

BMPF7013

Undertaking Research in Workplaces

Julia Mihalich

***A Study into Spinal Alignment as an Aid Towards the Development of Healthy
Vocal Function and Quality***

The Portfolio

Planned Program of Study

Postural misalignment in singers has become increasingly more prevalent due to our sedentary lifestyles. This essay aims to examine how to improve spinal alignment through myofascial release, static stretches, and various relevant exercises in the studio. The influence of a range of factors on spinal alignment was investigated to ascertain if preventative measures can be taken against postural misalignment in singing students.

In order to achieve this aim, the following objectives have been set:

1. To evaluate correlations between posture and phonation.
2. To explore relationships between indicators of voice quality and postural alignment.
3. To critically assess the individual postural concerns of each student.
4. To examine the potential effect of Kinesthetic awareness, Static stretching, and Self-myofascial release on postural alignment.

Preparatory Rationale

Posture, or more specifically, optimal postural alignment, has been a popular topic amongst vocal pedagogues. It is generally agreed that most vocal pedagogues recognize, to some degree, the importance of optimal postural alignment in singing. I have found that during the course of a vocal lesson, a student's posture may either be addressed too often or too little. Often times the student is not given an explanation as to how or why posture can impact the voice. A few common phrases often heard in a voice studio include: "head in line with the spine," "chest up," "shoulders back," "feet hip-width apart straight." As a student, I encountered similar instruction among other vague references to "good posture" and I was never given any

explanations as to 'why' good posture was relevant to singing. It was not until I took an introductory vocal pedagogy course in my second year at university that I was taught how and why posture affects the voice. Because the emphasis on my posture was never really addressed, poor postural alignment while singing has become a habitual issue for me.

There are copious amounts of vocal pedagogy texts addressing how a singer may achieve good alignment. There are also many studies regarding the effects of posture on vocal production. Many of these works have helped to establish the importance of postural alignment in the vocal community. However, the most commonly used pedagogical publications often provide a physical description of 'good' posture or a list of reasons how posture can positively affect the singing voice. Most of these works do not address corrective measures that can be taken in the studio other than giving verbal reminders, showing detailed illustrations, or physically adjusting a student's position. One of the goals of the vocal pedagogue should be to help students achieve habitually good postural alignment. I believe that this may be accomplished by working with the spinal column and surrounding muscles through the use of methods such as physical stretches, postural exercises, and the use of tools that promote myofascial release. I propose to examine the value of postural corrective methods as a teaching resource in current vocal pedagogy.

Shewell (2009) defines posture as a stance or shape we hold in a particular position, such as sitting or standing; It can be both static and dynamic, and it changes with positions and movements of the body. When the body is in good alignment and the natural curves of the spine are properly aligned, the body is able to resist gravity efficiently while simultaneously stimulating all internal physiological processes (Kovač, Imamović-Turković, & Merdan, 2019). With minimum restriction and compression from the surrounding muscles, the nervous, endocrine systems, and the vocal sub-systems may function unhindered, and the organs are able to function unrestricted (Sikes & Westefeld, 2002). Therefore, it can be argued that optimal postural alignment allows the body to function in a mechanically effective manner. "All parts of the body are connected with each other, thus any force causing a change in one segment will move other segments to compensate for loss of balance in the body. This especially concerns the human larynx [...]" (Rantala, Sala, & Kankare, 2018)." If the body itself is well-aligned and functioning in an efficient manner then it can be assumed that the vocal mechanism is also well-aligned and able to function in an efficient manner. McKinney (2005) suggests that when the vocal mechanism is in proper alignment and unnecessary tension has been eliminated, it becomes easier for the singer to initiate phonation and tune the resonators.

