seen as the tongue pushes food against the teeth and can be a sufficiently strong action to push food past the lips and out of the mouth (Logemann, 1998). Inability to effectively manipulate the bolus leads to incomplete mastication and food that is under chewed is combined with insufficient amounts of saliva failing to form a cohesive bolus.

In the oral phase tongue thrust can be related to the lack of coordination of weak tongue musculature that leads to difficulties with forming a cohesive bolus and trouble

transferring the bolus back towards the pharynx (Palmer, Drennan, & Baba, 2000). Food remains scattered around the oral cavity as the oral stage is voluntarily initiated. The non-cohesive bolus is pushed into the dorsum of the tongue but the tongue fails to elevate and trap food against the hard palate. In order to compensate for the non-cohesive bolus the tongue may make a seal with the teeth and thrust against the teeth to move the bolus posteriorly (Hanson & Mason, 2003). Other muscles that are typically used during swallow, such as the mentalis and lower portion of the orbicularis oris, may contract to resist the anterior force the tongue exerts (Hanson & Mason, 2003). Additionally, the molars do not occlude as the bolus is propelled backward which leads to underdeveloped buccal musculature, allowing food to enter lateral sulci (Hanson & Mason, 2003).

Five different types of tongue thrust have been identified, including anterior, unilateral, bilateral, bilateral-anterior, and closed bite (Zickefoose, 1989). The anterior tongue thrust is the most common type of tongue thrust, and during this swallowing pattern the lips are often open at rest while the tongue protrudes between the upper and lower teeth an anterior open bite with protrusive incisors. Unilateral tongue thrust is characterized by tongue protrusion on one side with an open bite on the side of protrusion. Bilateral tongue thrust is a posterior open bite due to the tongue protruding from the bicuspids to the molars on both sides of the mouth. Bilateral-Anterior tongue thrust is a bite in which the tongue's anterior protrusion spreads between the teeth allowing only the molars to occlude. A closed bite is characterized by a malocclusion in which the incisional edges of the mandibular anterior teeth protrude past those of the maxillary teeth with a forward protrusion of the tongue.

Etiology of Oromyofunctional Disorders

Tongue thrust is common in children younger than 4-years-old, but it can also be found in older children and continuing into adolescence and adulthood (Peng, Jost-Brinkmann, Yoshida, Chou, & Lin, 2004). Tongue thrust occurs when a child does not develop the mature swallow (Seikel, King, & Drumright, 2010). In the underdeveloped swallow, the bolus is held in what is considered to be an abnormal position at the front of the teeth in preparation of the swallow (Logemann, 1998). As the swallow is initiated, the tongue moves forward towards the lips and central incisors and may even push the bolus out of the mouth (Logemann, 1998). For some children, the tongue may extend beyond the gums and even stick out between the lips (Arvedson & Brodsky, 2002). Those who continue with the underdeveloped swallow may demonstrate a contraction and hyperfuncation of the facial muscles of the mentalis, orbicularis oris, and the buccinator (Peng, et al., 2004).

There are several hypothesized reasons why children do not transition to a mature swallow. One possible cause may be a blocked nasal passage (Sidder, 2006). A person with a normal swallow must be able to breathe through the nose with his or her mouth closed and with the tongue resting on the palate. For some children, mouth breathing may be a consequence of enlarged adenoids that create inadequate nasal respiration (Seikel, King, & Drumright, 2010). Mouth breathing can also occur due to sucking the thumb or pacifier (Sidder, 2006). In some cases, tongue thrust may be caused from a neurological impairment or as the result of a stroke or head trauma.

Hanson and Mason (2003) hypothesize that failure to develop the mature swallowing pattern could be due to a combination of genetically inherited traits and

habitual behaviors that encourage the underdeveloped tongue thrusting pattern. Tongue size, restricted nasal passageways, predisposition to allergies, enlarged tonsils, high or narrow arch, hypertonus of the orofacial musculature, and an imbalance between the number or size of teeth and the size of the oral cavity are thought to be genetic factors that habitually promote a low anterior resting posture for the tongue (Hanson & Mason, 2003). When the tongue is habitually held in a low anterior resting posture it is likely that the tongue will make a seal with the bottom teeth or be placed between the teeth during a swallow. Other oral habits are thought to create a low forward tongue resting posture such as digit sucking, cheek biting, and lip sucking are thought to maintain the tongue thrusting behaviors (Hanson & Mason, 2003).

Impact on Structures

Tongue thrust can impact a number of different structures causing a negative effect on normal facial and skeletal development (Sidder, 2006). This increased vertical height of the face is characterized by the lower face growing downward and backward versus downward and forward, and is accompanied by flaccid lips and retruded chin (Proffit, 1986). Tongue thrust is also associated with dentofacial deformities (Peng et al., 2004). When a child is a constant mouth breather, the dental arch will be narrow and the palate will form with an extreme vault (Seikel, King, Drumright, 2010). These abnormal developments occur because the tongue does not maintain the normal contact with the upper alveolar ridge and hard palate when breathing takes place through the nose.

Patients with a tongue thrust have a difficult time keeping their lips closed and may show signs of a slight curl to their upper lip (Sidder, 2006). Lip puckering or licking

of the lips before swallowing are often signs of tongue thrust (Sidder, 2006). Those who have tongue thrust often have difficulty with the phonemes of /d/, /t/, /s/, and /z/. Children who exhibit these orofacial myofunctional factors have a high incidence of seeking orthodontic care (Hale, Kellum, Richardson, Messer, Gross, & Sisakun, 1992).

History of Treatment

In 1961 researchers claimed that speech-language pathologists have the appropriate training to alter habit patterns related to the use of orofacial structures (Fletcher, Casteel & Bradley, 1961). Prior treatment for oromyofunctional disorders typically consisted of orthodontic treatment but failed to consider speech intervention. It was argued that speech therapy should be carried out in combination with orthodontic tactics for treatment of oromyofuncitonal disorders in early adolescence and adolescent clients. Later research by Andrianopoulous and Hanson (1987) concluded that a combination of orofacial myofunctional therapy and orthodontic treatment was found to be effective in decreasing tongue thrust. Researchers randomly examined two groups of participants who had undergone orthodontic treatment for a class II division I malocclusion. The first group consisted of 17 participants who had completed tongue thrust therapy before orthodontic treatment was begun. The second group consisted of 17 participants who had no previous experience with tongue thrust therapy. The authors found that orthodontic treatment alone was not enough to correct tongue thrust, as 71% of the non-therapy group demonstrated tongue thrust behavior while 18% of the treatment group demonstrated tongue thrust behaviors.

Early research claimed that tongue positioning exercises commonly found in "myofunctional therapy" in combination with articulation therapy that emphasizes

physical phonetic placement were found to be useful in repositioning the tongue tip posteriorly. Mason and Proffit (1974) hypothesized that articulation therapy not only improves initiation of speaking but also promotes repositioning of the tongue tip at rest and improves swallowing tasks in young children. Additional research contradicts the claim that articulation therapy is useful in the treatment of tongue thrust. Christensen and Hanson (1981) examined ten kindergartners diagnosed with severe anterior tongue thrust and severe frontal lisps to determine if a combination of orofacial myofunctional therapy and articulation therapy would effectively correct tongue thrust behaviors. The researchers determined that clients who received both direct orofacial myofunctional treatment and traditional articulation therapy demonstrated correct tongue placement and swallowing patterns. Children who only received articulation therapy failed to make gains in positioning of the tongue and placement. A similar study conducted by Gommerman and Hodge (1995) also showed articulation therapy ineffective in the treatment of oromyofunctional disorders.

A shift towards behavioral therapy using the operant conditioning methods became a common form of treatment for oromyofunctional disorders. Thompson, Iwata, and Poynter (1979) examined the effectiveness of operant techniques when treating tongue position and swallowing patterns in a single participant case study. The participant consisted of a 10-year-old diagnosed with spastic cerebral palsy and severe cognitive impairment. The desired behavior of the participant was proper placement of the tongue in the mouth. This behavior was positively reinforced with food when the desired behavior was achieved. When the adverse behavior was present the participant's tongue was pushed gently back into his mouth with a spoon. It was determined that the

technique was successful in reducing tongue-out behaviors from 97% occurrence observed at baseline to 27.2% observed during the final treatment phase (Thompson, Iwata, & Poynter, 1979).

Consistent findings were reported in a study conducted by Young and Vogel (1983) investigating the efficacy of using behavioral approaches to treat tongue thrust. The effects of positive practice and cueing were examined. The participant was provided with opportunities to correctly place the tongue and was cued by reminders in the form of cards placed around the participant 's environment. At the end of treatment it was determined that the output of correct tongue positioning increased from 0% at baseline to 97%. This evidence supports the use of behavioral treatment in the modifying tongue thrust.

In 1975 Barber and Bonus provide evidence for physical exercise to promote the reduction of tongue thrust. It was hypothesized that the weakness of circumoral muscles characteristic of tongue thrusters was caused by a combination of malocclusion of the teeth as well as the protruding force of the tongue. A lip resistance exercise was utilized consisting of resistance placed on the lips by means of a button attached to a string placed in the oral vestibule. Researchers observed that children in the experimental groups who participated in the lip exercise showed an increase in lip strength of 336%. Cephalometic radiographs and dental casts were also taken before and after testing to determine if increasing muscle strength would correct malocclusion and improve oral posture. No change in tooth position was noted. It was determined while the lip exercises did not change malocclusion of teeth the lip exercises were effective in strengthening lip muscles.

Support for orofacial myofunctional therapy was also reported by Harden and Rydell (1983). Researchers hypothesized that patients who had completed orofacial myofunctional therapy would continue to exhibit correct swallow behaviors 5 years post-treatment, while those who had refused therapy would still demonstrate tongue thrusting behaviors 5 years later. The researchers concluded that the 88% of participants who had completed therapy had correct resting position of the tongue while 100% of the control group maintained incorrect tongue resting posture. Improvements in both facial muscle contraction and ability to swallow clearly were seen in 94% of the participants who underwent therapy. In those participants who refused therapy 75% failed to demonstrate desired swallowing behaviors, exhibiting incorrect muscle contractions such as lip pursing, while 93% were unable to demonstrate a clear swallow.

