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When Swallowing Becomes Impossible

1. What is Dysphagia?

Swallowing is one of the most complex neuromuscular interactions in the human body. (ASHA 2010) “Dysphagia is a swallowing disorder that involves and one of the three stages of swallowing: oral, pharyngeal or esophageal. It is not a primary medical diagnosis but rather a symptom of underlying disease.” (Groher, Cary 2010) Womack states that it can occur anywhere between the mouth and the stomach in one of the four phases of swallowing: anticipatory, oral, pharyngeal and esophageal. (1996) It is a symptom recognized by signs such as coughing or choking during or after eating, food sticking, regurgitation, odynophagia, drooling, unexplained weight loss, and nutritional deficiencies. It is characterized by a delay or misdirection of something swallowed as food (medically, a ‘bolus’) moves from the mouth to the stomach. (Groher, Cary 2010).

Dysphagia is usually defined as a result of a physiologic change in the muscles needed for swallowing. Physiologic changes can lead to two signs of dysphagia: delay in the propulsion of a bolus as it travels from the mouth to the stomach and misdirection of a bolus; meaning the bolus could enter the upper airway or simply fails to reach the stomach during a stage of swallowing. The chart presented next shows the four stages of swallowing plus a preceding stage as presented by Ward and Morgan. Due to the intricate nature of the swallowing mechanism, one can see how easy it would be for a surgery or trauma to cause a swallowing disorder.

The Stages of Swallowing (Ward, Morgan 2009)

Stage	Primary Role	Key Characteristics
1. Pre-Oral anticipatory	Interaction of pre-oral motor, cognitive, psychosocial, and somatoesthetic elements	• Sensory acknowledgement that food is present and appropriate responses (visual, somatoesthetic, sensory)
2. Oral Preparatory	Preparation of food and fluid for oral transit and initiation of the pharyngeal swallow	• Duration and nature may change due to characteristics of the bolus and cognitive/emotive factors • Once in mouth, lips are pressed together and against incisors, sealing the oral cavity • Liquids: Lip seal and buccal tone assist oral control and manipulation of the liquid bolus and prevention of anterior spillage • Solids: Both tongue and buccal contractions work to manipulate the bolus, exposing it to the teeth for mastication. Velum remains relaxed. • During mastication, bolus is mixed with saliva and broken down into appropriate sized particles • Post-mastication, food particles are gathered to make a bolus of appropriate size and consistency for swallowing • Bolus is held near front or center of the palate in preparation for phase

3. Oral	Posterior propulsion of the bolus from the oral cavity into the pharynx within 1 second	• Anterior tongue is elevated and pressed against the hard palate to seal the oral cavity and contain the bolus • Velum begins to elevate • Sequential lingual stripping action creates propulsion of bolus past anterior tonsillar pillars into the pharynx to trigger “reflex” swallow • Due to combine effects of lip seal, buccal contraction, and lingual contraction/propulsion, interoral pressure is increased
4. Pharyngeal	Propulsion of the bolus through the pharynx and into the esophageal sphincter, and simultaneous protection of the airway, all within 1 second	• Soft palate is elevated against the posterior pharyngeal wall to seal the nasopharynx • Respiratory cycle is suspended creating a temporary apneic period • Bolus is propelled posteriorly in pharynx by contractions of the muscles of the tongue. • Bolus moves into oropharynx • Contractions of the submental, superhyoid, and infrahyoid muscles assist the superior and anterior movements of the hyoid and reposition the larynx superiorly to a position under the base of the tongue • Laryngeal closure is achieved through adduction of the true vocal folds • Base of the tongue connects with the posterior pharyngeal wall behind the tail of the bolus to propel it through the pharynx • Combined effects of • Laryngeal elevation and pharyngeal contraction help
4. Pharyngeal (continued)		

		to shorten the pharynx to assist movement of the bolus into the esophagus • Opening of the UES is achieved through the combined actions of relaxation of the cricopharyngeus muscle and the superior anterior movement of the hyoid and larynx
5. Esophageal	Transit of the bolus from the esophageal sphincter to the stomach	• Stage begins with entry of the bolus through the UES • Bolus transport through esophagus is achieved via esophageal peristalsis, which typically occurs every 2 to 4 seconds, with each wave transversing the length of the esophagus to the lower esophageal sphincter at the entrance to the stomach in 6 to 10 seconds