On the other hand, when the curvatures of the spine deviate from the ideals, forming a poor postural alignment, both the skeletal and muscular systems can be negatively influenced. A body in a state of poor alignment can develop compensatory behaviors, which over time produce "impairments, such as muscle imbalance across joints, poor alignment across joints, further muscle weakness and a contracture in the joints (Carlberg & Hadders-Algra, 2005)." Everything in our bodies is interconnected; thus, even the slightest change in a single joint may prove to be disadvantageous. These slight changes can manifest in joint load, endurance, strength, balance, muscle coordination, respiratory function, and ultimately the voice (Cardoso, Lumini-Oliveira, & Meneses, 2019). Research suggests a direct correlation between a singer's posture and vocal quality (Luck & Toiviainen, 2007). The vocal instrument requires that our spines be free of postural distortions and dynamically stabilized rather than held in various static positions. Functional disturbances caused by poor postural habits can affect the function of the vocal sub-systems including the respiratory system, the vocal tract and the resonatory system.

Sataloff (1991) suggests that it is beneficial to the singing teacher to acquire posture analysis and muscle conditions knowledge. It is important to note, however, that the relationships between posture and voice quality may differ for each singer. Therefore, singers should be assessed and advised on an individual basis (Luck & Toiviainen, 2007). To achieve optimal results for my singers, I must "reeducate the physiological processes in their mind-body conditioning as it relates to correct posture in singing (Asher, 2009)." I intend to analyze the obvious spinal misalignments, identify compensatory mechanisms, and choose alignment targets specific to individual students.

There are multiple ways in which postural alignment may be improved, for example, spinal manipulative therapy. Spinal manipulative procedures are the primary technique used by chiropractors to increase range of motion and reduce muscle tension in the spine and pain sensitivity (Fachinatto et al., 2015). As I am not a licensed chiropractor, I am not qualified to administer to preform any spinal manipulative procedures to my students. However, chiropractors often recommend various tools for personal use, such as foam rollers, that I could potentially use safely in my studio. Foam rollers and similar tools are often used for myofascial release, which refers to "a technique used to address and treat the connective tissue that mediates the muscles and bones of the body (Leborgne & Rosenberg, 2018)." It is widely accepted that postural alignment is multifactorial; It involves "complex interactions between bones, joints, connective tissue, skeletal muscles and the nervous system, both central and peripheral (Kauffman, 2007)." Therefore, It can be argued that working with the muscles and

facia surrounding the spinal column will directly affect postural alignment. I found numerous studies that examined self-myofascial release, postural alignment exercises, and static stretches and how they affect pain or specific musculoskeletal complaints. None of which, however, focused on the effects the aforementioned methods have on postural alignment. This suggests that this is a topic worthy of in-depth investigation. The rationale for my research, therefore, is to understand how self-myofascial release, exercises, and stretches can be used in the teaching studio as part of a scientifically informed teaching approach to postural correction.

Methodology

One of my main goals as a researcher is to create a well-informed study that addresses problems encountered by vocal pedagogues and to provide suggestions on how the issues can be improved. Pragmatic studies seek "to better understand and ultimately solve the problem (Salkind,2010)," which coincides with my goals. I concluded that a pragmatic study with a mixed-methods approach would be best suited to this project. I believe that using two different types of research will allow for the study to be more diverse, resulting in a better understanding of this phenomenon; Adopting both quantitative and qualitative methods in order to study these behaviors.

Questions about corrective strategies in posture are interesting but methodologically challenging. Given that the spinal column is naturally curved, measuring improvements would prove to be challenging. This is primarily due to the fact that the available methods used to detect changes in spinal alignment are limited for non-clinicians. I am a vocal instructor employed by several small music studios. Because my studio is not affiliated with any universities, I have limited resources: no technology, equipment, or outside funding. This proved to be problematic when deciding on a method for data collection to monitor improvements. There are various instrumental tests used to test postural alignment, many of which are only accessible to clinicians certified in their use. They have access to tools such as x-ray, ultrasound, 3D radiography. These tools would not be accessible for a small studio voice teacher such as myself. However, it occurred to me that though I might not be able to measure differences in the spine itself, I could potentially obtain a device that would allow me to measure aspects of vocal quality. I was able to find companies online that would rent out various products designed specifically for voice and speech research. In light of this, I decided to examine the effects of postural alignment on aspects of vocal quality by creating an aerodynamic assessment of my students. The equipment required for this type of assessment would allow me to quantitatively assess aspects of vocal quality, such as average subglottal

pressure, oral and nasal airflow (volume and rate), and pitch. If I am unable to obtain the equipment necessary for an aerodynamic assessment due to lack of funding, I will have to reevaluate my options. Potential alternatives include using a plumbline string device or taking photos of the students before and after postural corrective methods have been implemented.