Similar support for orofacial myofunctional therapy was also seen in Hahn and Hahn (1992). Ninety-eight participants, who previously completed myofunctional treatment for breathing and swallowing problems ten years prior, were re-examined for maintenance of desired behaviors and to determine if a correlation existed between maintenance and age of treatment. Three treatment groups divided by age included: 6-11 years, 12-16 years, and 17-57 years. It was determined that the majority of participants maintained normal swallowing patterns; 81% in the 6-11 year group, 83% in the 12-16 year group, and 100% in the adult group. The majority of participants also maintained correct tongue resting postures; 72% in the 6-11 year group, 71% in the 12-16 year group, and 87% in the adult group. Normal breathing patterns remained in 66% of the 6-11 year old group, 71% of the 12-16 year old group, and 86% of the adult group. Improved muscle tone and orofacial muscle patterns were observed in 72% of the 6-11

year olds, 63% of the 12-16 year olds and 67% of the adults. The results indicate that previous gains made in orofacial myofunctional therapy were maintained at a significant level regardless of age.

Current Treatment

Current treatment for oromyofunctional therapy varies vastly, and a number of different programs are available utilizing many different types of exercises. While the specific steps and names of exercises may vary, therapy programs tend to follow the same general outline. Clinicians hope to facilitate development of new oral motor patterns, strengthen and gain control over the new patterns, and promote automatic occurrence of the learned patterns through practice and repetition (Buchanan, 2007).

The development of new oral motor patterns is often the first step in oromyofunctional therapy. For a client with tongue thrust the correct resting place of the tongue tip on the alveolar ridge must be identified (Hanson & Mason, 2003; Pierce, 2002; Zickefoose, 1998). Through repeated practice the client learns to become familiar with both the motor pattern of raising the tongue tip to the alveolar ridge and how the tongue feels on the spot. Eventually, the client will advance to holding mints or small rubber bands against the spot with the tongue for extended periods of time (Hanson & Mason, 2003; Pierce, 2002; Zickefoose, 1989).

Localizing the correct spot on the alveolar ridge is then combined with other strengthening and sensorimotor exercises. The individual works on increasing awareness and strengthening of masseter and temporalis muscles, narrowing and flattening the tongue, as well as pressing the dorsum of the tongue to the hard palate (Buchanan, 2007; Hanson & Mason, 2003; Pierce, 1993; Zickefoose, 1989). Tongue dishing exercises can

be used to learn the correct motor movements needed to properly move saliva or food posterior in the oral cavity (Buchanan, 2007). Once mastered, the patterns become more difficult by combining exercises and adding sequential actions. Other, more complex exercises involve narrowing the tongue to fit against the hard palate, and "clicking" or "popping" it downward as well as dragging the tongue tip posteriorly against the hard palate. To work towards automation of the newly learned patterns, all motor movements should be practiced outside of the clinic setting to transfer the clinically learned behavior to naturalistic environments. (Buchanan, 2007; Hanson & Mason, 2003; Pierce, 2002; Zickefoose, 1989).

While a vast variety of techniques and exercises are currently used to treat oromyofunctional disorders, few studies have examined the effectiveness of specific tongue strengthening exercises on reducing tongue thrusting behavior. This is surprising due to the fact that the *Preferred Practice Patterns for the Profession of Speech-Language Pathology* (ASHA, 2004) facilitates the roles of the speech language pathologist in treating orofacial myofunctional disorders, such as tongue thrust. There is a current need to research the most efficient and effective strength training exercise of the tongue that promotes a mature swallowing pattern. By understanding the most efficient exercises for treating tongue thrust SLPs can provide the most effective treatment for this population.

Purpose

The purpose of the current study was to replicate a graduate thesis study conducted by Alexandria Buchanan (2007) to further examine the effectiveness of the slurp swallow exercise technique to improve tongue tip and dorsum strength. The slurp

swallow is an exercise included in many therapy programs. The exercise is designed to facilitate the initiation of the normal swallow as the tongue applies superior and posterior force against the hard palate with the tongue tip anchored on the "spot" on the alveolar ridge. Two central abnormal tongue thrust patterns are targeted by this exercise; anterior tongue protrusion and lack of superior lingual force during swallowing (Buchanan, 2007; Hanson & Mason, 2003; Pierce, 2002; Zickefoose, 1989).

The purpose of Buchanan's study was to determine if 10 treatment sessions utilizing the slurp swallow exercise would yield increases in measurements of both tongue tip and dorsum strength as measured by the IOPI in individuals diagnosed with tongue thrusting behaviors. During the 10 minute sessions clients received positive reinforcement during the therapy session and for completion of assigned practice at home. The null hypothesis was that no significant change in superior force exerted by the tongue would be observed after 10 therapy sessions and completions of home practice of the slurp swallow exercise. The research hypothesis was that there would be a significant change in superior force exerted by the tongue observed after ten therapy sessions and completions of home practice of the slurp swallow exercise. Buchanan's hypothesis was supported for three out of the four participants. Lack of motivation was cited as a factor for the decrease in performance across both the controls and the dependent variable for the participant that did not show improvement. Her findings indicated that the slurp swallow was effective in increasing lingual force.

Potential Risks

There were minimal potential risks associated with participation in this study. These included feelings of embarrassment or discomfort as the participant practiced the

exercises. The slurp swallow is a swallowing pattern exercise that, like all strengthening exercises, has the potential to cause muscle fatigue and mild soreness. This is a minimal issue in young, healthy children. There could have been some psychological effects involved related to receiving therapy including feeling uncomfortable or embarrassed about participating in research activities. These were considered mild as compared to children with the psychological effects experienced by the everyday experience of living with tongue thrust and its associated stigma (i.e., open mouth eating, mouth breathing, food spillage, etc.).

Minimizing Risks

Participants and the parents were informed of these risks verbally and in a written format within the informed consent material. The researcher closely monitored the participant to ensure that the participant was not experiencing more than mild muscle fatigue/soreness or more than feeling mildly uncomfortable or embarrassed during research sessions. If the participant verbally indicated or if the investigator judged that the participant was experiencing more than mild muscle fatigue/soreness or more than mild psychological discomfort, the session would have been stopped, however this did not occur during the sessions. The participant was also told during the first research session, and then periodically thereafter, that she was able to withdraw from the session and/or study at any time without any repercussions. Confidentiality was also protected by assigning a number to the participant so the participant's name would not appear on session notes.

Potential Benefits

It was not claimed that participation in the study would "cure" tongue thrust. The potential benefits gained from participation in the study were gaining tongue strength that

may be functional for swallowing. The potential benefit to the field of research is increasing the current knowledge about which treatments are effective in oromyofunctional therapy. This will ensure that clinicians will be able to provide members of society with the most effective treatment programs.

Chapter III - Methodology

Introduction

A single participant treatment research design was utilized to determine if 10 treatment sessions utilizing the slurp swallow exercise will increase tongue tip and tongue dorsum strength. This study attempted to replicate a study conducted by Alexandra Buchanan (2007) and use the same uniform procedures. Replicating the study is important in order to evaluate reliability and gain greater insight into specific oromyofunctional exercises for the treatment of tongue thrust.

Participant Recruitment

The inclusion criteria for this study included a diagnosis of tongue thrust with no prior or existing treatment for swallowing disorders. The potential participants were required to be typically developing with no cognitive impairment. The person had to be able to consume some level of food or liquid orally, but texture level was not included in inclusion criteria.

To recruit participants the primary researcher directly contacted 28 certified and licensed speech language pathologists (SLP) in Portland, Oregon and the surrounding community practicing in schools, private clinics, medical settings, and home treatment. A flyer describing the study and requesting participants was displayed in the lobby of 4 private practices. This flyer was also mass distributed to SLPs in the Portland Public School district via their e-mail networking service. Several of these SLPs stated they did not currently have patients that matched the criteria of this study.

Three of the 28 professionals directly contacted provided 4 participants for the study. These 4 participants were contacted, the inclusion criteria explained, and asked if

they would be willing to discuss completing the treatment plan with the researcher. If they were willing, the contact information was given to the researcher. Of these 4 participants two dropped out before beginning the treatment program and 1 did not qualify for the study after completing the Idaho State University Tongue Thrust Protocol. After this intensive search only one participant completed the program in entirety.

Participant

The sample consisted of 1 self-identified Caucasian female from Portland, Oregon, age 14, who demonstrated tongue thrust during swallow. The participant was pre-identified as having tongue thrust by a licensed speech-language pathologist and orthodontist. The participant demonstrated visible tongue protrusion during swallow and excessive use of labial musculature. Significant food residue in the oral cavity after swallowing was also observed. The above are all indications of tongue thrust. In addition, this individual has no prior treatment for tongue thrust and has not received any special education services.

Participant History

A thorough case history was conducted with the participant and her parental guardians on January 5, 2014. It was stated that the participant had been diagnosed with tongue thrust by her orthodontist in November of 2013, when her braces were removed. The participant wore orthodontic braces for two years to correct open spaces and type II malocclusion of dental arches. It was reported that the participant had no prior history of allergies, thumb sucking, pacifiers, or bottle use. The orthodontist informed the participant that if she did not correct her tongue trust then her teeth could return to her original misalignment within a year. This diagnosis was also confirmed in December of

2013, by a school-based licensed and certified SLP during an initial consultation and assessment. Even with the confirmation of a diagnosis of tongue thrust the participant did not qualify for school-based speech and language treatment because the issues with swallowing did not directly impact her academic or social growth. It was recommended to her by the SLP that she participate in the current study.