As shown on the chart above, the swallowing mechanism relies on sensory input from the muscles and mucosal surfaces of the structures involved to help regulate and fine tune the sequence of muscular contractions that results in a swallow. It makes sense that disruption of the sensory, muscular, or structural integrity of the oral cavity, pharynx and larynx will result in dysphagia. (Leonard 1997) Swallowing problems (dysphagia) may be classified as oropharyngeal or esophageal. Oropharyngeal dysphagia refers to difficulty in the passage from the mouth to the esophagus. In esophageal dysphagia, there is a disordered passage of food through the esophagus. These problems should be distinguished from feeding disorders, which are difficulties in presenting food to the mouth. Swallowing problems are related to neuromotor speech disorders in that they frequently accompany disturbances in speech movement (ASHA 2010).

Stages of Swallowing with a Bolus (ASHA 2010)

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

The American Speech-Hearing Language Association (ASHA) published literature from several studies stating that 61% of adults admitted to acute trauma centers, 41% of individuals admitted to rehab settings 30%-75% of patients in nursing homes and 25%-30% of patients admitted to hospitals show some degree of dysphagia. It is a symptom that covers all ages of patients, from infants to the elderly. (ASHA 2010) Dysphagia can result from any number of diseases, conditions, and surgeries. Jones and Rosenbeck cite over 73 conditions, and those are only the ones that are considered rare. One of those cited in many instances are surgeries involving the head and neck no matter the origin of the surgical problem.

2. Head and Neck Surgeries

While most studies done on head and neck surgeries related to dysphagia are done for surgery following cancer and/or chemoradiation, surgeries for malocclusions can also result in dysphagia. Surgery for cancer can range from an extraction of a tumor to removal of the infected area. Surgery to remove a tumor with some normal tissue results in a defect and loss of structures, which typically also produce dysphagia. The chosen method of reconstruction of the defect will determine the type and severity of the dysphagia. As far as malocclusions, the method of correction and the areas affected especially if a nerve is bothered, are both factors in the recovery process and the risk of developing dysphagia after surgery. (Williams 2011)

Radiation therapy can worsen the dysphagia when it is added to the cancer regimen due to hardening of tissues due to the exposure. (Leonard 1997) Most acute side effects of radiation therapy are due to mucosal inflammation, edema, sensory changes, and fibrosis. Predominantly, chronic effects lasting longer than three months can be linked to vascular changes and fibrosis, or the formation of scar tissue. Fibrosis can leave decreased tissue elasticity, vascular damage of small vessels and narrowing of the large vessels. While many patients with head and neck cancers will already be experiencing some type of dysphagia due to the location of tumors, patients must also worry about aspiration due to the dysphagia, which can lead to more serious

effects. (Jones & Rosenberg 2010) A rule of thumb that is followed when it comes to head/neck surgery for cancer is “the 50% rule”. Meaning that if less than 50% of the structure is removed during surgery then there should not be a significant or permanent swallowing problem.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

As shown on the previous image, there are very many structures that can be effected by and can affect the swallowing process if tampered with too much during surgery. There are 8 main

structure groups, that if effected can cause dysphagia in an oral/neck surgery whether it is following cancer surgery or any other type. These structures are the oral sphincter, the anterior floor of the mouth, the tongue, the mandible, the palate, the pharynx, the larynx and the base of the skull. (Leonard 1997)

When the oral sphincter is involved in a surgical cancer resection, functioning of the lips in swallowing is influenced by the size, sensation, and structural support of the reconstructed area post-surgery. When greater than 50% of the lips are removed before reconstruction, difficulty in bolus introduction is experienced by the patient. When the mental nerve on either or both sides is involved during the surgery, loss of sensation results in difficulty in maintaining oral competence even if the sphincter mechanism remains largely intact. The patient may also experience difficulty in bolus manipulation and drooling or loss of the bolus during preparation for swallowing. (Leonard 1997)

