

Module One:
The Treatment of Excessive
Supragastric and Gastric
Belching and with Speech and
Language Therapy

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Preface

As part of my work at the Refluxzentrum at Spital Limmattal in Zürich over the past three years, I have become the first SLT in Switzerland to exclusively specialize in the treatment of air-associated disorders. In this assignment, I will critically analyze supragastric belching and propose an evidence-based treatment strategy, followed by a reflection on my scientific exploration of the pathophysiology of excessive gastric belching

1. Part One – A Critical Evaluation and Developing a Therapeutic Strategy

1.1 Introduction

Excessive belching can occur at a frequency of more than twenty events per minute (Ten Cate et al., 2018) and significantly impair the quality of life of those affected (Bredenoord & Smout, 2010). Until about 2005, high-frequency belching was commonly associated with the swallowing disorder known as **aerophagia** (Hemmink et al., 2010). In aerophagia, an excessive amount of air is swallowed into the stomach and intestines, which is later partially expelled through frequent burping from the stomach, referred to as **gastric belching** (GB), and increased flatulence (Bredenoord, 2010).

With the introduction of the intraluminal impedance and pH monitoring technique, new belching patterns were detected (Kessing, Bredenoord & Smout, 2014). In these kinds of belching events, air is inhaled or injected into the esophagus before being expelled again in a proximal direction within one second (Kessing, Bredenoord & Smout, 2014). The entering air typically does not reach the stomach, which is why this type of eruption is called **supragastric belching** (SGB) (Zad & Bredenoord, 2020).

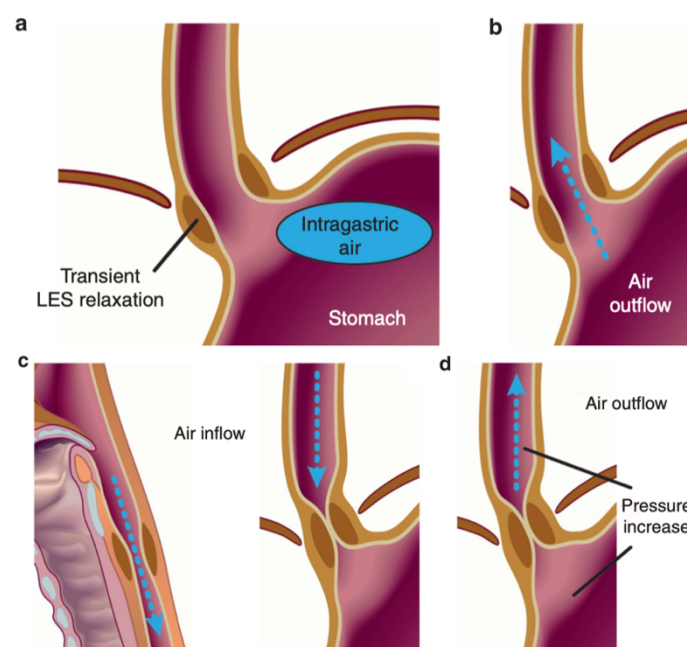


Figure 1: Airflow patterns in GB and SGB (Kessing, Bredenoord & Smout, 2014, p.1197). In a GB, air is initially swallowed into the stomach. Subsequently, a vagal reflex results in the expulsion of air through a single belch, which can occur up to 30 minutes later (a, b). In a SGB, air is inhaled or injected into the esophagus, before being expelled proximally within one second (c, d).

Since excessive GB and SGB significantly differ in terms of their pathophysiology (Paik & Gluckman, 2017), they also require different forms of treatment. While no controlled studies exist on the treatment of aerophagia or excessive GB (Bredenoord, 2013), expert opinion suggests reducing the amount of air swallowed (Gaziano, 2021). This can be achieved by altering the swallowing pattern or by decreasing the frequency of saliva swallowing, as confirmed in correspondence with Ten Cate (2021). The evidence base for the treatment of SGB looks more promising, with several studies demonstrating that SGB can be successfully managed with behavioural therapy – conducted by either SLTs (Hemmink et al., 2010; Ten Cate et al., 2018; Bolden & Gluckman, 2021; Punkkinen et al., 2022) or psychologists (Riehl et al., 2015; Glasinovic et al., 2017; Glasinovic et al., 2018; Sawada et al., 2019).

Reflux and esophageal hypomotility are two of the main triggers for excessive SGB (Koukias et al., 2015). In recent years, numerous studies have been published addressing the therapeutic treatment of reflux, notably Carvalho de Miranda et al. (2012) and Casale et al. (2016). Since reflux is a precipitating factor for SGB and also a primary cause of esophageal hypomotility (Popa et al., 2022), the training exercises presented in these studies should be incorporated into the established treatment modalities for SGB.

The first part of this assignment will therefore focus on the following research questions:

1. How does supragastric belching manifest in terms of its etiology and pathophysiology?
2. How is supragastric belching diagnosed?
3. Developing a therapeutic strategy: Which exercises and procedures can be used to treat supragastric belching in speech and language therapy?

1.2 Supragastric Belching – Etiology and Pathophysiology

In SGB, air is either sucked into the esophagus by generating negative intrathoracic pressure (air inhalation method) or forced into the esophagus by increased pharyngeal pressure (air injection method) before being expelled proximally within one second (Kessing, Bredenoord & Smout, 2014; Ten Cate et al., 2018). In the **air inhalation method**, a negative intra-esophageal pressure is caused by an aboral movement of the diaphragm while the vocal folds are closed (Kessing et al., 2012a). The opening of the upper esophageal sphincter (UES) can be facilitated by a head movement either in the anterior or cranial direction, as observed in videofluoroscopic recordings at Spital Limmattal (appendix 1, video 1). As a result, air is sucked into the esophagus (Hemmink et al., 2010). In the **air injection method**, the lips and the vocal folds are held in a closed position, while air is pushed into the esophagus (Ten Cate et al., 2018). Kessing, Bredenoord & Smout (2014) suggest that this occurs due to tongue root retraction, rather than peristaltic activation of the pharyngeal constrictors, while Hemmink et al. (2010) attribute it to pharyngeal contraction. Videofluoroscopic images of the air injection method captured at Spital Limmattal in Zürich show tightly pressed lips combined with a pharyngeal widening and slight laryngeal elevation, which opens the UES (appendix 1, video 2). Notably, the act of injecting or inhaling air does not induce esophageal peristalsis, as is typically observed in swallowing (Kessing, Bredenoord & Smout, 2014). Consequently, SGB cannot be classified as a swallowing disorder.

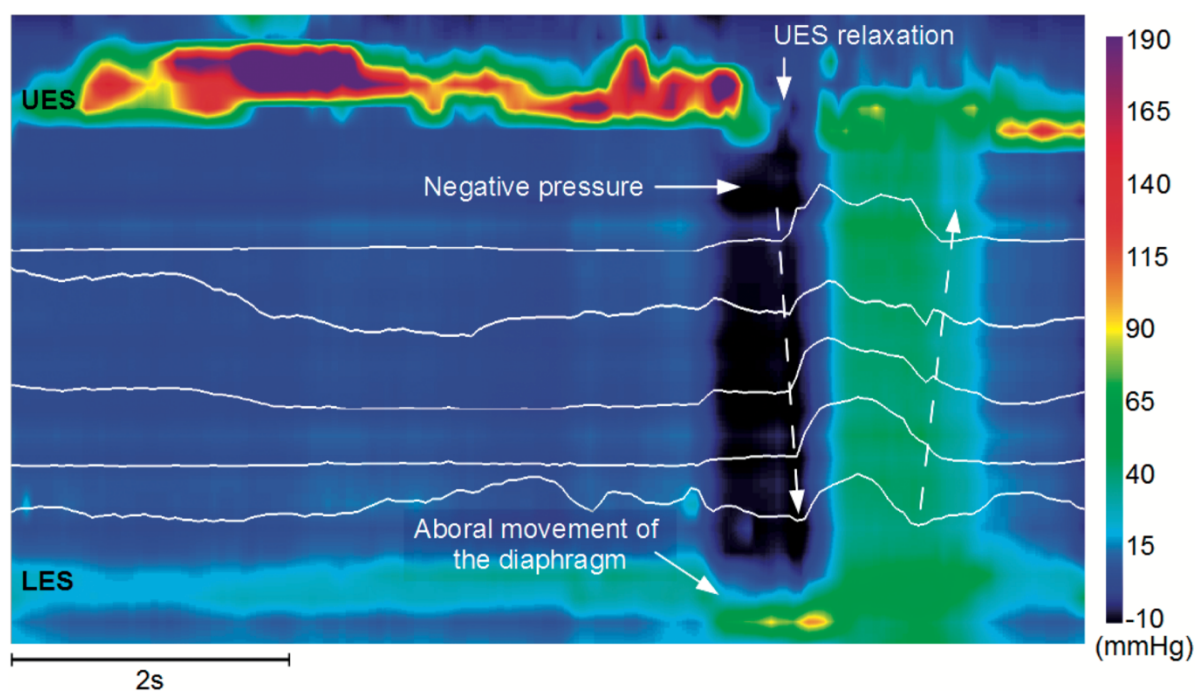


Figure 2: Image of a high resolution manometry (HRM) showing a SGB induced by the air inhalation method (Kessing et al., 2012a, p.93). With the vocal folds closed, an aboral movement of the diaphragm generates negative intra-esophageal pressure (indicated in black), sucking air into the esophagus, which is then expelled again within one second in the proximal direction. The impedance (white lines) first rises proximally, then distally, and then again proximally.