The qualitative research portion in this study will be a structured questionnaire dealing with the participants' opinions, feelings, and experiences. This aspect of the data collection will be relatively time and cost-effective. This questionnaire will allow me to ascertain the study's effects as perceived by the students. A possible disadvantage to this portion of the study is that the effects of the corrective methods that are perceived by the students may be a placebo effect. As with all forms of treatments, there is potential for a placebo effect to occur with the execution of these methods. A feeling that the muscles have lengthened and relaxed or a perception that any cracking sounds from the spine indicates effectiveness all contribute to the placebo effect.

Gantt Chart

The following chart shows the proposed timeline for this research task.

Task	March	April	May	June	July	August	September	October
Agree on Topic with Tutor								
Contemplate rationale. Develop aims and objectives								
Literature review								
Draft submission to tutor								
Write critical reflection on the learning process								
Re-writes								
Submission of assignment								

Literature Review

Drawing from my own practice-based experience and previous research, I was able to contrive six questions to initiate the literature review process:

1. How does body posture affect the singing voice? How does scientific research explicate changes in the vocal mechanism when the body is positioned in different postures?
2. What is an optimal posture? How can it be achieved?
3. What is poor posture? How can it be prevented?
4. What methods do I have to teach in order for students to achieve an optimal, well-balanced posture.
5. When have postural corrective methods been used in a successful manner? What would similar strategies be useful when cultivating good postural habits in the studio?
6. What research is there to suggest that postural correction methods have advantageous effects as a teaching aid. How might they affect the auditory perception and function of vocal quality?

The literature review's objective will be to review and analyze the current research on postural corrective methods and their potential effects on vocal function and quality. Through the use of purposeful data sampling (Cooper,1988) in this literature review, I will compare four categories of postural corrective techniques and their associated influences on phonation (a) Myofascial Release (b) Postural exercises (c) Static Stretching (d) Kinesthetic Awareness. The study will be multi-disciplinary, drawing from such fields as Manual Therapy, Sports Science, Vocal pedagogy, Physical and Speech Therapy. I intend the narrative tone of the literature review to remain constructive and developmental, rather than critical (Webster and Watson,2002). Findings of all relevant literature will be examined in depths in order to prevent reliance on one research study that may not be in accordance with findings from other studies (Dunst, Trivette, & Cutspec, 2002). The format in which I plan to organize this literature review will be methodological (Randolph, 2009).

Part of this multi-disciplinary review aims to bridge the gap between fields (Wagner, et al.,2011). I must be mindful, however, to keep a review focused and not to include material just for the sake of including more material. In this way, I can avoid creating a review that is trying to cover too many things at once. Currently, a number of questions remain to be addressed. The evidence presently shows varying degrees of success in postural correction studies; some studies exhibit successfulness and others' inconclusiveness. There are also varied opinions regarding the duration, frequency, and intensity of previous studies' techniques (Boff et al., 2020). If possible, this study will aim to find any commonality in research technique and

duration. This will require reviewing and critiquing a substantial amount of literature in order to resolve inconsistencies in the literature and provide new perspectives on the topic (Torraco, 2016). As I have previously studied posture and myofascial release, I must be careful to avoid bias. "This can render some reviews inclined toward positive findings (Berkeljon & Baldwin, 2009)." In order to avoid incorporating any biases into my review, Berkeljon & Baldwin (2009) suggest the inclusion of grey literature, which includes "unpublished studies and studies published outside widely available journals (Cooper, Marsolek, Riegelman, Farrell, & Kelly, 2019). "

Postural alignment is an essential issue in modern vocal pedagogy and has increased in occurrence with present-day sedentary lifestyle. Through some in-action exploration, I have observed the effects of bodily postural correction on singing and posture. My personal practice of yoga and self-myofascial release brought my attention to how these methods can affect the awareness of postural habits. I currently have limited knowledge of these topics, however, and do not yet fully understand why these methods may be helpful in posture correction or what effects they have on phonation.