Participant at Time of Study

The participant has never received any type of treatment to correct her swallow. She was required to wear a retainer at night. The Idaho State University Tongue Thrust Screening Protocol (Appendix a) was administered to the participant on January 5, 2014. This protocol was administered to screen the participant to confirm the presence of tongue thrust before inclusion in the study. The screening process consisted of observing the participant eating a cracker and drinking water. The participant presented with closed mouth breathing and closed relaxed lips at rest. It was determined that the participant was exhibiting bilateral upper tongue thrust during swallow with both liquids and food. The participant was able to form a bolus of food but small amounts of residue remained on the tongue and in the buccal cavity after the swallow. Complete dental contact was made by the tongue tip and dorsum on the teeth, and the tongue passed through the teeth when swallowing. Significant use of the lips to maintain the bolus in the oral cavity was also observed. The participant indicated avoiding softer foods, such as pudding and yogurt, due to difficulty with coordination of the swallow.

Experimental Design

A quasi-multiple baseline design across behaviors model was used to determine the effects of the slurp swallow exercise. Treatment effects were determined by the

examination of changes in the dependent variables. This included tongue tip and dorsum strength across baseline and treatment phases. Exposures to the slurp swallow exercise served as the independent variable. Control variables consisted of lip strength and the sustained vowel /a/. These lip strengthening exercises were utilized because they were predetermined to be unaffected by the slurp swallow exercise, which targets tongue strength. Baseline measurements of tongue strength and the control variables were established in the initial session by taking three measurements of each variable. In the remaining nine treatment sessions, measurements of all variables were recorded prior to practicing the slurp swallow exercise.

Instrumentation

The Iowa Oral Performance Instrument (IOPI) was used to measure tongue strength (Breakthrough Inc., Oakdale, IA; Model 1.5). The Iowa Oral Performance Instrument (IOPI) is a handheld digital voltmeter that measures the pressures in pascals exerted on a small bulb when the bulb is placed on the tongue and held against the hard palate. The IOPI displays the maximum force in kilopascals (kPa) (Hewitt et al., 2008). The IOPI is found to be a valid instrument that can be used to objectively establish measures of tongue strength (Youmans, Youmans, & Stierwalt, 2009). Ono, Hori, Nokubi (2004) report that the IOPI in assessment of tongue pressure that may not be an effective tool for evaluating natural mastication and swallowing, but can be used to provide information about the functional movement of the tongue during the swallow process. Prior to each session the machine was calibrated according to the manufacturer's instructions. The bulb of this handheld device was placed on the tongue and the participant pressed it against the hard palate with the tongue. The participant was

instructed to use only the tongue and was monitored to ensure that the jaw was not engaged during the measurement.

Procedures

A packet containing a description of the research procedures, informed consent letter, and youth assent letter (see Appendix b) was distributed to the participant's parents prior to the initiation of this study. The researcher discussed the information contained in the consent and assent forms and answered questions from the parents and participant during the initial research session. A screening procedure derived from the Idaho State University Tongue Thrust Protocol was used to verify presence of tongue thrust behaviors (appendix a). The screening procedure consisted of observation of the participant eating a cracker and drinking a glass of water. Presence of tongue thrust was verified by the researcher observing tongue protrusion during swallow, excessive use of labial musculature, spillage of food or liquid, and significant food residue in the mouth after swallowing.

Baseline

After the presence of tongue thrust was verified, the researcher familiarized the participant with the IOPI by explaining that it is a machine that measures tongue strength by measuring how hard a bulb connected to a tube is pressed against the roof of the mouth. The researcher placed a tongue bulb that was not connected to the IOPI on the anterior portion of the participant's tongue directly behind the teeth and instructed the participant to press the bulb against the roof her mouth. The procedure was then practiced until the researcher determined that the participant understood the measurement task. The researcher connected the tongue bulb to the IOPI and told the child that she was ready to see how strong her tongue is. The participant was instructed to press the bulb

against the roof of her mouth with as much force as possible three times. The resulting strength measurement was repeated three times. The bulb was then placed on the dorsum of the participant's tongue and the measurement process was repeated.

Control measures were then collected for baseline data. Lip strength and sustained vowel /a/ were chosen because it is presumed that tongue strengthening exercise, such as the slurp swallow, would not affect them. These exercises are however, sensitive to extraneous variables such as maturation. Lip strength was measured using the IOPI. The bulb was placed between the lips, ensuring that the teeth were not pressing on the bulb. The participant was instructed to press the bulb between the lips. To measure sustained production of the vowel /a/ the participant was instructed to produce /a/, for as long as she could. This measurement was collected over three trials and the time was recorded in seconds.

Treatment

In each weekly research session tongue strength and the control variables were measured as described in the baseline phase. After weekly measurements of all variables were recorded, the remainder of each of the ten-minute sessions was devoted to correctly performing the slurp swallow exercise fifty times. During the weekly at home parental supervised exercise routine no measurements of control variables were examined. The participant was required to perform the slurp swallow maneuver twice a week fifty times consecutively, taking breaks as needed. The slurp swallow exercise was completed as described in the Swallow Right program (Pierce, 2002):

1. Explain and help the child find the correct tongue placement spot on the alveolar ridge behind the teeth.

2. Instruct the child to place and hold his or her tongue on the spot.
3. Instruct the child to bite his or her back teeth together.
4. Instruct the child to keep the back teeth together and smile a wide, open-lip smile.
5. Instruct the child to slurp.
6. Instruct the child to swallow.

According to Pierce (2002) participants should be instructed periodically to feel the backward motion of the tongue as it moves posteriorly prior to the swallow.

Chapter IV – Results

Introduction

The purpose of the current study was to add to the available evidence regarding the effectiveness of the slurp-swallow exercise by replicating the Buchanan (2007) study. This study expands on the design of the Buchanan study by increasing the duration of treatment sessions to 10 weeks. The study sought to determine if block practice with 50 repetitions of the slurp-swallow exercise would increases measurements of both tongue tip and dorsum strength in an individual with tongue thrust. The participant attended 10 consecutive weekly researcher led treatment sessions and completed the exercise program 10 consecutive times at home under the supervision of a parent. Baseline measures of tongue strength and control variables were obtained during the initial session prior to the initiation of treatment. Sustained vowel /a/ and lip strength served as control measures. As treatment progressed measures taken on the participant demonstrated increased superior lingual force in both tongue tip and dorsum.

During treatment the participant reported to the researcher that the exercises became "easier" as sessions progressed. Water was provided to maintain oral moisture. The participant was allowed to pause for water at any point. As treatment progressed it was observed that water "breaks" were less frequently taken. Time to complete the 50 repetitions of the slurp-swallow decreased from 20 minutes during the first session to 9 minutes during the 10^{th} session. The participant reported feeling heightened awareness of sensations when swallowing during and between treatment sessions (see Appendix c). She reported that during the swallowing of liquids she noticed retraction of her tongue during swallow, but that task was still "awkward" with food.

The participant expressed a high level of motivation to correct her tongue thrust. When asked to rate the frequency and accuracy of her at home exercise program she indicated completing 10/10 programs consistently. She stated that is was of extreme importance to her to correct her tongue thrusting behavior and prevent future misalignment.

Baseline

Baseline measures were collected across three trials for each variable with very little variability between each trial. An average baseline of 10.33 kPa for dorsum and 9.67 kPa for tongue tip were achieved. Table 1 below illustrate the measures for superior lingual force as measured through tongue tip force and dorsum force across the baseline and treatment sessions.

Table 1 – Baseline Tongue Tip and Dorsum force measurements in kPa. Tongue tip force and dorsum force measurements in kPa with baseline, from means taken at the beginning of the session prior to 50 repetitions of the slurp-swallow exercise.

Tongue Force in Pascals (kPa)				
Location IOPI bulb	Trial 1	Trial 2	Trial 3	Mean Force
Tip	26	21	29	25.33
Dorsum	29	25	25	26.33

Treatment

Participant attended 10 research sessions weekly over 10 consecutive weeks and completed 10 out of 10 at-home parental supervised exercise programs. The participant demonstrated increases in both measures of superior lingual strength. The treatment phase tongue tip strength measurement averages at the end of the study were 31.7 kPa with a maximum average of 35.33 kPa compared to 25.33 averaged measure at baseline. Measurements of dorsum strength during the treatment phase were 33.56 kPa with a

maximum average of 40 kPa, compared with a baseline value of 26.33 kPa. Tables 2 and 3 below illustrate the measures for superior lingual force as measured through tongue tip force and dorsum force across the remaining sessions. The trend lines in Figures 1 and 2 illustrate the increases in tongue tip strength in both measurements taken at the beginning of each session. Evaluation of the linear trend lines and the baseline band indicates that there was a significant increase in both measures of tongue tip strength.

Table 2 – Treatment Tongue Tip Force measurements in kPa. Tongue tip force measurements in kPa with treatment, by means taken at the beginning of the session prior to 50 repetitions of the slurp-swallow exercise.

Tongue Tip Force in Pascals (kPa)				
Session Number	Trial 1	Trial 2	Trial 3	Average
2	29	28	30	29
3	28	26	24	26
4	30	32	28	30
5	31	32	32	31.67
6	34	31	33	32.67
7	26	33	34	31
8	34	33	36	34.33
9	37	35	34	35.33
10	36	37	33	35.33

Table 3 – Treatment Tongue Dorsum Force measurements in kPa. Tongue dorsum force measurements in kPa with treatment, by means taken at the beginning of the session prior to 50 repetitions of the slurp-swallow exercise.