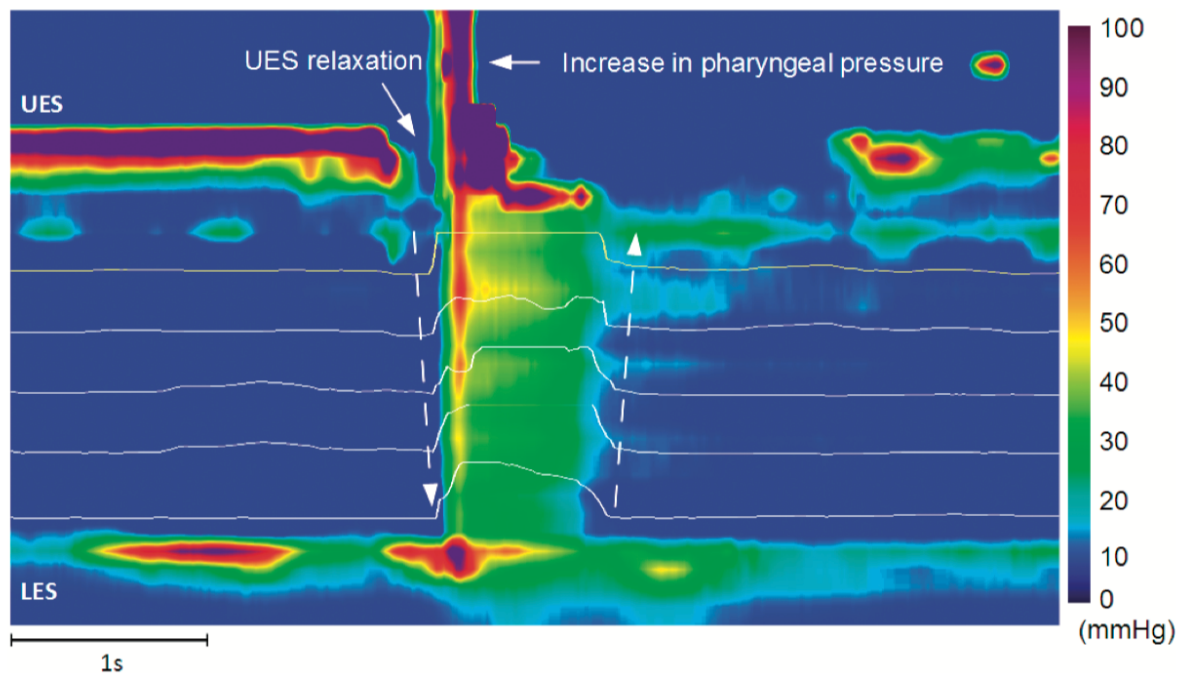


Figure 3: Image of a high resolution manometry (HRM) illustrating a SGB generated by the air injection method (Kessing et al., 2012a, p.93). In this technique, high pharyngeal pressure is built up (shown in red) with the lips and the vocal folds closed, pushing air into the esophagus before it is expelled proximally.

The underlying reasons why certain individuals develop more frequent or more severe SGB episodes compared to others are not yet fully understood. It is hypothesized that a particular discomfort in the esophagus or upper stomach region (Zad & Bredenoord, 2020) triggers the urge to belch. The **unpleasant feeling in the retrosternal region** may be provoked by **reflux (1)** or **esophageal hypomotility (2)** (Gluckman & Paik, 2017). High resolution manometry (HRM) studies by Elsafi et al. (2017) and Koukias et al. (2015) suggest that, although SGB has traditionally been associated with acid reflux, esophageal hypomotility is more frequently observed in these patients. Esophageal hypomotility therefore likely plays a more significant role in the development of SGB than previously believed. Additionally, videofluoroscopic observations of our team at Spital Limmattal indicated that patients with **significant amounts of swallowed air (3)** in the esophagus also exhibited more SGB episodes. Supported by Woodley et al.'s (2020) hypothesis on the etiology of “extraesophageal symptoms” (p.e10), it can be postulated that irritation or pressure on the esophageal mucosa – most likely caused by reflux, residual boli, air, or muscle tension in the esophagus – may trigger SGB through sensory-motor activation of vagal reflexes. Patients often report a sensation of an elevated pressure in the retrosternal region before the belch occurs (Koukias et al., 2015). While some experts consider these sensations to be paresthesia (Bolden & Gluckman, 2021), the clinical experience of our team at Spital Limmattal, along with the theory proposed by Woodley et al. (2020), suggests that patients' kinesthetic perception is, in fact, accurate.

The relationship between SGB and reflux resembles the chicken-and-egg dilemma, where a reflux episode can trigger SGB, while a forceful and deep SGB is also able to open the lower esophageal sphincter (LES), leading to reflux events (Popa et al., 2022). In this context, videofluoroscopic recordings conducted by our team demonstrate that supragastric belches are occasionally employed to push residual bolus fragments into the stomach (appendix 1, video 3). In this process, the air expulsion from the pharynx can be so strong that air is forced into the stomach, which would challenge the current definition of *supragastric* belching.

SGB is categorized a “behavioral disorder” (Hemmink et al., 2010, p.25), in which an unconsciously acquired action becomes self-perpetuating. Despite limited research on the connection between SGB and psychiatric conditions, cases of SGB have been reported in patients with anxiety disorders, depression, obsessive-compulsive disorder, and eating disorders (Popa et al., 2022). Typically, the treatment of behavioral disorders becomes more challenging as the psychological component increases (Harris, 2018). It is recommended that SLTs work closely with health care professionals to ensure holistic care without overstepping their professional boundaries (Gabbard, Crisp-Han & Hobday, 2014).

Symptoms are exacerbated under stress and when attention is directed toward them (Bredenoord et al., 2006), leading to the therapist often unintentionally becoming a trigger for more frequent SGB episodes. SGB does not occur during sleep (Karamanolis et al., 2010) and is significantly less frequent during active speech compared to listening, as noted by Ten Cate in personal communication (2021).

In addition to psychological influences, there are several activities that may promote the onset of a SGB event, as acknowledged in correspondence by Ten Cate (2021):

- Eating/drinking: can exacerbate esophageal motility issues or lead to increased air swallowing.
- Changes in posture, such as getting out of the car: can cause shifts in esophageal pressure.
- Lifting weights: can elevate pressure levels in the stomach and esophagus, and often involves breath-holding.
- Jogging: may result in breath-holding.

There are also precipitating sensations that a patient may experience just before a SGB occurs (Bolden & Gluckman, 2021). A common sensation might be an increased feeling of pressure

in the retrosternal area or in the neck just below the larynx, as confirmed in personal communication by Ten Cate (2021). In clinical practice, it is helpful for patients to recognize sensations and activities that may trigger SGB (Glasinovic et al., 2017). In such moments, the patient can pause and suppress the belch, for example, by using continuous diaphragmatic breathing with an open mouth (Katzka, 2013). The most important step in this therapeutic approach is that the patient does not hold their breath: when the vocal folds are open, it is mechanically impossible to push or pull air into the esophagus (Ten Cate et al., 2018).

Not only patients, but also healthy individuals engage in SGB, with a study by Koukias et al. (2015) indicating an occurrence of up to 13-15 times per day to be physiological. Excessive belching with several events per minute is observed exclusively in SGB (Bredenoord, 2010; Kessing, Bredenoord & Smout, 2014) – as shown in videofluoroscopic images taken at Spital Limmattal (appendix 1, video 4). These kinds of **belching attacks** can serve as a critical diagnostic indicator for the therapist to distinguish excessive SGB from GB in a clinical setting, without the need for an intraluminal impedance pH measurement. Additionally it can be stated that most patients seeking treatment for excessive belching are suffering from SGB rather than from excessive GB. This is due to the fact that patients experience SGB as bothersome, particularly when combined with a liquid reflux event, whereas GB are perceived as less troublesome (Kessing et al., 2012b). The instrumental diagnostics for SGB will be presented in the next section.

1.3 Supragastric Belching – Diagnosis

A clear diagnostic distinction between excessive SGB and increased GB can be ensured through intraluminal impedance and pH measurement (Bredenoord et al., 2004; Kessing et al., 2012a). SGB events are characterized by a rapid antegrade increase in impedance levels due to the direction of inhaled or injected air, followed by a return to the baseline caused by the fast expulsion of air in the proximal direction (Kessing et al., 2012b). In contrast, GB is marked by a retrograde movement of air, leading to a corresponding rise in impedance levels from the distal to the proximal esophagus (Kessing et al., 2012b).

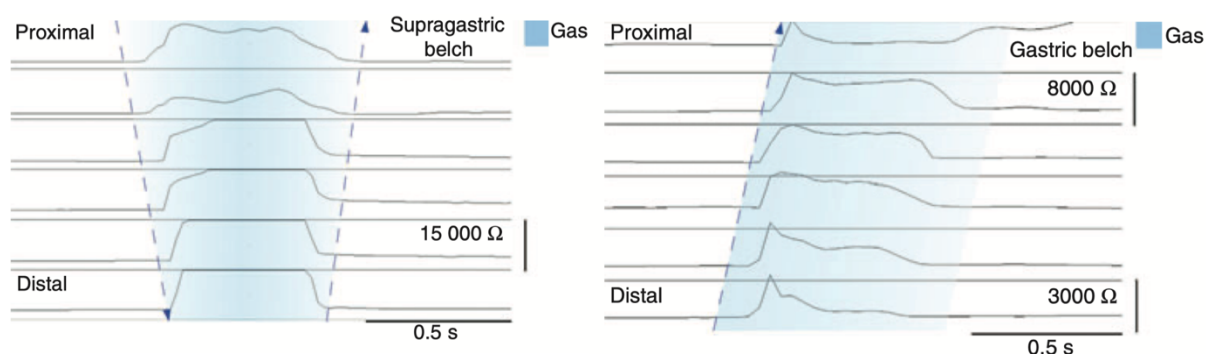


Figure 4: Intraluminal impedance pH measurement tracks of SGB and GB (Kessing et al., 2012b, p.1074). Left: Corresponding to the inhalation or injection and the subsequent expulsion of air in SGB, the impedance levels first rise proximally, then distally, and finally again proximally. Right: Reflecting the retrograde movement of air in GB, the impedance initially rises distally, and then increases proximally.