Through this independent learning project, I will lay the ground-work for a better understanding of the body mechanics of relevant forms of postural alignment and the influence that specific postural corrective methods have on singing. I will critically examine my findings with the intention of looking for answers to my six questions. I aim to enhance my awareness and understanding of these concepts so that eventually, I will be able to develop practical, scientifically informed strategies to use in the studio. By gaining a better understanding of the effects that postural alignment can have on the vocal mechanism and other vocal sub-systems, I may be able to formulate relevant vocal instruction to facilitate healthy phonation in my students.

Critical reflection on the Learning Process

My objective in undertaking this study was to enrich existing knowledge of the mechanics of the spinal column and surrounding muscles in order to employ more informed strategies of postural correction into my teaching. I wanted to challenge my own assumptions and to understand my limitations (Lia, 1988). In previous research, I briefly explored postural alignment as it relates to muscle tension. However, I still only have a fundamental understanding of the mechanics of the human skeletal and muscular systems. Understanding 'why things are as they are' will allow me to respond more concretely in future situations (Johns, 2009).

I have observed the effects that posture has on singing. However, my teaching in this area is based on a basic knowledge acquired from previous teachers and a small number of vocal pedagogy books. The teachers I studied with in the past never put much emphasis on postural alignment; we would warm-up and then sing repertoire. Subsequently, I have struggled with poor posture when I sing, and I have to remind myself regularly to be aware of my posture habits when performing. Now that I am a teacher myself, I understand that lessons do have time constraints, and it is not always easy to incorporate aspects of vocal technique in the allotted time. However, I feel that it is vital to instill habitually healthy vocal technique in my students so that they may sing for the majority of their lives. By bringing my past experience with my teachers to the new situations experienced in my own teaching, I can recognize similarities between these experiences (Schön, 1983). It is my goal to learn not only from my mistakes but also from my own teachers' mistakes so as not to pass them on to my students.

I chose postural alignment as the topic of this study for two reasons, the first being that I realized it would be beneficial to my practice as a voice teacher to be scientifically informed in my teachings of postural alignment. Bulman's (2013) statement that "Evidence-based professional practice demands that formal knowledge must be a key source of understanding" is one that aligns with my own views. I feel that it is crucial that my understanding of any subject in my professional practice is formed from research-based knowledge (Bulman, 2013). The second reason I chose this topic was that I wanted to explore a topic which I could tie into my previous research; Recalling from my "repertoire of experience(Schön, 1983)" in order to find similarities. My previous studies consisted of the effects of muscle tension as it relates to vocal production and the use of tools in the studio in order to enhance the learning experience of the student. Postural alignment gave me the perfect medium to incorporate ideas from all of my studies. In my current study, I found that vocal function and body alignment can be both directly and indirectly affected by the surrounding muscle. I also found that many studies regarding postural correction involved the use of some sort of prop or tool such as foam roller or a massage gun.

The timing of this project proved to be challenging for me, as it coincided with the adoption of two highly energetic kittens and my absorption of a new position at my studio on top of my already full teaching schedule. That, coupled with the stress of preparing for the holidays, lead to my beginning the research process much later than I had hoped. I usually conduct the majority of my studies in the evenings after returning home from work, though, with the added workload of my new position, I found myself feeling exhausted, and I would begin to fall asleep

during my reading. This proved to be very frustrating. As the deadline drew nearer, I decided that I could utilize my time more efficiently if I conducted my studies in the early mornings before my teaching day began. Once that issue was resolved, the next challenge I faced was overcoming my tendency to procrastinate. Procrastination has always been one of my most significant faults in my academic career; I believe that it stems from a subconscious fear of failure. I felt stressed over the prospect of this assignment prospect because I have never written a paper of this magnitude before. I eventually decided that instead of stressing over the assignment's size, I would set a goal for myself to write at least one small paragraph per day, relatively 150 words, to make the task seem less daunting. Some days, I could not hit my daily word count, but it did make the assignment feel much more manageable. "Weaknesses can be seen as more helpfully as opportunities for change and to move on (Bulman, 2013)."