Tongue Dorsum Force in Pascals (kPa)				
Session Number	Trial 1	Trial 2	Trial 3	Average
2	31	29	29	29.67
3	32	31	29	30.67
4	33	32	30	31.67
5	32	31	32	31.67
6	34	33	32	33
7	32	33	30	31.67
8	35	32	34	34.67
9	39	37	41	39
10	41	39	40	40

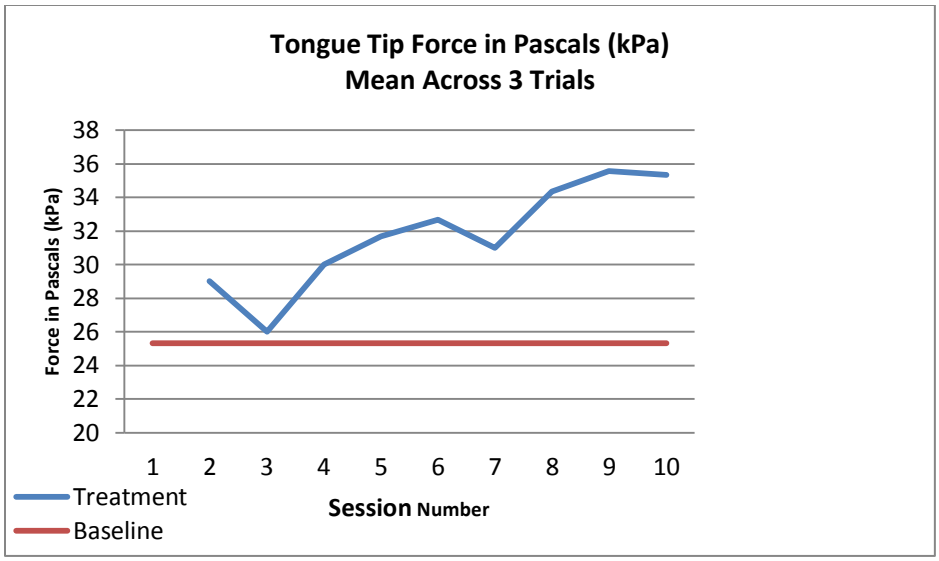

Figure 1 – Tongue Tip Force in Pascals

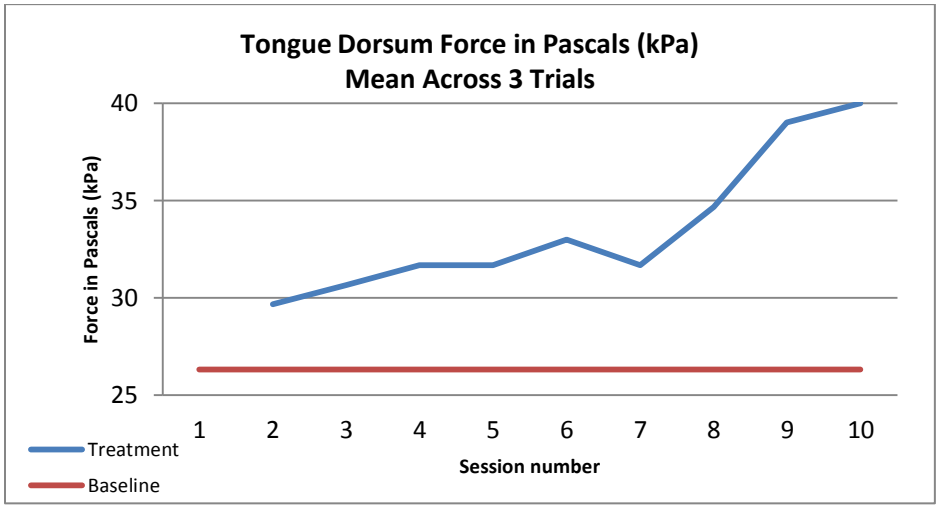

Figure 2 – Tongue Dorsum Force in Pascals

Control variables

Analysis of both lip strength and sustained vowel /a/ measurements at the beginning of each research session revealed that there was no significant increase in measurements of these two variables. Measurements of lip strength across all sessions averaged 10.87 kPa and measurements of sustained vowel /a/ indicated a mean of 9.28 seconds. Table 5 and 6 below provide the measures for lip strength as measured through lip force and sustained vowel as measured in seconds across research sessions. Figures 4

and 5 illustrate a relatively flat line indicating no significant level of variance. The lack of marked changes in both control variables suggest that the increase in tongue strength were due to the exposure of the slurp swallow exercise, rather than extraneous factors such as maturation.

Table 4 – Lip Force measurements in kPa. Lip force measurements in kPa, by means taken at the beginning of the session prior to 50 repetitions of the slurp-swallow exercise.

Lip in Pascals (kPa)				
Session Number	Trial 1	Trial 2	Trial 3	Average
1	12	11	12	11.67
2	11	10	12	11
3	9	12	11	10.67
4	13	9	12	11.33
5	11	12	10	11
6	9	11	9	9.67
7	13	11	12	12
8	10	9	11	10
9	12	11	11	11.33
10	10	9	11	10

Table 5– Sustained Vowel /a/ measurements in seconds. Sustained Vowel /a/ measurements in seconds, by means taken at the beginning of the session prior to 50 repetitions of the slurp-swallow exercise.

Sustained Vowel /A/ (sec)				
Session Number	Trial 1	Trial 2	Trial 3	Average
1	9.50	9.53	8.95	9.33
2	9.50	9.56	10.05	9.7
3	8.05	9.25	9.65	8.98
4	9.06	10.23	7.10	8.79
5	9.75	10.02	8.95	9.46
6	8.35	9.25	10.20	9.27
7	8.75	9.50	9.45	9.3
8	9.57	8.9	9.74	9.40
9	10.10	9.5	8.02	9.21
10	9.56	8.95	9.82	9.44

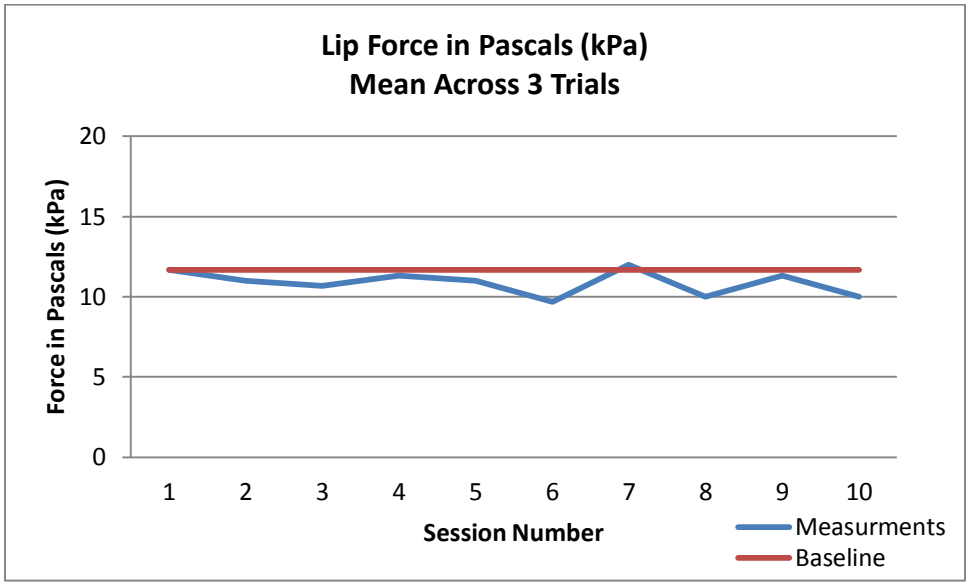

Figure 3 – Lip Force in Pascals

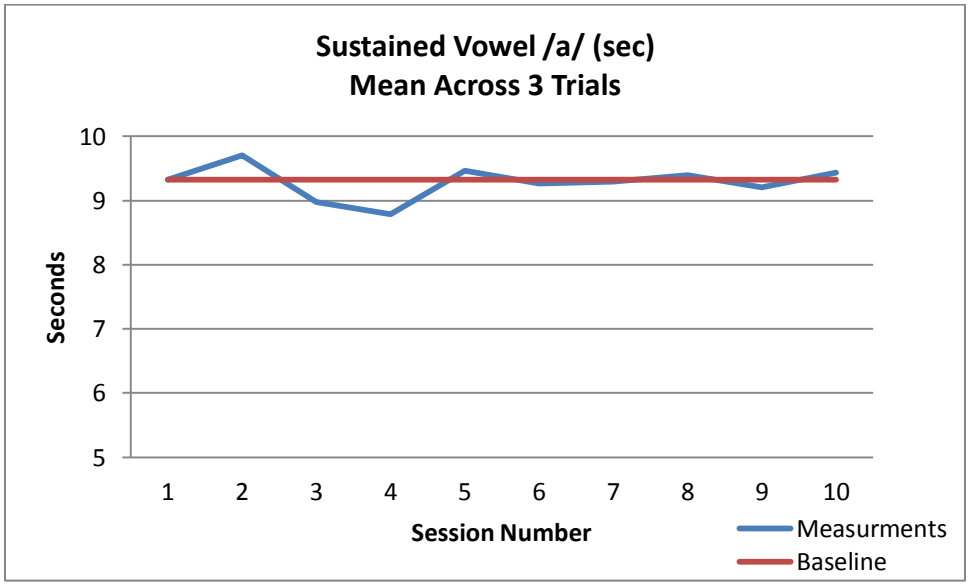

Figure 4 – Sustained Vowel /a/ in Seconds

Reliability

Inter-judge Reliability.

Inter-judge reliability procedures were conducted during 10% of the research sessions to determine the consistency of the measurement of variables. A certified speech-language pathologist attended the research sessions and independently recorded the measurements of the variables. The measurements recorded by the observer and the researcher were then compared to determine consistency of measurements of variables.

The scores gathered by the researcher and the observing SLP were compared using the Pearson Product-Moment Correlation Coefficient. By means of Microsoft Excel, the average of 3 trials for each measurement collected by the researcher across all sessions for the participant were compared using the Pearson Product-Moment Correlation Coefficient to the mean across 3 trials for each measurement collected by the SLP. A correlation coefficient (r) greater than or equal to +.70 was considered to have a very strong positive relationship between the two sets of scores.