The intraluminal impedance and pH measurement also quantifies the amount and severity of reflux events a patient experiences within a 24-hour-period (Kessing et al., 2012c), which is important as reflux may precipitate SGB (Koukias et al., 2015). An additional high resolution manometry (HRM) can be used to determine whether the patient utilizes an inhalation or injection mechanism (see figures 2 and 3). However, assessing the state of the patient's esophageal peristalsis using HRM is even more critical, as hypomotility or aperistalsis may trigger SGB (Elsafi et al., 2017).

In the clinical setting, lateral video recordings can be utilized to observe characteristic signs of the injection or inhalation method, for example the forceful pressing of lips immediately before the belch in the injection method or a pronounced anterior movement of the head before a belching event in the inhalation method (Bolden & Gluckman, 2021). The different types of belches can also be clearly distinguished in videofluoroscopic recordings, although this technique has not yet become a standard diagnostic tool for this disorder.

1.3 A Suggested Strategy for the Treatment of Supragastric Belching in Speech and Language Therapy



Figure 5: Suggested Treatment Strategy for Supragastric Belching (SGB)

The key components of **behavioral therapy** for SGB are consistent across all examined published studies on this topic (Hemmink et al., 2010; Katzka, 2013; Riehl et al., 2015; Glasinovic et al., 2017; Ten Cate et al., 2017; Glasinovic et al., 2018; Sawada et al., 2019; Bolden & Gluckman, 2021; Punkkinen et al., 2022). These components include:

- Providing a comprehensive explanation of the disorder's mechanism and ensure cognitive comprehension by the patient.
- Enhancing self-awareness through the use of video and mirror feedback.
- Identifying warning signals and symptoms before belching, such as a sensation of increased pressure or tension in the retrosternal area or below the larynx.
- Practicing calm, continuous diaphragmatic breathing without breath-holding/stops, initially with the mouth wide open and the tongue placed against the upper front teeth to prevent air from being sucked or pushed into the esophagus.
- Implementing these techniques into daily life and regaining control over the unconsciously acquired, self-induced behavior.

Some therapists also employ additional strategies. Ten Cate (2018) emphasizes the importance of restoring normal function in the “linguo-laryngeal-cricopharyngeal complex” (p.710), for example through maxilla relaxation, laryngeal manipulation, or Boone’s voice facilitating techniques (Boone et al., 2020). Riehl et al. (2015) suggest the implementation of alternative behaviors, such as yawning or passive muscle relaxation, to help patients break away from the SGB mechanism. Our team has found it effective, especially with the injection method, to instruct patients to place a thumb below the chin. This helps them feel the activity of the base of the tongue (Chapman & Morris, 2021) and the laryngeal elevation (Bartolome & Schröter-Morasch, 2022), allowing them to better control and prevent these movements. Some authors emphasize the importance of guiding patients to identify and challenge “unhelpful thinking patterns linked to the belching” (Glasinovic et al., 2018, p.541), such as the belief that it is impossible to release air from the stomach by SGB (Bolden & Gluckman, 2021). However, videofluoroscopic images from our institution have demonstrated that this is indeed possible. In such cases, a deep SGB opens the LES, allowing air to completely escape from the stomach (appendix 1, video 5). In other instances, an intensive SGB causes the air to flow out of the stomach, only to be immediately pushed back in by a subsequent SGB (appendix 1, video 6). The results of our videofluoroscopic examinations indicate that mixed forms between SGB and GB are possible. Moving forward, it is essential for this knowledge to be disseminated among therapists so they can provide accurate information to their patients.

Since reflux and esophageal hypomotility are suspected to be two of the main triggers for excessive supragastric belching (Elsafi et al., 2017), and because esophageal hypomotility can be induced by recurrent acid reflux episodes (Popa et al., 2022), it is plausible to include **reflux management** as part of the treatment for SGB. Acid reflux is usually treated with dietary and lifestyle changes (Lechien et al., 2021), such as a higher protein diet, a lower intake of acidic foods, and elevating the head of the bed; medication (Wilkie, Fraser & Raja, 2018), including proton pump inhibitors (PPIs) and alginate; and, in severe cases, surgery (Hakanson et al., 2019). However, recent studies show that it can also be managed with therapeutic training exercises: either through **intensive breath work involving inhalation against resistance** (notable studies include Carvalho de Miranda et al., 2012; Casale et al., 2016; and Ong et al., 2018), or by using a small device called **IQoro**, which is inserted into the mouth and pulled anteriorly (Hägg, Tibbling & Franzen, 2015; Franzen, Tibbling & Hägg, 2018). Both therapy strategies showed an increase in the tone of the LES and a reduction of reflux symptoms (Carvalho de Miranda Chaves & Navarro-Rodriguez, 2015; Hägg, Tibbling & Franzen, 2015). A study by Zdrhova et al. (2022) showed that training with intensive diaphragmatic breathing was even able to restore some of the esophageal contractility (see Figure 6).

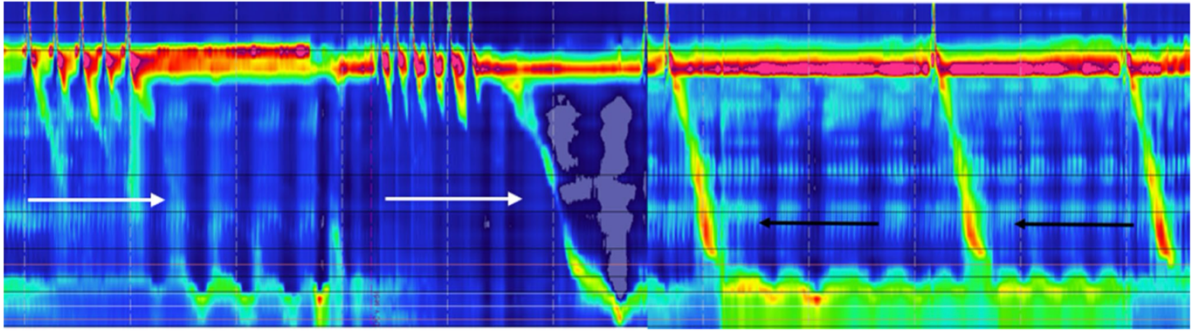


Figure 6: High resolution manometry (HRM) images by Zdrhova et al. (2022, p.612) displaying enhanced esophageal contractility resulting from intensive diaphragmatic breathing. The white arrows on the left indicate weak esophageal contractions during swallowing, while the black arrows on the right show stronger esophageal contractility.

Long-term training with the IQoro device has resulted in increased pharyngeal tension in some of our patients. In such cases, it may be beneficial to reduce the duration of the exercises or the number of exercise sessions per day (Hägg, 2024). If symptoms cannot be alleviated, training with the IQoro should be discontinued. Intensive breath work may cause light-headedness or restlessness (Bellissimo et al., 2020). In these situations, it is advisable to reduce the intensity of the exercises, take a break, or, in cases of severe side effects, stop exercising completely.

Pharmacological interventions could also prove helpful in severe cases. Studies by Kunte et al. (2015) and by Greenhill (2012) showed a significant decrease in the belching rate among patients suffering from excessive SGB with the use of the neuromodulators Pregabalin and Baclofen. While Baclofen inhibits the mechanosensitivity of vagal afferents peripherally (Kunte et al., 2015), Pregabalin is suspected to reduce chemosensitivity in the esophageal region, as confirmed by a small placebo-controlled study by Chua et al. (2012).

In summary, an effective treatment for SGB should not only incorporate established behavioral strategies but also address reflux management and include the use of neuromodulators such as Pregabalin and/or Baclofen in severe cases (Greenhill et al., 2012; Kunte et al., 2015) to optimize patient outcomes. The treatment strategy for SGB developed for this assignment (see figure 5) proposes the integration of (sphincter) muscle training to combat reflux and esophageal hypomotility, acknowledging that these factors significantly contribute to the development of SGB. This innovative approach (see appendix 2 for a list of handouts detailing the strategy) aims to minimize SGB by strengthening the LES and improving esophageal contractility, while also recognizing that well-established behavioral strategies remain essential and should continue to be integrated into the overall treatment plan.

2. Part Two – A Critical Reflection

2.1 A Critical Reflection on my Learning Journey and Practical Work with Air-Associated Disorders

In this section, I will reflect on my learning process and development as a practitioner. As I had never written a critical reflection on academic level, I initially referred to some of the well-known concepts to structure my learning process. While the **Reflective Cycle** by Gibbs (1988) and the **Reflective Model** by Schön (2017) were helpful, the **Experiential Learning Cycle** by Kolb & Kolb (2024) particularly resonated with me due to its systematic approach in four steps and its emphasis on reflection and practical application (see figure 7).



Figure 7: The Experiential Learning Cycle by Kolb & Kolb (2024, p.8)

Over the past three years, during my work at the Refluxzentrum at Spital Limmattal, I have dealt extensively with the treatment of air-associated disorders, particularly excessive SGB and GB. Having analyzed one of these two disorders in the first section of this assignment, I will now use Kolb & Kolb's framework (2024) to reflect on my growth as a learner and practitioner throughout this period, with particular focus on the insights gained during the process of writing this assignment.