Through this project, I feel that I gained a more in-depth understanding of how the muscles of the body work together to create our posture and how our day-to-day habits may affect our posture. I also feel that I was also able to attain a higher level of understanding into the inner working of the voice and how it can be affected by one's posture. As previously mentioned, I have very little formal training when it comes to posture and the voice so this was very exciting for me.

Not only has this project identified the gaps in my postural knowledge, but it has also helped me become more aware of my own postural habits. "Reflection is about being "mindful of self (Johns 2009)." I know that, just like my students, I spend the majority of my day in front of various screens and devices. If I am to expect them to exercise healthy postural habits at home and in the studio, I must hold myself to the same standard.

Overall, the process was a challenging one that opened my eyes to how much I still need to learn about research strategies and methodologies. I realized how essential both good time management and organization was in writing an essay of this magnitude. In hindsight, I would have started the writing process sooner so as to spend more exhaustively researching each aspect of my study. If I had managed my time more effectively, I believe I would have been better prepared for this assignment. On reflection, I would have taken the literature review far more seriously, as it turned out to be the most challenging aspect of this assignment for me. I found that I did not fully understand all of the methodologies associated with this subject and ended up putting it off until the last minute as a result. Though this study ended up being more difficult than I had anticipated, however, it allowed me to develop a more thorough

understanding of body mechanics and postural alignment and aided in the continuation of my professional growth as a scientifically informed practitioner.

The Assignment

Introduction

This independent study will explore and analyze both optimal and suboptimal postural alignment as they relate to singing. Though I have always had a general, if not vague, understanding of the correlation between postural alignment and vocal production, I recognize that optimal posture is crucial for good vocal production. In my teaching, I have found that alignment is something with which students of all ages and levels struggle. I believe this to be due, in part, to the predominately sedentary lifestyle of our modern society. The majority of my students spend hours sitting hunched over a screen every day. I have found this to be especially true in times of the COVID-19 pandemic. Due to quarantine restrictions, many people are unable to leave their homes. In order to produce the best possible vocal quality in my students, I feel that I must stress the importance of maintaining "correct" posture, not only in the studio but throughout their day-to-day lives (Luck & Toiviainen, 2007). This study will, therefore, attempt to examine the mechanics of postural alignment and develop a scientifically informed strategy to help diminish suboptimal postural habits and adverse effects caused by them. To determine whether these positions correspond with my own point of view, I must first understand the differences between optimal postural alignment and suboptimal or "poor" postural alignment. The following section will specify the differences between these two forms of alignment.

Optimal Postural Alignment

Kendall et al. (2005) proposed good posture is a "state of muscular and skeletal balance which protects the supporting structures of the body against the injury or progressive deformity" regardless of the position (erect, lying, squatting or stooping) in which these structures are working or resting." This type of posture allows the force of gravity to travel down the body without placing stress on the joints and muscles of the back or neck (Friedlander, 2018). Correct alignment has been advocated to be crucial in setting up a good condition for the coordination of the vocal process (Ware, 1998). Optimal posture of the body is considered the most mechanically effective form of posture, allowing for the unrestricted function of the neuromuscular system (Czaprowski, Stoliński, Tyrakowski, Kozinoga, & Kotwicki, 2018;

Cardoso et al., 2019). Thus, adopting this form of alignment implies an absence of stress, strain, opposing forces, and maximum physiological and bio-mechanical efficiency (Franco et al., 2014).

Suboptimal Postural Alignment

Wong et al. (2008) described poor posture as any prolonged deviations from the neutral spine. This implies "inefficient use or frank misuse of joints and associated muscles and ligaments, with progressive and, ultimately, irreversible injurious effects, with associated physical, and possibly painful disability (Paterson, 2009). "The natural curvature pattern of the spine is considered normal if it allows equal distribution of forces across the spine. Misalignments are either an exaggeration or insufficiency of standard curvature patterns (Franco et al., 2014). "Postural misalignments can be classified as either non-structural or structural. Structural misalignments indicate the presence of abnormalities within the bones and soft tissues such as scoliosis and other issues that cause structural disorders of body posture (Czaprowski et al., 2018). Non-structural misalignments, conversely, disturb the physiological loading of the musculoskeletal system in a specific way, which may lead to a functional disorder. This paper will be primarily focusing on the possible non-structural misalignments, of which there are four main types (Czaprowski et al., 2018) (see Appendix 1):

1. Lordotic posture refers to an exaggerated inward curve of the lumbar spine.
2. Kyphotic posture or kyphosis refers to a forward rounding of the upper thoracic spine, often resulting in a forward head position.
3. Flat-back posture refers to when the spine loses its natural curve in the lower thoracic and lumbar area and becomes flat.
4. sway-back posture refers to an increased posterior tilt in the pelvis.