The anterior floor of the mouth contains structures that have responsibilities in hyoid elevation and the tongue elevation stages of swallowing. When tissue is lost in this area, difficulty in bolus preparation and propulsion for the oral cavity in the pharynx results from a loss of tongue maneuverability. If the lingual nerve and the hypoglossal nerve are involved in the resection, problems with the tongued sensation, taste, and tongue mobility will result. Physicians have to be careful not to limit posterior tongue mobility by closing the defect so that the tongue is pulled anteriorly. (Leonard 1997)

Loss of portions of the tongue after cancer surgery can significantly impact oral and pharyngeal movement of the bolus. Anterior defects are most likely to cause the most problems with oral bolus manipulations and difficulty in propelling the bolus in to the pharynx, especially if the tongue cannot contact the palate. The pharyngeal phase is effected when loss of posterior tongue tissue occurs, resulting in difficulty in generating the forces required to propel the bolus into the upper esophagus. Many times if cancer is in the anterior of the mouth, tongue or lateral

pharyngeal wall it will infect the mandible as well. (Leonard 1997) Care must be taken in mandibular and maxillary osteotomies as well, as nerves in the jaw that control sensations in the lip and lower anterior portions of the mouth can affect movement of a bolus through the oral phase of the swallowing mechanism. (Williams 2011)

Surgical and cancerous caused defects of the hard palate result in oro-nasal fistulae. A fistula causes an open chamber instead of a closed structure. This can allow bolus material can pass into the nasal cavity during the preparation for swallowing; causing manipulation of the bolus to become almost impossible, as the tongue cannot retrieve material from the nasal cavity. Defects in the palate cause difficulty with pressure generation and inefficient bolus transfer. Soft palate defects inhibit the dual sphincter function of the soft palate. It acts as the divide between the oral and pharyngeal cavities as it is fully relaxed and resting on the tongue base. It then elevates and divides the nasopharynx from the oropharynx during the pharyngeal phase of swallowing. Soft palate defects are difficult to reconstruct and therefore usually result in chronic dysphagia problems because of the lack of full closure and loss of pressure that allows the bolus to move inappropriately. (Leonard 1997)

The pharynx acts as a chamber that provides resistance to the posterior movement of the tongue base; generating pressures needed to propel the bolus through the pharyngoesophageal sphincter. Loss of portions of the pharynx can result in weakening of the pharynx walls and potential for residue from the bolus in the pharyngeal cavity. Patients complain of severe dysphagia when posterior portions of the pharynx are altered during surgery. (Leonard 1997)

Surgeries involving the larynx vary greatly as does the occurrence of dysphagia with them. Because of the slow growing nature of laryngeal cancer, sometimes only partial laryngectomies are needed, while many patients require total laryngectomies that result in removal of entire larynx, including the epiglottis, thyroid and cricoid cartilages, hyoid bone, true

and false vocal folds, aryepiglottic folds, pyriform sinuses, partial pharynx, strap muscles, portions of the tongue base, several rings of the trachea and possibly the ipsilateral lobe of the thyroid gland. As one might expect, a great many problems would result from this including the need for a synthetic epiglottis so that the patient would have a chance to be able to swallow properly at all. (Jones & Rosenberg 2010) Laryngectomy patients must rely on the forces generated by the base of the tongue against the pharyngeal walls to drive the bolus inferiorly. A “pumping” action of the tongue is often observed in these patients to help generate the increased pressures required to compensate for lack of the pharyngoesophageal sphincter opening. (Leonard 1997) One high note for total laryngectomy patients is that during reconstruction, many times the airway is separated from the digestive tract so aspiration is no longer a concern.