2.2 Experiencing

Three years ago, Dr. Urs Zingg, head surgeon of the Refluxzentrum at Spital Limmattal, suggested I specialize in the treatment of air-associated disorders related to reflux. As a former reflux patient myself, I found the opportunity appealing and agreed. I quickly realized that this type of therapy was not widely offered in Switzerland, so I turned to the international literature, including pioneering work by Liesbeth Ten Cate (Hemmink et al., 2010; Ten Cate et al., 2018). The descriptions of the concrete speech therapy approach in the consulted articles seemed somewhat vague, though, leaving me feeling unprepared to treat patients effectively.

To bridge this gap, I arranged several online supervisions with Ten Cate. In practice, I found Ten Cate's approach to be helpful for many SGB patients. However, treating excessive GB or aerophagia proved more challenging. In my literature review, I encountered a lack of controlled studies (Bredenoord, 2013) and found that existing therapies were based solely on expert opinion, such as Gaziano (2021). I faced a dilemma: how could I treat a disorder with unclear pathophysiology and limited research on its therapy?

2.3 Reflecting

This situation raised the question of how a well-known disorder like aerophagia could still lack an evidence-based treatment. Could some expert conclusions be incorrect? For example, does excessive GB always result from increased air swallowing? Dr. Daniel Pohl, chief gastroenterologist at Universitätsspital Zürich, responded to my query with, "Yes, of course, where else would the air in the stomach come from?"

At this point, I felt myself moving through a whole turn in Kolb & Kolb's (2024) Experiential Learning Cycle. I experienced slight irritation at Dr. Pohl's remark (experiencing), but reflecting on my familiarity with hierarchical environments and working with highly discerning doctors, I recognized my resilience in handling critical feedback (reflecting). I then evaluated that the issue remained unresolved despite his authoritative stance (thinking) and concluded that the best course of action was to trust my instincts and continue questioning whether other factors could contribute to increased air in the stomach (acting). In this context, an interesting article by Cangemi & Lacy (2022) discussed potential causes of abdominal distention and bloating, such as diet, small intestinal bacterial overgrowth (SIBO), constipation, visceral hypersensitivity, and abdomino-phrenic dyssynergia. Conversations with nutritionist therapists revealed that food intolerances and SIBO can produce gas, but that it cannot flow back through the pylorus into the stomach, ruling out some potential causes for excessive GB. However, gastric hypersensitivity seemed plausible: could

it be possible that the vagal reflex that opens the LES (Kessing, Bredenoord & Smout, 2014) is triggered more quickly in individuals with gastric hypersensitivity, resulting in increased GB? Searching for supporting articles, I found studies by Tack et al. (2001) and by Farré et al. (2013) suggesting that increased visceral hypersensitivity is associated with a higher frequency of (gastric) belching. Despite these considerations, I couldn't dismiss the possibility that excessive GB may still be linked to increased air swallowing.

2.4 Thinking

I then considered how to objectively measure aerophagia. Studies by Hemmink et al. (2009) and Bredenoord (2013) used abdominal X-rays to determine excessive air cumulation in the intestines. This approach might help determine if a patient indeed suffers from excessive air swallowing.

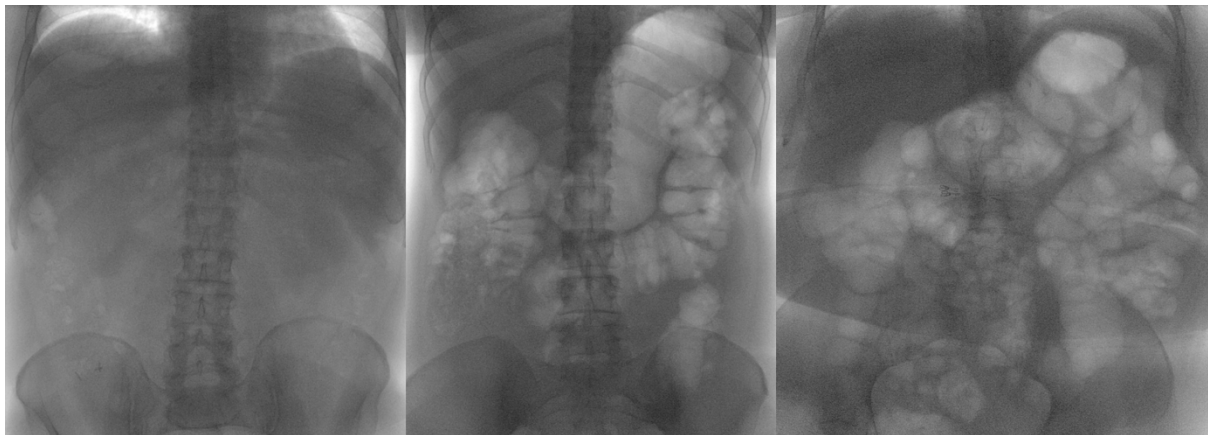


Figure 8: X-ray images showing minimal (left) and excessive air (middle, right) in the gastrointestinal tract (Frischknecht, 2024e).

Others, like Masui et al. (2021), measured air swallowing episodes using intraluminal impedance and pH measurements. I concluded that these methods might be worth trying in practice. Additionally, videofluoroscopy could potentially show the amount of air in the stomach and esophagus before and after meals.

2.5 Acting

I decided to put my ideas into action. First, I had a gastroenterologist on our team show me how to manually count air swallows in the tracks of the intraluminal impedance and pH measurement. For this, each counted air swallow must be at least 1000 ohms (Ω) above the baseline (Hemmink et al., 2009; Yazaki & Sifrim, 2022). However, I quickly realized that scrolling through these tracks was very time-consuming: it took about an hour and a half per

patient. Therefore, this method didn't seem practical for everyday practice, though it could prove very beneficial for research purposes. Could it be possible for technicians to develop a function in the intraluminal impedance pH measurement that would allow the automatic counting of air swallows?

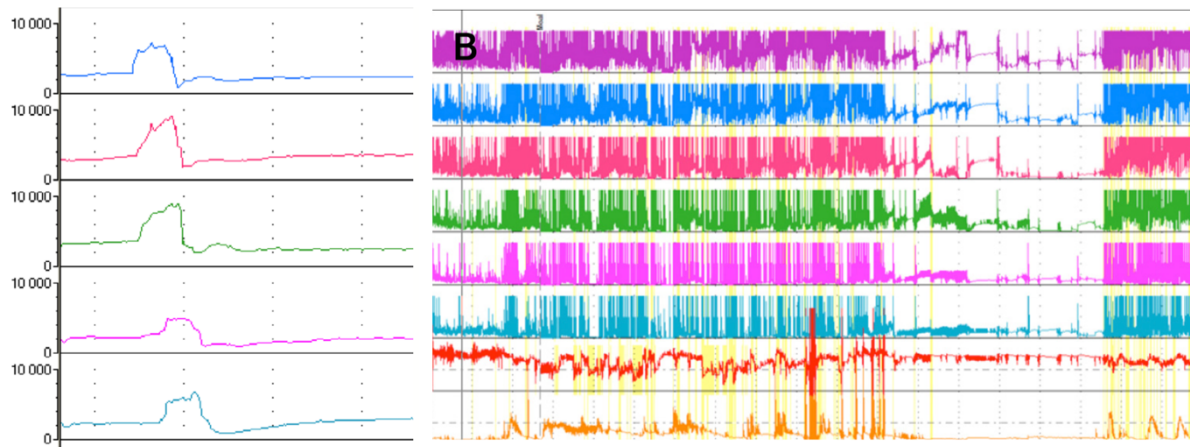


Figure 9: Left: Impedance patterns for an air swallow (Halb, Pomerleau & Faure, 2014, p.1011). Right: Full track of an intraluminal impedance pH measurement (Koukias et al., 2015, p.401).

Next, I completed training in videofluoroscopy. During my initial patient exams, it was fascinating to observe the air movements in the esophagus (appendix 1, video 7). I soon noticed that the gastric air bubble was not always more pronounced after the examination – just one GB was usually enough to empty the stomach of air. Reflecting on why air sometimes moves into the intestines, causing bloating and increased flatulence in aerophagia patients, I recalled the studies by Tack et al. (2001) and by Farré et al. (2013). It suggested that gastric hypersensitivity might determine how quickly GB occurs. Potentially, the earlier or the more frequent GB takes place, the less air is transferred to the intestines. Along with a **low LES tone (1)** and **delayed gastric emptying (2)** (both not discussed in this paper), **gastric hypersensitivity (3)** is now one of my current **working hypotheses** on the pathophysiology of excessive GB.

The most apparent hypothesis, however, remains that **specific swallowing techniques (4)** may influence the amount of air swallowed into the esophagus. Several factors may contribute to this:

- Bolus size
- Bolus consistency
- Swallowing speed
- Strength of the swallow

- Coordination of the swallow
- Unusual swallowing technique including tongue thrust or slurping (appendix 1, video 8)
- Intrathoracic pressure dynamics
- Anatomical conditions (such as a wide hypopharyngeal space)

I decided to collaborate with a multicentered team, including Spital Limmattal, Kantonsspital Baden, and the Schweizer Hochschule für Logopädie Rorschach, to investigate these factors using videofluoroscopy, abdominal X-rays and clinical swallowing assessments. We are currently preparing the ethics application.

Throughout my journey of dealing with air-associated disorders, I have observed significant growth as a learner and as a practitioner. My encounter with Dr. Pohl, although initially challenging, strengthened my resilience and enhanced my confidence in navigating complex situations. I have learned that reflection in practice is essential for personal and professional growth, as it enables me to continually assess my experiences and adapt to challenges by carefully considering my actions and their outcomes. My ability to critically analyze complex mechanical and biochemical issues has greatly improved over the course of this assignment, leading me to identify four working hypotheses regarding the pathophysiology of excessive GB, which I intend to investigate one by one. My passion for innovation in this field has grown as I aspire to generate knowledge that will ultimately improve the well-being of my patients.