When r was calculated for means of the control variable sustained vowel /a/ correlation coefficient of +.98 was obtained, indicating a strong positive relationship. A correlation coefficient of +.87 was obtained for the second control variable of lip strength, also indicating a strong positive relationship. The correlation coefficient for the dependent variables indicated very strong positive relationships between the means collected across 3 trials for each measurement by the researcher and those collected by the SLP. When r was calculated for tongue tip measurements the correlation coefficient was +.98. Comparison of dorsum strength measurements calculated r = +.97.

Procedural Reliability.

Measurement of procedural reliability was conducted in order to determine if the research protocol was followed consistently. A checklist outlining the procedures (Appendix d) as described in the Method section was given to a certified speech-language pathologist attending the research sessions. The SLP observed more than 50% of sessions. The SLP marked a plus next to items on the checklist if the procedure was followed as stated. The procedural reliability score was determined by dividing the number of plus marks by the total number of items on the checklist then multiplying that number by 100. Procedural reliability was calculated to be 96.87% indicating high procedural accuracy.

Participant Rating and Report

Swallow ratings recorded by the participant show an overall increase in the participant's rating of her swallow. Comments by the participant indicated that she felt the exercises increased in ease as the course of treatment progressed. She also indicated that she was feeling more confident about her swallow function and expressed an overall increase in awareness of how she swallowed. She reported during the final research session that her tongue now retracted easily with minimal effort when swallowing liquids, but awareness and more effort is still needed to retract the tongue when swallowing solids. She indicated that if she focuses her attention on her tongue when eating she is able to successfully use the mature swallow more often than she was able to do at the initiation of treatment.

Summary

The participant was a 14 year old female who demonstrated moderate tongue thrust. She attended 10 treatment sessions over 10 consecutive weeks and completed 10 at home treatment supervised exercise programs. Measurements of superior lingual force of tip and dorsum indicated increased force across baseline and treatment sessions, suggesting the increase in tongue strength can be attributed to exposure to the slurp swallow exercise, rather than extraneous factors such as maturation. Both control measurements of sustained vowel /a/ and lip strength did not increase across treatment sessions. The 50 repetitions of the slurp-swallow were interrupted by the need to moisten the oral cavity with water throughout the treatment sessions. The participant expressed a high level of motivation to correctly perform the slurp-swallow and to remediate the tongue thrust.

Chapter V – Discussion

The purpose of the current study was to determine if 100 trials (50 trials per research session + 50 trials at home) of the slurp swallow exercise over the course of 10 weeks would increase the superior lingual force of individuals with tongue thrust. One participant completed the entire treatment protocol and completed baseline measures. This included 10 weekly research sessions at her school under the supervision of a certified SLP and 10 parentally supervised sessions at home. The research hypothesis was supported by the results of the participant. The participant demonstrated significantly clear increases in both superior force exerted by the tongue tip and dorsum. Only minor changes in control variables further supports the hypothesis of the slurp swallow exercise being responsible for the increases in tongue strength. The results of the study provide additional data that supports the use of the slurp swallow exercise in tongue thrust remediation programs.

It is possible that the increase in tongue force may be due to increases in neural activity rather than actual increases in strength. Results obtained most likely reflect development of a new motor pattern, as evidenced by the difficulty the client had with hard food. The IOPI is used to measures the force exerted by the tongue, so it is possible that increases in measurements were recording an increase in firing of neural activity to muscle motor units activating muscles, rather than actual increase in strength. Gabriel, Kamen, and Frost (2006) report that during strength training, increases in neural activity create greater synchronicity and coordination before increases in muscle mass are made. This increased neural activity causes a greater number of muscle motor units to be activated, which creates a more effective muscle contraction. It is possible that in

practicing the unfamiliar movement of exerting superior lingual force during swallow increased the neural activation to the tongue and allowed the participant to "learn" how to retract her tongue when swallowing. The increase in motor units used may have led to greater control and coordination over the tongue movement and possibly the increases in the IOPI measurements. Although the exact cause of the increase in force exhibited may not be known, the slurp swallow has shown to be an effective maneuver for tongue thrust therapy.

Past research regarding the effectiveness of the slurp swallow has identified a need to increase the sample size to increase reliability of findings. This study also sought to increase understanding of the effectiveness of the slurp swallow maneuver in the treatment of tongue thrust over an extended period of time. It expanded the duration of the exercise program to 10 weeks with 10 research monitored and 10 at home directly monitored exercise sessions. Positive results for the participant of this study contribute to the body of evidence that supports further research into the use of the slurp swallow exercise in the remediation of tongue thrust.

Chapter VI - Summary and Conclusion

In summary, the research hypothesis of this study that a significant change will be observed in the superior force exerted by the tongue in children with tongue thrust behaviors after 10 therapy sessions of the slurp swallow exercise was supported. Intrinsic motivation to correct tongue thrust was noted through interactions with the participant when she verbally expressed a desire to remediate her tongue thrust. The participant reported a desire for water to maintain moisture in the oral cavity when practicing the slurp swallow exercise across 50 repetitions. Water was available at all times. The participant required breaks from repetitions of the exercise. This study replicates previous graduate thesis research conducted by Alexandra Buchanan (2007) in order to increase reliability and further add to the body of evidence regarding the efficacy of the slurp swallow exercise for the treatment of tongue thrust.

Limitations

This study has two known limitations. One limitation of the study was the small sample size. Even though the sample size was small, the knowledge gained will directly add to the overall number of participants in studies that look specifically at the slurp swallow exercise as a means of increasing tongue strength in children with tongue thrust behaviors.

Another limitation is repeated use of the IOPI could have produced these findings. The IOPI was used three times a week with the participant, increasing familiarity with this task. A follow up session should be utilized 3 months after treatment to determine if increases observed in tongue strength are maintained. Future research should be focused on differentiating motor programming versus strength in oral motor training.

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Appendix A: ISU Tongue Thrust Protocol + Screening Procedure

Consent Forms, Explanation of Methods and Screening for Tongue Thrust-Prior to Session 1

1) Introduction and brief overview of the study
2) Present copies of the written consent forms.

a. Subjects under 18 years of will have parent written consent form, and will also sign a consent form themselves

b. Subjects over 18 years of age will require only one written consent form

3) Review written consent forms, provide information about nature of the study, possible benefits and risks and provide information regarding the voluntary nature of participation

a. Include time to answer any questions the subject or parent may have

4) Once consent has been given, collect the case history following the Idaho State Tongue Thrust Protocol (either subject or parent/guardian as informant)

ISU Tongue Thrust Protocol

Note: To derive a total score for prediction purposes circle numbers in "score" box for items representing problems.

Subject Number:_____ Researcher's Name:_____

Date:_____

Case History Information

Characteristic	Presence/ absence	Score	Notation
Feeding History			
Nursed or bottle fed			
Age for solid food (4-6 for cereal)			
Age hard food (carrot, celery)			
Food preferences (hard, soft)			
History swallow problem (choke, gag)			
History regurgitation			
• Tx regurgitation			
• Persistent regurgitation			
Food allergy			
Family Issues (genetics)			
Fam. Hx. Tongue thrust			
Fam. Hx feeding problems			
Fam hx low tone			
Fam hx allergy			

Fam. Hx upper respiratory			
Fam Hx Macroglossia			
Fam Hx Small nares			
Fam Hx Deviated septum			
Fam Hx Dental problems (small mouth requiring extractions)			
Fam Hx Mouth breathing or nasal			
Habits			
Digit sucking (lips, tongue, finger, thumb, hand)			
Late bottle use			
Late pacifier use			
Mouth breathing			
Cheek biting			
Medical/Anatomical history			
Open spaces during mixed dentition			
Diastema?			
Micrognathia?			
Missing dentition?			
Hypertrophied adenoids/tonsils			
Allergies			
• New?			
• Old?			
• When develop?			
• Treated?			
Hypertrophied turbinates?			
Cleft palate?			
Tonsillitis			
• ENT visits for tx?			
• Removed?			
• When			
Neurophysiological issues			
Low sensory awareness /sensation seeking			
Drooling, saliva pooling			
Oral discrimination ability			

5) Conduct tongue thrust assessment following ISU Tongue Thrust Protocol

a. The researcher will say to the subject, "I want to see how you swallow. I am going to take a peek into your mouth, look at your teeth and tongue then I am going to have you swallow several times. I am going to have you swallow some water and a cracker. Some of the time I

will ask you to swallow with your lips open, so I will hold your lips apart as you swallow, sometimes I will feel your neck and jaw while you swallow, and sometimes you will swallow with your lips closed. Let's give it a try."

b. Then the researcher will proceed to conduct a swallow assessment following the guidelines below:

		Assessment Protocol			
Characteristic	**Action**	**Clinician Instructions to the subject**	**What the clinician is doing**	**Score**	**Notation**
1. Observation	Observe client at rest	"Look at me and relax"	Observing the facial features at rest for numbers 1-5, score and make notes		
2. Facial tone	Observe client at rest				
3. Facial symmetry	Observe client at rest				
4. Mouth or nose breathing	Observe client at rest				
5. When mouth open, how much of upper dentition is covered by lip?	Criterion: Upper lip covers ½ of upper teeth			Less=1	
6. Rest posture of tongue	observe: contact upper dental arch at rest	"I am going to gently pull on your lower lip so I can look in your mouth" Ask the subject "where does your tongue sit when you are not talking or eating?"	Gently grasp the lower lip with thumb and forefinger of a gloved hand, pull the lip down and observe tongue resting posture	If not=1	