From examining the findings, I concluded that poor posture is unhealthy because it is not balanced or efficient. It can lead to issues such as muscle weakness or tension, pain, compensatory behaviors, and reduced range of motion. If anything in the body is out of place due to poor posture, it is most likely not able to function optimally. This can lead to other issues along the kinetic chain, potentially affecting the surrounding muscles and other systems of the body. It would seem that poor postural alignment is just poor body mechanics.

Causes of Poor Posture

Posture is not exclusively a musculoskeletal matter (Ingraham, 2019). Many factors can potentially affect one's postural alignment such as pain, past injuries, gender, body weight, personal habits, environment, and mood (Tattersall & Walshaw. 2003; Pfab, 2016). Though I could not exhaustively examine every facet of *these factors*, *I believe they should still be noted and taken into account when assessing the postural habits of students.*

The following section will elaborate on a few common causes of poor postural habits.

Sedentary Life

In my own practice, I begin each lesson with an assortment of movements and stretches though these stretches are not specific devised for improving postural alignment. I found that when I ask my students if they have performed any kind of physical activity during the day, and more often than not, the answer is no. It is safe to assume that if the students are not moving throughout the day, they must be remaining primarily sedentary, most likely in the same static position. In light of this, I designed the movement executed at the beginning of my lessons to focus on using muscles that have been inactive during the day and encouraging mobility and range of motion in the spine.

It can be argued that modern society encourages a sedentary lifestyle. I have found this to be especially true in the times of COVID-19. There are significantly-reduced demands for physical activity. Many people have been restricted from leaving their homes and are forced to work and academic duties at home in front of a computer. "Even individuals that are considered physically active often still spend a considerable amount of time in sedentary behaviors (Pfab, 2016)." It is understood that humans lived as hunter-gatherers for approximately 99.5% of our existence, and "since evolution is a slow-acting process, modern humans are not yet well adapted to a sedentary lifestyle (Freese, Klement, Ruiz-Núñez, Schwarz, & Lötzerich, 2017)." Our bodies are not designed to remain held in static posture for hours at a time. Heneghan et al. (2018) suggest that sedentary behaviors may induce musculoskeletal changes, contributing to the dysfunction of adjacent spinal regions. It should also be noted that musculoskeletal problems are often connected to symptoms of voice disorders (Rantala, Sala, & Kankare, 2018).

This lifestyle is detrimental to people's overall cardio-metabolic health and one's spinal health (Owen, Healy, Matthews, & Dunstan, 2010). It is necessary to ensure the proper activity of the skeletal muscles responsible for maintaining good body posture. When these muscles are not stimulated to resist gravity for an extended period, their stabilizing function is disturbed, resulting

in muscular weakness (Czaprowski et al., 2018). Sedentary behaviors are especially harmful to "the rapidly growing spines and ligaments of children (Smith & Leggat, 2007)."

Much of our sedentary life is spent in a seated position. While in a seated position, "We tend to sit slouched, with our legs crossed, pelvis tilted, stomachs compressed and lower back stretched (Irving, Epstein, & Harries, 2004). People often hunch over their devices and stretch the head towards the screen. This prolonged immobilization often leads to specific muscles tightening or shorten while others lengthen and weaken (Pfab, 2016). Deviations of the vertebral column often lead to muscle shortening, which in turn cause other muscles to be misused and become painful. Theroux et al. (2015) found that postural misalignments may result in higher muscle tension, higher muscle overuse, fatigue, and thus a higher risk of injury (Thérout, May, Fortin, & Labelle, 2015). Remaining in a seated position for an excessive amount of time may also place strain on the muscles and spinal discs in the back and neck (Malanga, 2019). It has also been suggested that poor posture, when seated, can affect a person's standing posture. This is due primarily to muscle memory, as the body gets used to being incorrectly positioned (Pfab, 2016).