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Glossary

Abdomino-phrenic dyssynergia: A paradoxical response of the diaphragm and the abdominal muscles that can occur after eating a meal. Instead of the natural physiological reaction, in which the diaphragm relaxes and the abdominal muscles contract to accommodate swallowed chyme and air, the diaphragm contracts (descends) and the abdominal muscles relax. This paradoxical movement creates more space in the abdomen for the accumulation of air, as well as exacerbating abdominal distention, discomfort, and bloating. In the context of aerophagia, abdomino-phrenic dyssynergia is a differential diagnosis to consider, as it can also result in an increased accumulation of air within the stomach and the intestines.

Aboral: Moving in the direction furthest away from the mouth.

Air-Associated Disorders: A collective term for excessive supragastric and gastric belching, as well as aerophagia. These conditions involve abnormal swallowing, inhaling, or injecting of air into the esophagus, sometimes affecting the digestive system. Symptoms include excessive belching, discomfort, bloating, abdominal distention, and flatulence.

APAP devices (Auto-titrating Positive Airway Pressure): A type of positive airway pressure machine used to treat obstructive sleep apnea. Unlike CPAP (Continuous Positive Airway Pressure) machines, which deliver a constant pressure throughout the night, APAP devices automatically adjust the air pressure based on the patient's needs. The device continuously monitors the patient's breathing patterns and adjusts the pressure to keep the airway open. This improves airflow and reduces apnea episodes during sleep. In the context of aerophagia, it has been reported that sleep apnea patients using CPAP devices may swallow a larger amount of air. In such cases, switching to an APAP device is recommended.

Aperistalsis (esophageal): A condition where normal muscle contractions (peristalsis) in the esophagus are absent or significantly reduced. This lack of movement hinders the passage of food and liquids, often causing discomfort and difficulty in swallowing (esophageal dysphagia).

Aerophagia: The excessive swallowing of air, which accumulates in the stomach and intestines. It can lead to symptoms such as frequent gastric belching, increased flatulence, bloating, and abdominal discomfort. In severe cases, it may cause complications that can be life-threatening.

Air inhalation method: A type of supragastric belching in which air is sucked into the esophagus by generating negative intrathoracic pressure. This is caused by an aboral

movement of the diaphragm while the vocal folds are closed, creating suction that draws air into the esophagus. After this, the air is expelled proximally within one second.

Air injection method: A type of supragastric belching in which air is pushed into the esophagus by increased pharyngeal pressure before being expelled proximally within one second. To push air into the esophagus, the lips and the vocal folds are kept closed. It is not yet fully understood whether the injection occurs due to tongue root retraction, contraction of the pharyngeal constrictors, slight laryngeal elevation, or a combination of these factors.

Antegrade: A term used to describe a forward movement in the normal direction of flow. When applied to the esophagus, it usually refers to the normal, forward movement of a bolus through the esophagus towards the stomach.

Behavioral therapy: A type of therapy that focuses on identifying and changing unhealthy behaviors. It is based on the idea that these patterns are learned through experiences and can be modified by altering an individual's learning and conditioning. The goal is to replace negative habits with positive ones through techniques like positive reinforcement, desensitization, and exposure therapy.

Belching: Also known as burping, belching can occur through two distinct mechanisms: gastric or supragastric. Both involve the release of air from the esophagus in a proximal direction. For more details, see the definitions of gastric belching and supragastric belching.

Belching attacks: A condition in which individuals must belch repeatedly in succession without interruption. It can involve as many as 20 belches per minute. Belching attacks occur exclusively with supragastric belching and can, in severe cases, resemble an episodic attack.

Bolus: A mass of swallowed food or liquid.

Constipation: A condition characterized by infrequent or painful bowel movements. It often involves dry, hard stools that are difficult to pass. This may lead to discomfort, abdominal pain, and a sensation of incomplete evacuation. In the context of aerophagia, constipation is a differential diagnosis to consider, as it can also result in an increased accumulation of gas within the intestines.

Contractility (esophageal): The ability of the esophagus to generate coordinated, rhythmic contractions that transport food and fluids from the pharynx to the stomach. Reduced activity or failure of esophageal contractility can lead to esophageal dysphagia and impaired clearance of reflux events from the esophagus.

CPAP devices (Continuous Positive Airway Pressure): A type of positive airway pressure machine used to treat obstructive sleep apnea. CPAP devices deliver a continuous, steady stream of air through a mask worn over the nose and mouth. The consistent backpressure helps to keep the upper airway open and reduces apnea episodes during sleep. In the context of aerophagia, it has been reported that sleep apnea patients using CPAP devices may swallow a larger amount of air. In such cases, switching to an APAP device (Auto-titrating Positive Airway Pressure) is recommended.

Computed Tomography (CT) Imaging: A medical imaging technique that uses X-rays and computer technology to create detailed cross-sectional images of the body. It is particularly effective for visualizing organs, bones, and certain soft tissues, such as those involved in the detection of tumors. CT imaging can also help analyze the movement of soft tissue and cartilages, such as the laryngeal cartilages. In contrast, MRI (Magnetic Resonance Imaging) is particularly skilled at imaging soft tissues like the brain, spinal cord, and muscles. Unlike MRI, CT imaging involves exposure to ionizing radiation, which may increase the risk of long-term health effects, including cancer.

Diaphragmatic breathing: Also known as belly breathing, diaphragmatic breathing involves the abdominal wall moving outwards during inhalation due to the contraction of the diaphragm and inward during exhalation, either due to elastic recoil or the activity of the abdominal muscles. In the context of supragastric belching, continuous diaphragmatic breathing can be used to prevent inhaling or injecting air into the esophagus, as the vocal folds remain open in this technique, making it impossible to push or suck air into the esophagus. Additionally, intensive diaphragmatic breathing involving inhalation against resistance can improve the function of the lower esophageal sphincter (LES), reduce reflux events, and increase esophageal contractility and peristalsis.

Distal: Farther from the origin of a structure or away from the center of the body. In the context of the esophagus, *distal* refers to the lower part of the esophagus, while *proximal* refers to the upper part, which is contrary to the usual anatomical convention where distal means farther away from the body's center. This is because the upper part is considered the origin of the esophagus.

Distal esophagus: The lower part of the esophagus, which transitions into the stomach through the lower esophageal sphincter (LES).

Excessive Gastric Belching: Frequent belching from the stomach, occurring more than 25-30 times per day.

Excessive Supragastric Belching: Frequent supragastric belching, occurring more than 13-15 times per day. Excessive supragastric belching often includes *belching attacks* with several events per minute.

Flexible Endoscopic Evaluation of Swallowing (FEES): A diagnostic procedure in which a flexible endoscope is inserted through the nasal cavity to visualize the pharynx, larynx, and the upper part of the trachea to observe the swallowing act. FEES helps to assess functional anatomy, airway protection, and swallowing efficiency by detecting pharyngeal residues, laryngeal penetration, and tracheal aspiration. It is typically performed using various bolus consistencies, such as fluid, semi-solid, and solid. Unlike the videofluoroscopic swallow study (VFSS), FEES has the advantage of avoiding radiation exposure. However, it does have limitations: it is not able to show the intradeglutitive process due to a white-out caused by the contraction of the pharyngeal constrictors, potentially leading to missed small aspirations. Additionally, it cannot diagnose the esophageal phase of the swallowing act.

Flatulence: Farting. The release of gas from the digestive tract through the rectum.

Gastric Belching: A type of belching in which accumulated air from the stomach is released through the esophagus, pharynx and mouth. In gastric belching, air is usually swallowed first before being vented during transient relaxations of the lower esophageal sphincter (tLESR), which are initiated by stomach distention through a reflex triggered by the vagus nerve. As air passes through the esophagus in the proximal direction, it initiates another reflex that relaxes the upper esophageal sphincter (UES), allowing the air to be expelled orally. In cases of delayed gastric emptying, gas produced during digestion in the stomach may also be released through a gastric belch. Gastric belching is a natural physiological process that prevents the accumulation of excessive gas in the stomach or intestines. Typically, a single gastric belch is sufficient to release all accumulated air from the stomach, which is why belching attacks with several events per minute do not occur in gastric belching. Unlike supragastric belching, gastric belching is generally not perceived as bothersome by patients.

Gastroenterology: The branch of medicine focused on the diagnosis and treatment of disorders related to the digestive system, which includes the esophagus, stomach, intestines (small and large), liver, pancreas, and gallbladder.

High Resolution Manometry (HRM): A diagnostic technique used by gastroenterologists to evaluate esophageal function by measuring and mapping pressure changes along the esophagus. The results are presented with high spatial resolution and the intensity of the pressures is shown in colors (warmer colors represent stronger pressures). HRM employs catheters with closely spaced pressure sensors to provide detailed information about

esophageal motility and sphincter function. It is used to diagnose disorders such as achalasia, esophageal dysphagia, gastroesophageal reflux disease (GERD), and eosinophilic esophagitis (EoE). In cases of supragastric belching, HRM can help determine whether esophageal hypomotility or aperistalsis are contributing factors to a patient's excessive supragastric belching. It is also able to reveal if a patient utilizes an inhalation or injection mechanism.

Hypersensitivity (visceral): A condition in which the internal organs, particularly the gastrointestinal tract, become unusually sensitive. This exaggerated sensitivity can lead to symptoms such as discomfort and bloating and is often seen in irritable bowel syndrome (IBS) or functional dyspepsia (FD). It is typically diagnosed with balloon distention to assess sensitivity. Pharmacological treatment may include tricyclic antidepressants (such as Amitriptyline, Nortriptyline, or Doxepin) or neuromodulators (such as Pregabalin or Gabapentin). Behavioral therapies and gut-directed hypnotherapy have also been shown to help manage symptoms and improve quality of life. In the context of excessive gastric belching, visceral hypersensitivity should be considered when evaluating why a patient belches more frequently than normal, as it may lead to a more rapid triggering of the vagal reflex associated with gastric belching.