7. Lip movement during dry swallow	Observe for open or clamped (watch for wrinkle of chin as sign of clamping)	"Please swallow"	Observe lips during dry swallow, score and make notes	Present= 1	
8. Tongue out, mouth open	Perception of macroglossia?	"Stick out your tongue for me"	Note the size of the tongue in relationship to the mouth, score and note	1	
Oral Examination:					
1. Dentition	Bite down on molars; Tongue depressor in buccal cavity; Ask to spread lips	"I am going to slide this tongue depressor between your check and teeth. Please bite down on your back teeth while I look at the sides of your teeth. Spread your lips apart."	Model desired behavior, then gently slide tongue depressor between the buccal cavity and the teeth, observe relationship of the teeth and note malocclusions below, see figure 1		
• Class I malocclusion	Mandibular 1st molar ½ tooth ahead of maxillary 1st molar; anterior teeth maligned			1	
• Class II	Retracted mandible			1	
• Class III	Prognathic mandible			1	
• Open bite	Front teeth don't occlude			1	
• Closed bite	Back teeth don't occlude				
• Teeth meet at rest	Observe rest posture re:			1	

	muscles of mastication				
2. Nares:					
• Deviated septum	Ask in Hx; observe	"I am going to look at your nose now"	Observe the nares at rest		
• Apparent blockage	Ask in Hx; observe breathing				
3. Lips • Contact	Criterion: Rest along entire length without effort	"Look straight at me"	Observe the lips at rest and score and write down observations for the criteria below	If not=1	
• Chapping?	Chapping indicates mouth breathing, tongue thrust				
• "fat" lower lip: low tone?	Indicates low tone				
• Overjet:	If excessive dental overjet, crease in lower lip where teeth rest			1	
4. Hard palate • High Vault	View with open mouth, flashlight	"Open your mouth as big as you can" May need to ask the subject to tip the head back slightly	With a pen light observe the hard palate, noting the vault	1	
5. Soft palate • Elevates with /a/?	Transilluminate Watch in /a/ Observe and palpate	"I am going to watch the back of your mouth, so I can see it better I am	Using the pen light cast the beam into the nares, palpate, and observe for elevation of		

		going to shine my light near your nose." "Say /a/ for me"	the velum on /a/		
• Length adequate?	Transilluminate Watch in /a/ Observe and palpate		Using the pen light cast the beam into the nares, palpate, and observe relative size and shape of the velum		
• Blue coloration? (submucous)	Transilluminate Watch in /a/ Observe and palpate		Using the pen light cast the beam into the nares, palpate, and observe for discoloration that may indicate submucous cleft		
6. Tongue • Microglossia	Observe, mouth open	"Please open your mouth again"	Observe and note the size of the tongue in relationship to the mouth		
• Macroglossia	Observe, mouth open		Observe and note size of the tongue in relationship to the mouth	1	
• Lingual frenulum	Protrude tongue; heart shape anterior?	"Stick your tongue straight out"	Model, then observe the tongue as it is protruded, not any irregularities	1	
• resting posture?	Ask; criterion = contact upper dentition at rest		Note previous answer from above	1	

Water Swallow					
1. Water retention	Water on tongue, open mouth, retains water?	"Now I am going to put a little bit of water on your tongue. I need you to keep your mouth open and hold the water on your tongue"	Place 1 cc of water on the tongue of the subject, note if the subject is able to hold the water		
2. Water swallow x3 lips closed • Masseter contract?	Swallow water: Palpate	"This time you are going to swallow the water"	Position fingers under the jaw to palpate the swallowing mechanism following Logeman's 4 Finger Palpation method, offer the subject small sips of water and observe for masseter contraction, laryngeal elevation, spillage, tongue protrusion, thyroid elevation, symmetrical contact, make note of any irregularities. Repeat 3 times	Fail=1	

• Symmetrical contract?	Swallow water: Palpate				
• Thyroid elevate?	Swallow water: Palpate			Fail=1	
3. Water swallow, lips open x 3 • lip tension?	Swallow water: Lips open, pull lips open Observe protrusion, interdental	"When you take a sip of water this time I am going to open your lips and watch what goes on inside your mouth. Wait for me to tell you to swallow" Once in place for observation say "Swallow"	Offer small sip of water, pull bottom lip away from the teeth and toward the chin, gently with a gloved hand, instruct the subject to swallow and observe for and note lip tension, water loss, tongue thrust. Repeat 3 times	Tense=1	
• Water loss?	Swallow water: Lips open, pull lips open; Observe protrusion; interdental; water loss			Loss=1	
• Tongue thrust?	Swallow water: Lips open; pull lips open; Observe protrusion; interdental			1	
Food mastication					
1. Cracker/cookie mastication x 3 • bolus: scatter, tube, ball?	Observe before swallow, after swallow	"Here is a cracker. I want you to take a bite, chew it up, BUT before you	Allow the subject to bite offered cracker, note the size of the bite. Observe the subject as	Scatter=1	

		swallow I want to see it, so let me know when you are ready to swallow"	he or she chews. When he or she indicates that she is ready to swallow, have him or her open the mouth and observe the bolus size, shape, mixture and note each.		
• Saliva: mixed?	Observe			Dry=1	
• too large bite?	Observe				
• Too small bite?	Observe				
• Lips open when chew?	Observe			1	
2. Cracker/cookie swallow X 3 number of swallows?	Observe	Cue to swallow "Ok Swallow" "Now that you have swallowed I need you to open your mouth"	Palpate for masseter contraction during swallow Observe if the client cleans the oral cavity with the tongue or follows the swallow with water. Watch the lips during the swallow observe for clamping. Observe the open oral cavity for food remains in the sulcus or on the tongue. Repeat and observe 3	>2 swallow= 1	

			times		
• Cleaned using tongue?	Observe				
• Followed with water?	Observe			1	
• Lips clamp in swallow?	Observe; watch for wrinkling of mentalis			Clamp or wrinkle =1	
• Masseter contract?	palpate			no contraction = 2	
• Food remains in sulcus after swallow	Observe after swallow using tongue depressor	"I am going to look at the sides of your teeth"	Gently slide tongue depressor into the buccal cavity and observe and note debris	1	
• Excessive food on tongue after swallow	Look for position of tongue and lips on glass			1	
• Tongue protrudes in swallow	Pull down lower lip	"You are going to take bites of the cracker again, but this time when you let me know you are ready to swallow I am going to pull your lip down again and see what is going on inside your mouth. Wait for me to tell you to swallow"	Offer the subject another cracker, when he or she indicates they are ready to swallow, gently pull down the lower lip and cue the subject to swallow, observing the tongue movement	1	

		Get into position "Ok Swallow"			
3. Type of tongue thrust • Unilateral Left • Unilateral right • Spread • Bilateral • Upper thrust • Lower thrust	Pull lip down Resting posture Swallowing movement Look at dentition		When making observations of the tongue during swallow note here the type of thrusting that is observed if thrusting is present		
4. severity • 0=normal • 1= dental contact, but not pass through teeth or over teeth • 2.=dental contact, and between teeth, onto occlusal surface, or contact lips	Observation: be specific!		Observe the tongue protrusion, note the severity and describe the degree to which the tongue protrudes.		
Total Score (add circled numbers)					

Revised 9-1-04

Developed by Molly Borgreen, Kerry Bradshaw, Cara Breiter, Judy Carroll, Sharla Castillo, Matthew Hess, Wendy Lee, Emily Orchard, Tony Seikel, Elizabeth Staiger, Megan Summers, Vanessa Sutton

Baseline Measurements and Therapy Session-Session 1

1) Instruct the subject: "Today, we are going to use this device to measure different strengths in your mouth. " Familiarize the subject with the IOPI. Allow the subject to see the bulb, demonstrate for the subject how the bulb is placed by placing it in the clinician's mouth with gloved hands. Replace bulb, and gloves and discard the used ones. Proceed with IOPI measurements following the procedure below:

Task	Clinician's Instructions to Subject	What Clinician Does	Record Data
1. IOPI Tongue Tip.		Procedures for Clinician 1.Turn left knob to "Peak" Press "Reset." 2.Check screen for low battery symbol. Change battery if needed. 3. Press "Chk Cal". The voltage reading should be 000 +/- 1. If not, calibrate using the following directions at bottom. 4. Attach connecting tube to tongue bulb. IOPI is now ready to use. 5. Turn IOPI screen away from subject	
IOPI Tongue Tip		If at any time the bulb moves out of place or directions are not followed, re-administer the directions.	
IOPI Tongue Tip	"I'm going to place this bulb on the tip of your tongue."		
IOPI Tongue Tip	"Open your mouth"		
IOPI Tongue Tip		Clinician places bulb in mouth, making sure bulb is completely behind the front teeth.	
IOPI Tongue Tip		Make sure they are not biting on tubing.	
IOPI Tongue Tip	"Close your lips"		
IOPI Tongue Tip	"When I say go press with the tip of your tongue against the roof of your mouth as		

	hard as you can, hold until you are told to stop."		
IOPI Tongue Tip - 1	"Go"		
IOPI Tongue Tip - 1		Have subject press until IOPI number stabilizes	
IOPI Tongue Tip - 1	"Stop"		
IOPI Tongue Tip - 1			_____Record final number on screen
		Check positioning of bulb and reposition if needed.	
	"We are going to do it again."	Push "reset"	
IOPI Tongue Tip – 2	"Go"		
IOPI Tongue Tip – 2	"Stop"		
IOPI Tongue Tip - 2			_____Record second reading
		Check positioning of bulb and reposition if needed.	
	"We are going to do it again."	Push "reset"	
IOPI Tongue Tip – 3	"Go"		
IOPI Tongue Tip – 3	"Stop"		
IOPI Tongue Tip - 3			_____Record third reading
2. IOPI Dorsum	"Now I'm going to place the bulb on a different part of your tongue. Open your mouth and say /a/"	Push "reset"	

IOPI Dorsum		Look for the peak of the tongue dorsum when subject says /a/.	
IOPI Dorsum		Place the tip of the bulb at the peak.	
IOPI Dorsum - 1	"Close your mouth and push as hard as you can against the bulb"	Have subject press until IOPI number stabilizes	
IOPI Dorsum - 1	"Stop"		
IOPI Dorsum - 1			_____Record reading
		Wipe bulb with tissue, reposition bulb & repeat Push "reset"	
IOPI Dorsum – 2	"Go"		
IOPI Dorsum – 2	"Stop"		
IOPI Dorsum – 2			_____Record reading
		Wipe bulb with tissue, reposition bulb & repeat Push "reset"	
IOPI Dorsum – 3	"Go"		
IOPI Dorsum – 3	"Stop"		
IOPI Dorsum - 3		Wipe bulb	_____Record reading
3. IOPI Lip strength		Push "reset"	
IOPI Lip Strength	"Now I'm going to place this between your lips but be sure not bite the bulb directly"		