“When head and neck cancers invade the base of the skull, the impact on swallowing is often due primarily to the loss of cranial nerve function” (Leonard 1997) Weakening of the pharynx can occur due to tumor interference in the vagus and glossopharyngeal nerves and therefore the pharynx does not perform well and dysphagia can occur. Eventually the tongue can be affected, causing both the oral and pharyngeal phases of swallowing to struggle. (Leonard 1997)

As seen in the above paragraphs on the eight main structure groups, head and neck surgeries can have a large effect on whether or not a patient develops dysphagia as a side effect. Evaluations are done by a speech pathologist to determine whether or not a recommendation for therapy is the option that needs to be taken by the patient. Evaluations are done using stroboscopy to watch a person swallow for the oral and pharyngeal stages of the swallowing mechanism. Other methods using x-rays and colored dye are used to track a bolus through the swallowing stages. The information established by the tests are presented to a team of experts of different fields who decide on the diagnosis. After the diagnosis has been given, one must then address the issue of treatment.

3. Treatment of Dysphagia after Surgery

The gathered team must decide what type or types of therapy to recommend to the patient. There are three categories, behavioral, medical and surgical. Typical patients for behavioral therapy include patients who have had certain head and neck surgeries and cancers, so that is the category that will be discussed.

Behavioral therapies are directed to dysphagia patients when the strength, endurance and/or mobility of structures involved in swallowing are diminished. Weakness or limited movement of the mandible, lips, tongue, pharynx or larynx identifies the need for this type of therapy. Bedside testing can suggest what types or amounts of food materials they can safely have. (Leonard 1997) Womack states in her dysphagia food handbook that there are three categorized textures for solid foods and four levels of liquids that are recommended by a speech pathologist, nurse or dietician to the patients. The textures for solids are “Dysphagia Blenderized” where food has a moist, pudding-like consistency without pulp or small food particles, “Dysphagia Mechanical” consists of moist, soft-textured and simple-to-chew foods that form easily into a cohesive bolus; examples include moistened ground meats, soft mashable vegetables, and soft cooked fruits and mashed bananas, the third is “Dysphagia Advanced” where patients can have the same food as Mechanical except in regular texture with the exception of had, chunky food. The four categories for liquids are thin, nectar, honey and pudding. Commercial, synthetic thickener is used at each stage so that correct thickness is achieved. (Womack 1996) Treatment continues with a qualified professional who implements strategies that cater to each individuals need to get them as far away from their dysphagia problems as their post-surgical bodies will allow them.

4. Conclusion

In this paper, the affects on the human swallowing mechanism post-surgery of head/neck have been discussed. Examples in diagram and image form have been provided to show the reader the mechanisms that are affected when pieces of the complicated system of swallowing are tampered with. Through this research, I have seen what I can expect from a maxillary/mandible (or bilateral) osteotomy that I am going to be experiencing soon. Dysphagia is a side effect that many people do not know about, but by the numbers presented it is obvious that it is a very prevalent side effect. The amount of information available on the subject is great and that shows that the professionals who work with it have a passion for the people who suffer from it.

Works Cited

American Speech Hearing Association. www.asha.com

Groher, Dr. Michael E. and Crary, Dr. Michael A. Dysphagia: Clinical Management in Adults and Children. Mosby Inc. 2010.

Jones, Dr. Harrison N. and Rosenbek, Dr. John C. Dysphagia in Rare Conditions. Plural Publishing. San Diego, CA. 2010.

Leonard, Dr. Rebecca and Kendall, Dr. Katherine. Dysphagia Assessment and Treatment Planning. Singular Publishing Group, Inc. San Diego, CA 1997.

Pistorio, Ashley L. 2007

<http://www.medicalhistology.us/twiki/pub/Main/ChapterThreeSlides/HeadFaceNeckMuscles.gif>

Ward, Dr. Elizabeth C. and Morgan, Dr. Angela T. Dysphagia Post Trauma. Plural Publishing. San Diego, CA. 2009

Williams, Dr. Darren R. D.D.S. (Personal Oral and Maxillofacial Surgeon) Memphis, TN. January 2011

Womack, Pam. Scoop It... Mold It...Pipe It!!! 1996.