Hypomotility (esophageal): A condition where the normal muscle contractions (peristalsis) in the esophagus are reduced in strength or frequency, leading to a less efficient transport of food and fluids. Typical symptoms include esophageal discomfort and dysphagia. In the context of air-associated disorders, esophageal hypomotility, in addition to reflux, is considered one of the precipitating factors that may contribute to the development of excessive supragastric belching.

Intraluminal impedance and pH monitoring: A diagnostic technique that combines pH monitoring, which detects changes in acidity, with impedance monitoring, which measures the resistance to electrical current flow between electrodes in the esophagus. Intraluminal impedance pH monitoring is typically performed over a period of 24 hours. It can identify acidic and non-acidic reflux, as well as differentiate between different swallowing events (such as saliva, bolus, and air swallowing) and types of belching (including supragastric and gastric belching).

Lower esophageal sphincter (LES): A ring muscle located at the junction between the esophagus and the stomach. It functions like a valve, regulating the passage of food and liquids from the esophagus to the stomach. Additionally, it prevents backflow (reflux) of stomach contents into the esophagus, helping to protect the esophageal mucosa from irritation and damage.

Magnetic Resonance Imaging (MRI): A medical imaging technique that uses strong magnetic fields and radio waves to create detailed images of the body's internal structures. MRI is particularly effective for visualizing soft tissues such as the brain, spinal cord, and muscles. Unlike CT imaging, MRI does not involve ionizing radiation, which makes it a preferred method for examining soft tissues and diagnosing conditions like tumors, tears, and inflammation.

Paresthesia: Abnormal sensations in parts of the body. It can manifest as prickling, tingling, or numbness. Paresthesia can also involve misperceptions of kinesthetic sensations, where patients may experience abnormal or distorted feelings related to movement or body position. These kinesthetic misperceptions can lead to sensations that don't align with actual physical stimuli or movements.

Proximal: Close to the origin of a structure or nearer the center of the body. In the context of the esophagus, *proximal* refers to the upper part of the esophagus, while *distal* refers to the lower part, which is opposite to the usual anatomical convention that proximal means closer to the body's center. This is because the upper part is considered the origin of the esophagus.

Proximal esophagus: The upper part of the esophagus, which is located close to the larynx and pharynx.

Reflux: Backflow of stomach contents into the esophagus, which can be acidic or non-acidic. In acid reflux, stomach acid moves into the esophagus, often causing irritation and symptoms such as heartburn. Non-acid reflux may include bile or undigested food and can also cause discomfort, but typically without the burning sensation associated with acid reflux. In the context of air-associated disorders, reflux, in addition to esophageal hypomotility, is considered one of the precipitating factors that may contribute to the development of excessive supragastric belching.

Retrograde: A term used to describe a backward movement against the normal direction of flow. When applied to the esophagus, it refers to the backward movement of a solid or fluid bolus, or air, toward the proximal esophagus, rather than toward the stomach.

Retrosternal: Area behind the sternum.

Small Intestinal Bacterial Overgrowth (SIBO): A condition characterized by an abnormal increase in bacteria in the small intestine. Typical symptoms include bloating, abdominal distention, and discomfort. It is usually diagnosed with the help of breath tests, small intestine fluid sampling, small bowel biopsies, stool tests, and imaging (such as ultrasound, CT, or MRI). Treatment usually includes antibiotics, with Rifaximin being the most commonly used medication. The optimal

diagnosis and treatment of SIBO are still debated among experts. In the context of aerophagia, SIBO is a differential diagnosis to consider, as it can also result in an increased accumulation of gas within the small intestine.

Supragastric Belching: A type of belching in which air is either inhaled or injected into the esophagus, before being expelled again in a proximal direction within one second. In supragastric belching, the air typically does not reach the stomach, which is why this kind of eruption is termed *supragastric*. Patients usually experience discomfort in the esophagus or upper stomach region, which may be caused by esophageal hypomotility, reflux, or an increased intake of swallowed air. Unlike gastric belching, supragastric belching is not believed to be triggered by a reflex but is considered a behavioral disorder, in which an unconsciously acquired action becomes self-perpetuating. Excessive supragastric belching can occur up to 20 times per minute (belching attacks) and has a significant impact on patients' quality of life.

Tongue thrust: A condition in which the tongue protrudes and presses against or between the front teeth during swallowing, speaking, or at rest. It can result from an abnormal swallowing pattern, where the tongue pushes forward instead of moving upward and backward. In the context of aerophagia, it is hypothesized that tongue thrust might increase the amount of air swallowed into the esophagus. This may occur because the forward movement of the tongue, just before the triggering of the reflexive swallowing phase, could create a larger air pocket behind the tongue root, which is then pushed back and down into the esophagus during the swallowing process.

Upper Esophageal Sphincter (UES): A ring muscle located at the junction between the pharynx and the esophagus. It functions like a valve, regulating the passage of food and liquids into the esophagus. Additionally, it prevents the backflow of bolus, liquids and stomach acid into the pharynx (regurgitation). When air flows back from the esophagus into the pharynx, passing through the (partially) closed upper esophageal sphincter, it produces the sound that is typically associated with belching.

Videofluoroscopic Swallow Study (VFSS)/Videofluoroscopy: An imaging technique that uses fluoroscopic X-ray technology to visualize and evaluate the swallowing process. It provides video recordings of the swallowing act, allowing for the assessment of functional anatomy, swallowing efficiency, and airway protection. Compared to the more commonly performed Flexible Endoscopic Evaluation of Swallowing (FEES), videofluoroscopy offers the advantage of capturing the entire swallowing act and enabling precise calculation of various parameters. This supports a highly accurate, hypothesis-driven approach to treating swallowing disorders. In the context of air-associated disorders, videofluoroscopy enables the

observation of the movement and volume of air in the esophagus, assesses the severity of supragastric belching, and determines whether esophageal hypomotility with residual bolus in the esophagus may contribute to the development of excessive supragastric belching.

Appendix I: An Analysis of Air-associated Disorders Using Videofluoroscopic Swallow Studies (VFSS)

Video 1: Supragastric Belching (SGB) – Air Inhalation Method (Frischknecht, 2024c)

Available at: https://youtu.be/h1_Ld3Y5488

This video shows a SGB produced by the air inhalation method. In this type of belching, a negative intra-esophageal pressure is generated by an aboral movement of the diaphragm while the vocal folds remain closed (Kessing, Bredenoord & Smout, 2012a). This causes air to be sucked into the esophagus. This video also reveals that the opening of the upper esophageal sphincter (UES) can be facilitated by an anterior movement of the head when the air inhalation method is applied. This is a new finding that hasn't been described in previous literature.

Video 2: Supragastric Belching (SGB) - Air Injection Method (Frischknecht, 2024d)

Available at: <https://www.youtube.com/watch?v=TX2bFI-eGak>

In this video, a SGB can be seen in which the air injection method is applied. In this type of belching, the lips and the vocal folds are tightly closed, and air is pushed down into the esophagus. Some experts, including Kessing, Bredenoord & Smout (2014), propose that this is achieved by tongue root retraction rather than by pharyngeal peristalsis. Conversely, other authors, such as Hemmink et al. (2010), attribute it to pharyngeal contraction. The patient in this video uses a technique characterized by tightly pressed lips, pharyngeal widening, and slight laryngeal elevation, which appears to open the UES.

Video 3: Use of Supragastric Belching (SGB) to Push Residual Bolus Fragments into the Stomach (Frischknecht, 2024e)

Available at: <https://youtu.be/PIPeBYMLfuM>

This video demonstrates how SGB can be utilized to push residual bolus fragments (solid, liquid) into the stomach. In some cases, the force of air expelled from the pharynx can be so powerful that it is pushed into the stomach. This observation challenges the traditional definition of *supragastric* belching, which states that air does not reach the stomach.

Video 4: Excessive Supragastric Belching (SGB) in the Esophagus (Frischknecht, 2024b)

Available at: <https://youtu.be/8oyRgseWvcw>

The two videos in this clip illustrate excessive SGB in the esophagus:

- The first video is recorded in the Fencer's Stance Position, where one hand and shoulder extend anteriorly while the other hand and shoulder project posteriorly to prevent obstruction of the esophagus in the videofluoroscopic images. The second video is shot in the traditional Anterior-Posterior-Position (AP).
- Excessive supragastric belching is defined as occurring more than 13-15 times per day (Koukias et al., 2015), but it can manifest up to 20 times per minute during a belching attack, significantly impacting patients' quality of life (Bredenoord & Smout, 2010). In the slow-motion visualization of severe cases, the movements of the esophageal walls reveal that, although the inhaled or injected air remains in the esophagus for only about one second or less, its intake appears to happen more rapidly than the subsequent expulsion of air.

Video 5: Deep SGB Opening the Lower Esophageal Sphincter (LES) for Complete Air Release from the Stomach (Frischknecht, 2024a)

Available at: <https://youtu.be/ZlvvaWo0vbA>

This video demonstrates that deep SGB can open the LES, allowing for complete release of the air from the stomach. This mixed type of SGB and GB has not been previously described in the literature and may explain why some patients report a feeling of relief after a SGB.

Video 6: Deep SGB Opens the LES for Complete Air Release and Reentry into the Stomach Caused by a Second SGB (Frischknecht & Albrecht, 2024)

Available at: <https://youtu.be/-o-UWFosbro>

In this video, an intensive SGB opens the LES, and causes air and other stomach contents to reflux into the esophagus, just before a subsequent deep SGB pushes both the air and bolus back into the stomach. This illustrates that, under certain circumstances, it is possible for air to leave the stomach in a proximal direction without being expelled through the mouth, only to reenter the stomach again.