IOPI Lip Strength		Place bulb between lips (parallel with lips), but not between teeth.	
IOPI Lip Strength	"When I say go press your lips together"	Have subject press until IOPI number stabalizes	
IOPI Lip Strength – 1	"Go"		
IOPI Lip Strength – 1	"Stop"		
IOPI Lip Strength – 1			_____Record reading
		Reposition bulb between lips parallel with lips & Repeat Push "reset"	
IOPI Lip Strength – 2	"Go"		
IOPI Lip Strength – 2	"Stop"		_____Record reading
		Reposition bulb between lips parallel with lips & Repeat Push "reset"	
IOPI Lip Strength – 3	"Go"		
IOPI Lip Strength – 3	"Stop"		_____Record reading
		Push "reset"	

2) The clinician then measures the sustained vowel /a/:

Task	Clinician's Instructions to Subject	What Clinician Does	Record Data
Sustained Vowel /a/	"Now we are going	Model a sustained vowel /a/	

	to measure how long you can say /a/ in one breath. You are going to breath in then say "ahhhhhh"	for the subject	
Sustained Vowel /a/	"It's your turn, when I say 'Go' say /a/ as long as you can. Ready take a breath, Go"	Start stop watch when you say "go" stop when the sustained vowel is no longer audible	
Sustained Vowel /a/	"Let's do it again, ready take a breath 'Go'"	Start stop watch when you say "go" stop when the sustained vowel is no longer audible	
Sustained Vowel /a/	"Let's do it one more time, ready take a breath 'Go'"	Start stop watch when you say "go" stop when the sustained vowel is no longer audible	

3) The clinician tells the subject, "We are now going to learn to find 'the spot'. The spot is the place just behind your teeth where your tongue should touch when you swallow. "

Task	Clinician's Instructions to Subject	What Clinician Does	Record Data
Establishing "The Spot"	"Reach your tongue up to touch the roof of your mouth behind your top teeth"	Help the subject find the spot and hold the tongue there with modeling, tactile cues with gloved hands, toothette or tongue depressor as needed or required to gain proficiency at finding the spot.	
Establishing "The Spot"	"Now hold your tongue there while I count to 5"	Count aloud 1-5	
Establishing "The Spot"	"Good. Let's try it again"	Provide feedback as necessary to ensure the correct placement of the tongue. Count aloud 1-5	
Establishing "The Spot"	"That's good, let's do it again"	Provide feedback as necessary to ensure the correct placement of the tongue. Count aloud 1-5	

Establishing "The Spot"		Repeat the last step until subject can reliably find the spot	
Practicing the "Slurp Swallow"	"Now we are going to practice an exercise with our tongue on the spot"		
Practicing the "Slurp Swallow"	"Hold your tongue on the spot, then close your teeth, and smile big. Don't let your tongue fall down, keep it on the spot"	Model for the subject then ensure correct tongue placement	
Practicing the "Slurp Swallow"	"Next we are going to SLURP then swallow, like this"	Model for the subject	
Practicing the "Slurp Swallow"	"Ok now it is your turn, put your tongue on the spot, close your teeth, smile, slurp and swallow"	Prompt the subject through the steps with verbal and visual cues	
Practicing the "Slurp Swallow"	"That's good, we need to do it 50 times. I will mark them down as we go. Remember if you need a break, let me know."	As the subject completes the slurp swallow exercise, observe for signs of fatigue, tally each slurp swallow on the data collection form, and provide encouragement as needed.	

Practicing the "Slurp Swallow"	Periodically instruct the subject to “to feel the backward motion of the tongue as it moves posteriorly prior to the swallow”		

IOPI measurements Therapy Session-Session 2-10

1) Inform the subject that you will repeat the measures that were done the session before and practice the slurp swallow exercise again. Proceed with IOPI measurements following the procedure below:

Task	Clinician’s Instructions to Subject	What Clinician Does	Record Data
2. IOPI Tongue Tip.		Procedures for Clinician 1.Turn left knob to “Peak” Press “Reset.” 2.Check screen for low battery symbol. Change battery if needed. 3. Press “Chk Cal”. The voltage reading should be 000 +/- 1. If not, calibrate using the following directions at bottom. 4. Attach connecting tube to tongue bulb. IOPI is now ready to use. 5. Turn IOPI screen away from subject	
IOPI Tongue Tip		If at any time the bulb moves out of place or directions are not followed, re-administer the directions.	

IOPI Tongue Tip	"I'm going to place this bulb on the tip of your tongue."		
IOPI Tongue Tip	"Open your mouth"		
IOPI Tongue Tip		Clinician places bulb in mouth, making sure bulb is completely behind the front teeth.	
IOPI Tongue Tip		Make sure they are not biting on tubing.	
IOPI Tongue Tip	"Close your lips"		
IOPI Tongue Tip	"When I say go press with the tip of your tongue against the roof of your mouth as hard as you can, hold until you are told to stop."		
IOPI Tongue Tip - 1	"Go"		
IOPI Tongue Tip - 1		Have subject press until IOPI number stabilizes	
IOPI Tongue Tip - 1	"Stop"		
IOPI Tongue Tip - 1			_____Record final number on screen
		Check positioning of bulb and reposition if needed.	
	"We are going to do it again."	Push "reset"	
IOPI Tongue Tip – 2	"Go"		
IOPI Tongue Tip – 2	"Stop"		
IOPI Tongue Tip - 2			_____Record second reading

		Check positioning of bulb and reposition if needed.	
	"We are going to do it again."	Push "reset"	
IOPI Tongue Tip – 3	"Go"		
IOPI Tongue Tip – 3	"Stop"		
IOPI Tongue Tip - 3			_____Record third reading
2. IOPI Dorsum	"Now I'm going to place the bulb on a different part of your tongue. Open your mouth and say /a/"	Push "reset"	
IOPI Dorsum		Look for the peak of the tongue dorsum when subject says /a/.	
IOPI Dorsum		Place the tip of the bulb at the peak.	
IOPI Dorsum - 1	"Close your mouth and push as hard as you can against the bulb"	Have subject press until IOPI number stabilizes	
IOPI Dorsum - 1	"Stop"		
IOPI Dorsum - 1			_____Record reading
		Wipe bulb with tissue, reposition bulb & repeat Push "reset"	
IOPI Dorsum – 2	"Go"		
IOPI Dorsum – 2	"Stop"		
IOPI Dorsum – 2			_____Record reading

		Wipe bulb with tissue, reposition bulb & repeat Push "reset"	
IOPI Dorsum – 3	"Go"		
IOPI Dorsum – 3	"Stop"		
IOPI Dorsum - 3		Wipe bulb	_____Record reading
3. IOPI Lip strength		Push "reset"	
IOPI Lip Strength	"Now I'm going to place this between your lips but be sure not bite the bulb directly"		
IOPI Lip Strength		Place bulb between lips (parallel with lips), but not between teeth.	
IOPI Lip Strength	"When I say go press your lips together"	Have subject press until IOPI number stabalizes	
IOPI Lip Strength – 1	"Go"		
IOPI Lip Strength – 1	"Stop"		
IOPI Lip Strength – 1			_____Record reading
		Reposition bulb between lips parallel with lips & Repeat Push "reset"	
IOPI Lip Strength – 2	"Go"		
IOPI Lip Strength – 2	"Stop"		_____Record reading
		Reposition bulb between lips	

		parallel with lips & Repeat Push “reset”	
IOPI Lip Strength – 3	“Go”		
IOPI Lip Strength – 3	“Stop”		_____Record reading
		Push “reset”	

2) The clinician then measures the sustained vowel /a/:

Task	Clinician’s Instructions to Subject	What Clinician Does	Record Data
Sustained Vowel /a/	“Now we are going to measure how long you can say /a/ in one breath. You are going to breath in then say “ahhhhhh”	Model a sustained vowel /a/ for the subject	
Sustained Vowel /a/	“It’s your turn, when I say ‘Go’ say /a/ as long as you can. Ready take a breath, Go”	Start stop watch when you say “go” stop when the sustained vowel is no longer audible	
Sustained Vowel /a/	“Let’s do it again, ready take a breath ‘Go’”	Start stop watch when you say “go” stop when the sustained vowel is no longer audible	
Sustained Vowel /a/	“Let’s do it one more time, ready take a breath ‘Go’”	Start stop watch when you say “go” stop when the sustained vowel is no longer audible	

3) Conduct therapy session with practice of the slurp swallow:

Task	Clinician’s Instructions to Subject	What Clinician Does	Record Data

Establishing "The Spot"	"Reach your tongue up to touch the roof of your mouth behind your top teeth"	Help the subject find the spot and hold the tongue there with modeling, tactile cues with gloved hands, toothette or tongue depressor as needed or required to gain proficiency at finding the spot.	
Establishing "The Spot"	“Hold your tongue on the spot while I count to 5"	Count aloud 1-5. Provide feedback and repeat exercise as needed to ensure placement	
Practicing the "Slurp Swallow"	"Now we are going to practice the slurp swallow"		
Practicing the "Slurp Swallow"	"Hold your tongue on the spot, then close your teeth, and smile big. Don't let your tongue fall down, keep it on the spot"	Model for the subject then ensure correct tongue placement	
Practicing the "Slurp Swallow"	"Remember from last time how we SLURP then swallow, like this"	Model for the subject	
Practicing the "Slurp Swallow"	"Ok now it is your turn, put your tongue on the spot, close your teeth, smile, slurp and swallow"	Prompt the subject through the steps with verbal and visual cues	
Practicing the "Slurp Swallow"	"That's good, we need to do it 50 times. I will mark them down as we go. Remember if you need a break, let me know."	As the subject completes the slurp swallow exercise, observe for signs of fatigue, tally each slurp swallow on the data collection form, and provide encouragement as needed.	