Looking down at the cell phone, tablets too frequently and for too long may induce neck pain and damage sustained from what is often referred to as "Text Neck" (Knaapen, Cazeneuve, Cambrosio, Castel, & Fervers, 2010; Sunil Neupane, U T Ifthikar Ali, 2017). It has been suggested that any changes in the position of the head can affect the postural muscles of the limbs and chest. For example, a hunched back and forward head position can lead to hyper-contraction of the chest and pectoral muscles, causing kyphotic posture and tight hip flexors causing sway-back posture (Pfab, 2016; Dayme, 2009). This postural deviation is associated with a resultant overstretching of the scapular muscles, preventing the body from achieving proper alignment of the shoulders (Wilk et al., 2002). A forward head position will be associated with compensatory arching of the back and an abnormal pelvis position. When the head is misaligned, other parts of the body move in or out of line to maintain balance, and thus, energy is expended to counteract the effect of gravity (Dayme, 2009).

Lack of Awareness

I found that good spinal alignment or optimal posture is not something that students think about on a day-to-day basis. People are used to adopting whatever position is most comfortable. "Because many students lack awareness of how they use their bodies, it is likely that they do not know that their habitual posture is inefficient." The way they habitually hold themselves while

seated or standing feels correct because it is familiar. (Gauthier, 2002) Evidence suggests that postural control requires significant attentional resources (Woollacott & Shumway-Cook, 2002). This may vary depending on the age and balance abilities of the individual as that postural control appears to be more attentionally demanding in older adults compared to young; and performance of a secondary task that is attentionally demanding, such as singing, can have a more negative effect on postural control in older adults compared to young (Woollacott & Shumway-Cook, 2002). Thus, the teacher must remain vigilant of the students' postural habits and bring attention to any apparent misalignments as needed. It is my intention to help my students cultivate sensory and kinesthetic awareness of their body posture in order to reduce any suboptimal postural habits. Ingraham (2019) argues that our posture is a "physical manifestation of your comfort zone." Perhaps the way we hold ourselves merely seems comfortable because it is habitual. When a student is asked to adjust or change their postures, it may feel foreign to them at first, but optimal overtime alignment may become habitual.

Age

An infant does not need to be taught how to sit or stand with good alignment; they do it automatically. Poor postural alignment is something that is learned over time. Ruiz et al.(2011) stated that "sedentary behavior determines most people's lives from an early age." The older we become, the less time we spend running around playing and the more time we spend seated in front of a television or other device. It is common knowledge that older adult singers tend to have more muscle pain and postural issues as opposed to young singers(Otayek et al., 2020). This is likely because their bodies have experienced more "wear and tear" than that of a young person. However, I feel that postural problems do not have to be severe to be of interest. A minor misalignment in a young singer may, over time, become habitual and eventually lead to more severe problems. It is critical to be mindful of each student's specific postural misalignments regardless of the severity.

Psychology and Emotional State

One postural influence worth examining, however, is the psychological and emotional state of the singer. Misalignments in body posture have been linked to psychological issues such as negative emotions, stress, and lack of motivation. If a student has a bad day at school or at work, this could be reflected in how they hold themselves. Poor postural habits have been linked to depressive disorders, lack of confidence, and higher stress levels, particularly kyphotic posture postures (Pfab, 2016). It is important to note that posture is not just a passive indicator

of mental states, but it can also affect an individual's mental states and behavior. In Riskind & Gotay's (1982) study *'Physical posture: Could it have regulatory or feedback effects on motivation and emotion?'* Participants temporarily positioned in a slumped-over physical posture later showed significantly lower persistence on a standard learned helplessness task and rated themselves as having higher stress levels. In light of this evidence, it is critical that vocal teachers encourage good posture in their students during lessons. A student maintaining poor posture during a lesson could potentially lose confidence or become stressed while singing, which would negatively affect phonation and possibly song interpretation.