Video 7: Air Movements in the Esophagus (Frischknecht & Bruggisser, 2024a)

Available at: <https://youtu.be/wQhu6wmZSSE>

This video shows the passage of swallowed air through the esophagus into the stomach in three different patients. The first patient was suspected of suffering from aerophagia, but in fact, had gastroparesis and exhibited one of the smallest amounts of swallowed air among all patients we have diagnosed with videofluoroscopy at Spital Limmattal. The second patient demonstrated an increased amount of swallowed air, and the antegrade movement of the air through the esophagus was clearly visible, creating small bubbles upon entering the stomach. The last patient exhibited a moderate amount of swallowed air; however, due to a stuck solid bolus and suboptimal esophageal peristalsis, the air repeatedly moved between the distal and proximal sections of the esophagus.

Video 8: Tongue Thrust and other Unusual Swallowing Techniques (Frischknecht & Bruggisser, 2024b)

Available at: <https://youtu.be/1VJeJcqSC7Q>

In this clip, four different types of unusual swallowing techniques are presented that may lead to increased air swallowing:

- The first video shows a patient using the tongue thrust technique, where the tongue protrudes and presses between (or against) the front teeth during swallowing. This creates an air pocket behind the base of the tongue just before the reflexive part of the swallowing act, which may lead to the swallowing of that air.
- The second video demonstrates a patient who is slurping, meaning the patient is sucking in air while taking in a fluid bolus (small air bubbles can be seen forming at this moment). The increased intake of air into the oral cavity may result in air being swallowed during the following swallow.
- The third video shows a patient who appears to press air into the esophagus while reswallowing. Unlike in SGB, the air pressed into the esophagus does not seem to rise up again proximally. The technique used by this patient is not yet known or fully understood by our team.
- The fourth video illustrates a patient with a low position of the back of the tongue, allowing a substantial air bubble to accumulate between the bolus and the soft and hard palate before swallowing. It seems plausible that the amount of air in this space could impact the volume of air that gets swallowed.

Appendix II: A Suggested Treatment Strategy for Supragastric Belching – Handouts

On the following pages, some handouts for patients are presented that show how the *Suggested Treatment Strategy for Supragastric Belching (SGB)* developed in Part 1 of the assignment can be implemented in practice.

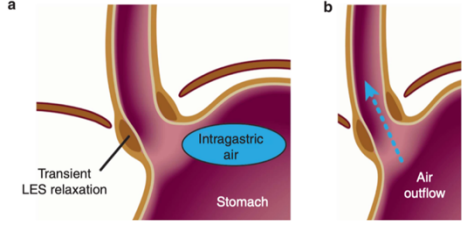
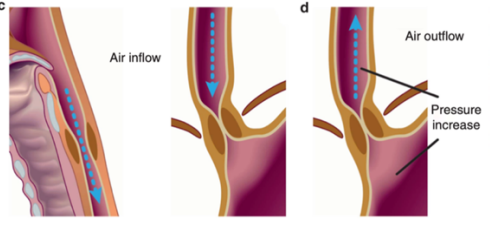
Note:

- Due to the limited word count, the disorder **excessive gastric belching (GB)** could not be covered in as much detail in the theoretical part of the assignment as **supragastric belching (SGB)**. In therapeutic practice, however, it has proven particularly helpful for patients to compare the two disorders in order to better understand their respective pathophysiologies. This approach is illustrated in the first handout "Gastric and Supragastric Belching" on p.38.
- The handouts on the following pages are designed for the treatment focus of speech and language therapy or psychological intervention. The medical or surgical treatment of reflux, as well as pharmacological therapy for excessive SGB, fall within the physician's area of responsibility. As part of anti-reflux management, a nutritional therapist is often involved as well.

The handouts on the following pages are presented in the following order:

- Handout 1: Gastric and Supragastric Belching (theoretical comparison of the two disorders)
- Handout 2: Emergency Breathing to Treat Supragastric Belching
- Handout 3: Stop Supragastric Belching with a Thumb Below the Chin and Breathe Away Discomfort with Subsequent Diaphragmatic Breathing
- Handout 4: Anti-Reflux Therapy with the IQoro
- Handout 5: Inspiratory Breath Work

Handout 1: Gastric and Supragastric Belching

	Gastric Belching (GB)	Supragastric Belching (SGB)
	 Figure 10: In GB, air reaches the stomach (Kessing, Bredenoord & Smout, 2014, p.1197).	 Figure 11: In SGB, air usually <u>does not</u> reach the stomach (Kessing, Bredenoord & Smout, 2014, p.1197).
Normal frequency	Up to 25-30 times/day	Up to 13-15 times/day
Origin of belching	Reflex (vagus nerve)	Unconsciously acquired behaviour that can be voluntarily influenced
Mechanism	Air is swallowed into the stomach beforehand - When eating or drinking - When swallowing saliva	Pushing: air is pushed into the esophagus <u>with the lips pressed together</u> and a <u>backwards motion of the base of the tongue</u> and/or a <u>contraction of the pharyngeal constrictors</u>. Sucking: air is sucked into the esophagus by <u>moving the head forwards</u>, which opens the upper sphincter of the esophagus, and <u>lowering the diaphragm</u>.
Caused by	- Unphysiological swallowing pattern - Frequent swallowing of saliva (due to reflux, anxiety, stress) - Hypersensitivity in the stomach area - Tic - Sleep apnea: CPAP devices	Irritation of the esophagus due to: - Esophagus that is too weak or contracts irregularly - Reflux - Excessive air in the esophagus due to increased air swallowing
Belching attacks	No	Yes
Diagnostics	24h impedance pH monitoring - Videofluoroscopy - Abdominal X-ray in the late afternoon	24h impedance pH monitoring - Video recording - Observation of the belching mechanism
Therapy	- Change in swallowing technique - Reduction in the number of swallows - Anti-reflux treatment - Medication (e.g. Clonazepam) - Sleep apnea: APAP device instead of CPAP device	- Cognitive comprehension of the belching mechanism - Diaphragmatic breathing without breath-holding/stop - IQoro - Intensive breath work: inspiration against resistance - Anti-reflux treatment - Pharmacological treatment in extreme cases (Pregabalin, Baclofen)

Handout 2: Emergency Breathing to Treat Supragastric Belching

- > Do this for 2-5 minutes each time you **feel a discomfort** in the stomach, behind the sternum or in the esophagus.
- > Additionally, do this whenever you encounter **other triggers** in everyday life, e.g.:
 - After a meal
 - When changing position:
 - From lying to sitting
 - When getting out of the car
 - When working out at the gym
 - When jogging
 - In difficult emotional situations

Instructions

1. Open your mouth wide and breathe in and out slowly through your mouth.
2. Imagine your throat is very wide, like a pipe.
3. Place one hand on your abdomen and the other on your chest: only the hand on your abdomen should move.
 - Inhalation: belly moves outwards
 - Exhalation: belly moves inwards
4. Count your breath internally: inhale for a count of 6, exhale for a count of 6.
5. Don't stop your breath flow, it should be continuous!
6. Practice different exercise levels:
 - Mouth wide open with cork in the mouth
 - Mouth wide open without cork
 - Mouth slightly open, tip of the tongue behind the upper front teeth
 - Mouth closed

Practice continuous diaphragmatic breathing in the following positions first:



1. lying on the back



2. lying on the side



3. sitting



4. standing

Figure 12: Continuous diaphragmatic breathing can be practiced in four positions (Thyme-Frøkjær & Frøkjær-Jensen, 2014, pp.95-98).

Why is diaphragmatic breathing helpful to treat supragastric belching?

- In order to produce supragastric belching, a **breath-hold** is needed to suck or push the air into the esophagus, requiring the vocal folds to be closed. If diaphragmatic breathing is continuous (and therefore the vocal folds remain open), **supragastric belching becomes mechanically impossible**.
- The esophagus and trachea share a wall. If there is excess pressure in the esophagus, diaphragmatic breathing can help **equalize the esophageal pressure**, as the increased airflow in the trachea can push against the esophagus.
- Deep diaphragmatic breathing lowers the abdominal organs, reducing **pressure on the stomach**. This decreases the number of reflux episodes.
- Deep, slow breathing **calms the autonomic nervous system**. The relaxation of the body and mind helps to reduce the urge to constantly push or suck air into the esophagus.

Handout 3: Stop Supragastric Belching with a Thumb Below the Chin and Breathe Away Discomfort with Subsequent Diaphragmatic Breathing



Figure 13: Placing a thumb below the chin can help monitor sublingual movement and prevent supragastric belching (Frischknecht, 2022, p.65).

Instructions

1. As soon as you realize that you need to belch, immediately place your thumb below your chin. The base of the tongue must not move.
2. Open your mouth wide and breathe in and out slowly through your mouth.
3. Imagine your throat is very wide, like a pipe.
4. Place one hand on your abdomen and the other on your chest: only the hand on your abdomen should move.
 - Inhalation: belly moves outwards
 - Exhalation: belly moves inwards
5. Don't stop your breath flow, it should be continuous!
6. Breathe into your belly without stopping until the feeling of pressure in your esophagus decreases.

Handout 4: Anti-Reflux Therapy with the IQoro



Figure 14: The IQoro device (Hägg, 2024).

1. Place the long, round end of the IQoro between your lips and your front teeth.
2. Press your lips together loosely and pull the IQoro firmly forwards – as if you are trying to pull it out of your mouth.

Training:

- Pull for 3 sets of 10 seconds each.
 - Pause for 3 seconds between each pull.
 - Exercise 3 times a day (before each main meal).
- = Train 90 seconds per day.**

Tips:

- **Double the repetitions for the next training session** if you have not been able to practice during the day or have forgotten a session.
- If possible, do not miss any sessions. Only **consistent use** over several months can achieve a satisfying result!
- You can use the free **IQoro app** to receive **reminders** for your training sessions.