Practicing the "Slurp Swallow"	Periodically instruct the subject to “to feel the backward motion of the tongue as it moves posteriorly prior to the swallow”		

Calibration of IOPI (Complete prior to each session):

1) Determine the elevation within +/- 150 feet (Pocatello’s elevation 4464’: Boise’s elevation is 2700’, Ulysses, PA 2,110’ elevation is)
2) Press “Chk Cal” button. The reading should be 000
3) Place the plunger of the 30 ml syringe at the 30 ml mark. Do not fill the syringe with water.
4) Insert the tube on the end of syringe to one the extra “female” luer lock connectors. Screw the syringe “female” luer lock onto the connecting tube “male” luer lock.
5) Slowly depress the plunger on the syringe to the 15 ml mark.
6) Record the number shown on the digital display. There can be some variation in hitting the 15ml mark on the syringe, so your reading may be off by the 3 to 5 kPa for any one measurement. We recommend taking several measurements and averaging the results.
7) Compare the results with the figures in Appendix D, kPa Calibration Readings for Different Altitudes, taking into consideration your altitude.

Appendix B: Information Packet

Introduction Letter and Summary of Procedures

Dear Parents/Guardians,

My name is Amy Krause. I am attending Idaho State University as a Graduate Student in the Speech-Language Pathology Program. I am working on a thesis that is exploring the effectiveness of a tongue strengthening exercise called the Slurp Swallow. I am gathering this information on children and adults who exhibit tongue thrusting behaviors with no co- existing conditions. The study will develop data that can be used in a larger study examining the effects of tongue thrust in an aging population.

I am asking for volunteers to be participants in my study. Each participant will practice the exercise during each session. I will measure tongue strength before and after each block of practice using the Iowa Oral Pressure Instrument (IOPI), which is a standard clinical measurement device in speech pathology. The instrument should not cause the subject any discomfort. The IPOI is used by placing a small plastic bulb on the roof of the mouth and having the participant apply pressure using their tongue. The first session will take approximately 30-60 minutes and will include a parent interview and a swallow evaluation. If a participant is wheat or gluten intolerant, we can substitute a gluten-free product during the assessment. Subsequent sessions will take approximately 10 to 20 minutes.

Please consider allowing your child to participate in the study or participating yourself if you think you have tongue thrust. Again, the participants I need should be within the **ages of 5-50 years**. Due to the age requirement, I will need parent's consent to allow their child to participate. If at any time you choose not to participate, you do not have to continue. If at any time during the course of the study you have any questions or would like more information about what we are doing, please call me. You can reach me at my cell phone 607-743-7130. You can also e-mail me at any time at dunnamy@isu.edu. Thank you for your consideration.

Amy Krause

Idaho State University
Human Subjects Committee
Assent Form

☐ **Youth Assent Form (Ages 13-17)**

The Treatment Efficacy of Oromyofunctional Exercise (Slurp Swallow) in Strengthening the Tongue in Persons with Tongue Thrust

1. My name is Tony Seikel (Rachel Durrant, Misty Torrey)

2. We are asking you to take part in a research study because we are trying to learn more about how to treat problems related to tongue thrust.

3. If you agree to be in this study you will first be asked to chew a cracker, drink some water, and allow me to look at your facial muscles as you swallow. I will ask to look in your mouth as you swallow, and will pull your lip down once or twice to see your tongue.

After that, you will be asked to bite down while I measure muscle strength, and I will ask you to say "ah" three times. You will then be asked to do some exercises that involve putting a little water on your tongue, and then putting your tongue on the roof of your mouth and moving it toward the back of your mouth. After practicing this several times we will make the measures again. We will have 10 sessions in which we do these exercises and take these measures. We'll ask you to do the same exercises at home as well.

4. The only real risk is if you were to get some water down your throat it might make you cough.

5. This study will help us figure out if the type of activities we do helps people swallow better.

6. We have already received permission from your parent(s) for you to participate in this research. Even though your parent(s) have given permission, you still can decide for yourself if you want to participate.

7. If you don't want to be in this study, you don't have to participate. Remember, being in this study is up to you and no one will be upset if you don't want to participate or even if you change your mind later and want to stop. Being in this study is not required, and you can still come to speech therapy if you don't join the study.

8. You can ask any questions that you have about the study. If you have a question that you didn't think of now, you can ask me later.

_____
Your Name (please print)

_____ _____
Your Signature **Date**

_____ _____
Signature of Witness **Date**

HSC
12/2005

Appendix C: Participant Rating Form

Date_____

Session #____

Please circle response

1. On a scale of 1-10 please rate the current level of awareness you have regarding your swallowing:

   1 2 3 4 5 6 7 8 9 10

   Not aware Aware Extremely Aware

2. On a scale of 1-10 please rate the current level of difficulty you may have with swallowing:

   1 2 3 4 5 6 7 8 9 10

   Extremely Difficult Average Easy

3. On a scale of 1-10 please rate your level of difficulty with completing the exercises.

1 2 3 4 5 6 7 8 9 10

Extremely Difficult Average Easy

Appendix D: Procedural Reliability Checklist

Date_____

Session #____

Please Place a Check in the Box of Items that are Observed:

Instrumentation:

- ☐ Turn on IOPI
- ☐ Check screen for low battery symbol
- ☐ Attach connecting tube to tongue bulb
- ☐ Keep IOPI screen facing away from subject

Tongue Tip Stregth:

- ☐ Say: "I'm going to place this bulb on the tip of your tongue."
- ☐ Say: "Open your mouth."
- ☐ Place bulb in client's mouth completely behind the front teeth
- ☐ Make sure client is not biting on tubing
- ☐ Say: "Close your lips."
- ☐ Say: ""When I say go press with the tip of your tongue against the roof of your mouth as hard as you can, hold until you are told to stop."
- ☐ Say: "go" and "stop"
- ☐ Record measurement
- ☐ Check positioning of bulb and reposition if needed
- ☐ Say: "We are going to do it again"
- ☐ Push reset
- ☐ Say: "go" and "stop"
- ☐ Record measurement
- ☐ Check positioning of bulb and reposition if needed
- ☐ Say: "We are going to do it again"
- ☐ Push reset
- ☐ Say: "go" and "stop"
- ☐ Record measurement

- ☐ Push reset

Tongue Dorsum Strength

- ☐ Say: "Now I'm going to place the bulb on a different part of your tongue. Open your mouth and say /a/"
- ☐ Look for the peak of the tongue dorsum when subject says /a/.
- ☐ Place the tip of the bulb at the peak.
- ☐ Say: "Close your mouth and push as hard as you can against the bulb"
- ☐ Have subject press until IOPI number stabilizes
- ☐ Say: "stop"
- ☐ Record measurement
- ☐ Wipe Bulb with tissue, reposition bulb
- ☐ Say: "go" and "stop"
- ☐ Record measurement
- ☐ Wipe Bulb with tissue, reposition bulb
- ☐ Push reset
- ☐ Say: "go" and "stop"
- ☐ Record measurement
- ☐ Push Reset

IOPI Lip Strength:

- ☐ Say: "Now I'm going to place this between your lips but be sure not bite the bulb directly"
- ☐ Place bulb between lips (parallel with lips), but not between teeth.
- ☐ Explain and help the child find the correct tongue placement spot on the alveolar ridge behind the teeth.
- ☐ Say: "When I say go press your lips together"
- ☐ Say: "go" and "stop"
- ☐ Record measurement
- ☐ Reposition bulb between lips parallel with lips
- ☐ Push reset
- ☐ Say: "go" and "stop"
- ☐ Record measurement

- ☐ Reposition bulb between lips parallel with lips
- ☐ Push reset
- ☐ Say: “go” and “stop”
- ☐ Record measurement
- ☐ Push reset

Sustained Vowel /a/

- ☐ Say: “Now we are going to measure how long you can say /a/ in one breath. You are going to breath in then say “ahhhhhh”
- ☐ Model a sustained vowel /a/ for the subject
- ☐ Say: “It’s your turn, when I say ‘Go’ say /a/ as long as you can. Ready take a breath, Go”
- ☐ Start stop watch when say “go”
- ☐ Stop when the sustained vowel is no longer audible
- ☐ Record measurement
- ☐ Say: “Let’s do it again, ready take a breath ‘Go’”
- ☐ Start stop watch when say “go”
- ☐ Stop when the sustained vowel is no longer audible
- ☐ Record measurement
- ☐ “Let’s do it one more time, ready take a breath ‘Go’”
- ☐ Start stop watch when say “go”
- ☐ Stop when the sustained vowel is no longer audible
- ☐ Record measurement

Practice Slurp Swallow

- ☐ Instruct the child to place and hold her tongue on the spot.
- ☐ If needed, help the subject find the spot and hold the tongue there with modeling, tactile cues with gloved hands, toothette or tongue depressor as needed or required to gain proficiency at finding the spot.
- ☐ Say: “Hold your tongue on the spot while I count to 5"
- ☐ Count aloud 1-5. Provide feedback and repeat exercise as needed to ensure placement
- ☐ Say: "Now we are going to practice the slurp swallow"
- ☐ Say: "Hold your tongue on the spot, then close your teeth, and smile big. Don't let your tongue fall down, keep it on the spot"

- ☐ Model for the subject then ensure correct tongue placement
- ☐ Say: “Remember from last time how we SLURP then swallow, like this"
- ☐ Model for the subject
- ☐ Say: "Ok now it is your turn, put your tongue on the spot, close your teeth, smile, slurp and swallow"
- ☐ If needed prompt the subject through the steps with verbal and visual cues
- ☐ Say: "That's good, we need to do it 50 times. I will mark them down as we go. Remember if you need a break, let me know."
- ☐ Tally each slurp swallow on the data collection form
- ☐ As the subject completes the slurp swallow exercise, observe for signs of fatigue
- ☐ Provide encouragement as needed.