Training with the IQoro strengthens your muscles:

- the sphincter between the esophagus and the stomach
- the sphincter between the pharynx and the esophagus

By strengthening these two muscular sphincters, less stomach acid and a smaller amount of stomach enzymes (including pepsin) will enter your esophagus, larynx, and pharynx.

Order your IQoro here: www.iqoro.com

Handout 5: Inspiratory Breath Work



Figure 15: The Aerofit Active device (Aerofit, 2024).

1. Set up a breath work trainer, such as the *Aerofit Active* or the *Aerofit Pro*, so that you **inhale against resistance**.
2. Bring the breath work trainer to your mouth and **breathe deeply into your belly**.

Training:

- Inhale 40 times to your maximal capacity against resistance.
- Exercise twice per day.
- Train for at least 8 weeks.

Tips:

- It is recommended to **start training with 30% of the Maximum Inhalation Force (max. IP)**.
- If this is not possible to measure max. IP, you should start with a resistance that feels comfortable for you. It should challenge you but **not cause dizziness**.
- If you **experience light-headedness** or **inner restlessness** during training, this is a reaction from your autonomic nervous system. In this case, reduce the intensity of your training or take a break.
- **Increase the level of resistance each week by 5% of the Maximum Inhalation Force (max. IP)** or increase the resistance slightly (e.g. from level B to level C on the *Aerofit Active* device).

Breath work involving inspiration against resistance strengthens the passage between the esophagus and the stomach. This means that less stomach acid and a smaller amount of stomach enzymes (including pepsin) will enter your esophagus, larynx, and pharynx.

Appendix III: A Personal Development Plan (PDP)

Plan the empirical modules of the MA during the early stages of the course.

1.	Objective	Determine which empirical projects I would like to carry out as part of the Master's degree (MA).
	Action	Several online meetings with Debbie Winter. Discuss which topics interest me, how they could be implemented in practice, and what support I need from external experts to realize these projects.
	Timescale	The first two online meetings took place in August 2024. Another meeting would be possible in October or November once I have spoken to Dr. Claudio Storck from Universitätsspital Basel.
2.	Objective	Idea 1: Carry out a prospective single-case study using CT imaging to measure pharyngeal width and laryngeal height when producing an accent from the belly wall, according to the accent method developed by Svend Smith in 1937.
	Action	Talk to Dr. Silke Potthast, head radiologist at Spital Limmattal, to find out whether such a study would be feasible and how much it would cost (answer: yes, free of charge). Call the ethics committee of the Canton of Zürich to determine whether an ethics application is required for a single-case study using CT imaging (answer: no). Consult with Dr. Claudio Storck, laryngologist at Universitätsspital Basel, to find out how long the individual images may be to ensure that permissible radiation exposure is not exceeded.
	Timescale	Meeting with Dr. Silke Potthast: took place in August 2024. Telephone call with the ethics committee of the Canton of Zürich: took place in August 2024. Discussion with Dr. Claudio Storck: in October or November 2024.

3.	Objective	Idea 2: Conduct a retrospective study using CT scans of singers to analyze the movements of the cricoid and thyroid cartilages in the voice quality of belting.
	Action	Speak to Dr. Claudio Storck to find out if I could use their existing CT scans of singers for a retrospective study and whether sound recordings of the notes sung are available. Phone the ethics committee of the Canton of Zürich to determine if an ethics application is required for this study. If this is all feasible, request that the CT data of the singers be transferred electronically to the radiological system (Merlin PAKS) of Spital Limmattal.
	Timescale	Discussion with Dr. Claudio Storck: in September or October 2024. Telephone call with the ethics committee of the Canton of Zürich: in October or November 2024. Transfer of data: by June 2025.
4.	Objective	Idea 3: Carry out a prospective laryngoscopy study on the activity of the pharyngeal constrictors and the epilarynx.
	Action	Speak to Dr. Salome Zwicky to determine whether I can perform laryngoscopic examinations on patients within our practice on my own, as opposed to only when a doctor is present in the room. If this is not possible, organize such examinations at Spital Limmattal. Recruit about 20 singers who are willing to participate in this study.
	Timescale	Meeting with Dr. Salome Zwicky: in October 2024. Recruit singers: by September 2025.

Acquire and Generate Knowledge (Air-Associated Disorders)

1.	Objective	In collaboration with Kantonsspital Baden (KSB) and Schweizer Hochschule für Logopädie Rorschach (SHLR): Conduct a study using videofluoroscopy to examine the pathophysiology of <i>supragastric belching</i> and <i>aerophagia</i> .
	Action	Write Module One of the MA at UWTSD on the topics of <i>supragastric belching</i> and <i>aerophagia</i> in order to prepare the theoretical framework of the study. Hold various meetings with the specialists from the other two institutions to set up the study. Assist in preparing the ethics application. Assist in searching for sponsors (in a supporting role).
	Timescale	Complete the assignment for Module One: by the end of October 2024. Meetings with the specialists from KSB and SHLR: ongoing. Write the ethics application: by June 2025. Search for sponsors: until June 2025.
2.	Objective	Follow the latest developments in the field of <i>air-associated disorders</i> .
	Action	Continued reading of newly published scientific articles on this topic. Online supervision sessions with the pioneer Liesbeth Ten Cate from Holland.
	Timescale	Both: ongoing.

Acquire and Generate Knowledge in addition to Developing Technical Skills (Voice)

1.	Objective	Enhance my interpretation skills for laryngoscopic images.
	Action	Online supervision sessions with Tom and Sara Harris for nearly every new voice therapy patient, during which the patients' laryngoscopies are analyzed in detail. Joint laryngoscopies with Dr. Salome Zwicky and Dr. Kathrin Degenhardt, both experienced laryngologists.
	Timescale	Ongoing.
2.	Objective	To be officially authorized to perform laryngoscopies/endoscopies without medical supervision.
	Action	Acquire the official certificate for the <i>Flexible Endoscopic Evaluation of Swallowing</i> (FEES) procedure, so that I can perform endoscopies on my own. To obtain this certificate, four tasks must be completed and passed: 1. basic course with theoretical examination, 2. 30 directly supervised endoscopies, 3. 30 indirectly supervised endoscopies (no supervisor in the room, but one available for questions), 4. final practical examination.
	Timescale	Basic course with theoretical examination: completed in November 2023. 30 directly supervised endoscopies: completed in January 2024. 30 indirectly supervised endoscopies: ongoing, expected to be completed by spring 2025. Final practical examination: expected around summer 2025.
3.	Objective	Improve my ability to evaluate and objectively calculate radiological findings (videofluoroscopy, X-ray, CT).
	Action	Conduct videofluoroscopies and X-rays (abdomen). Ask my colleague Johanna Albrecht to demonstrate how to calculate two-dimensional areas on videofluoroscopic and X-ray images. Request that radiologist Dr. Silke Potthast shows me how to calculate volumes on CT images. Have Dr. Claudio Storck show me how best to evaluate the movements of the cricoid and thyroid cartilages on CT images. Analyze and calculate CT images as part of my MA assignments.

	Timescale	Perform and analyze videofluoroscopies/X-rays: ongoing. Two-dimensional calculation (Johanna Albrecht): carried out in August 2024. Three-dimensional calculation (Dr. Silke Potthast): by March 2025. Analyze movements of the cricoid and thyroid cartilages (Dr. Claudio Storck): by September 2025. Analyze and calculate CT images: in Module Three and in one of the later modules of the MA.
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Career Planning

1.	Objective	Write a comprehensive book on the topics of <i>voice therapy</i> and <i>laryngoscopic diagnostics</i> , which will be unique in its structure (the second book in the <i>Reset Your Voice</i> series).
	Action	Write the final draft. Discuss with the publisher (ProLog) who will create the images, what they will cost, and in what kind of format the book will be released. Produce demonstration videos.
	Timescale	Write the final draft: completed by the end of August 2024. Speak to the publisher: done in September 2024. Shoot videos: in February/March 2025. Planned date of publication: end of 2025/beginning of 2026.
2.	Objective	Publish the second <i>Reset Your Voice</i> book in English.
	Action	Once the German version is published: translate the text into English using www.deepl.com . Review the translation personally. Hand it over to Tom and Sara Harris, who offered to complete the final translation for me. Contact Noel McPherson at Compton Publishing, the English publisher with whom I would like to work with (Tom and Sara Harris will introduce me to him).
	Timescale	If the German version is published by the beginning of 2026 at the latest, it should be possible to launch the English version at the end of 2026/beginning of 2027.
3.	Objective	Become an internationally recognized speaker on various speech and language therapy topics.
	Action	Hold multiple lectures and courses on the subjects of <i>voice therapy</i> , <i>singers and voice disorders</i> , <i>laryngeal manipulation and manual therapy in the anterior neck area</i> , as well as <i>air-associated disorders</i> .
	Timescale	Ongoing. The next lectures and courses will take place at the beginning and end of November 2024 in Zürich, in March 2025 in Vienna, in April 2025 in Bern, in July 2025 in Silvaplana, and in September 2025 in Cologne

4.	Objective	Work in the field of speech and language therapy research.
	Action	Complete the MA with VSC at UWTSD (a Master's degree is required for a research position at Schweizer Hochschule für Logopädie Rorschach). Carry out as many empirical projects as possible during the MA and aim to publish parts of assignments. Focus primarily on quantitative research as it is more frequently conducted than qualitative research at Schweizer Hochschule für Logopädie Rorschach.
	Timescale	Finish MA: by October 2027 at the latest (I may have to take a six-month study break due to the publication of the second "Reset Your Voice" book)