Posture and Vocal Function

Research has shown that optimal postural alignment is necessary for the vocal tract to function efficiently, allowing for the flexibility and freedom of the singing's respiratory muscles (Morris, M. L. et al., 2020). It allows for more effortless shifts in the tension between muscles, which in turn allows the larynx to move freely without blockages, thus benefiting voice production (Cardoso, Lumini-Oliveira, & Meneses, 2019). Though the skeletal system provides the framework for the human body, the muscles are responsible for body positioning and movement. Leborgne & Rosenberg (2018) suggested that efficient muscular balance is "essential for optimal posture and voice production."

The vocal mechanism requires a well-balanced system to function optimally. Often, a sufficient balance of the vocal system is achieved naturally by the singer, and a voice problem never develops. However, if the system is excessively out of balance, then a voice disorder can occur (Ebersole, 2018).

Optimal alignment requires minimal muscular effort without causing excessive strain on the various tissues. Thus, allowing the singer to remain externally free and able to comfortably activate the internal moving parts and vibrating structures utilized in singing (Friedlander, 2018). Though optimal postural alignment alone "cannot guarantee good singing; poor posture, however, will almost certainly impede vocal progress (Lomax, 2010)."

Healthy vocal production requires the laryngeal function to be coordinated, efficient, and physiologically stable (Waddell, 2005)." Thus, it can be argued that any imbalance in the vocal tract affects vocal quality. It is evident from the data that postural misalignments have consequences along the kinetic chain. For example, a change in the placement of one joint can manifest in gait, joint load, neural function, endurance, strength, balance, muscle coordination, respiratory function, and ultimately the voice (Cardoso et al., 2019). Postural habits have also

been shown to affect our movement capabilities and range of motion. Fabrocini (2016) described body posture as the foundation of all movement. It has been suggested that when postural alignment is dynamic and balanced, ease of movement will ensue (Gould, 1971). In light of this, optimal postural alignment is essential for musical theater and pop singers, who frequently move during performances executing choreography or blocking. "The movements and postures of body segments are inseparable from communication behavior and voice use and are intrinsic parts of it (Rantala, Sala, & Kankare, 2018)." Suboptimal posture would inhibit a singer's movement, which would prove especially detrimental to the interpretation of the music being performed.

It can be argued that the function of the vocal tract can be directly affected by body posture. Studies show that vocal tract configuration is affected by body position, presumptively because of adjustments to orientation in the gravitational field (Vorperian et al., 2015). Cardoso et al. (2019) suggested that imbalances in the structures such as that of the neck and head can lead to changes in the soft tissue of the pharynx and in the muscles in charge of elevating the larynx, which impairs control and vocal resonance. Compensatory behaviors caused by poor postural habits can also lead to muscle tension in the neck, shoulders, jaw, and tongue (Morris, M. L. et al., 2020). Tension in the muscles of the vocal mechanism may lead to inefficient vocal production. Misalignment of the head and neck has been suggested to correlate with changes in the shape of the soft tissue of the pharynx and consequent impingement on the resonance of the voice (Aura, Geneid, Bjørkøy, Rantanen, & Laukkanen, 2020). It should be noted that A common posture found by dysphonic speakers "involves the weight being distributed posteriorly: the pelvis is anterior to the torso with increased thoracic kyphosis and to some extent lumbar lordosis (Rantala, Sala, & Kankare, 2018)." Thus, it can be argued that poor postural habits may be a causing factor in people with voice disorders.

Postural deviations or misalignments are known to produce changes in the respiratory system. For example, When the trachea becomes bent from poor neck posture, the air pressure is inefficiently distributed within the respiratory system, and tension is formed. (Morris et al., 2020). An ideal upright body posture allows the internal abdominal organs to sink down with the help of the force of gravity creating more space for breathing movements with higher lung volume (Rantala, Sala, & Kankare, 2018). The breathing mechanism functions best when the body is aligned, and any change in posture can interfere with its normal functioning. Different postural misalignments, such as forward head posture and kyphosis, have been shown to alter mobility in the cervical and thoracic spine. This, in turn, impairs normal breathing mechanics by reducing

diaphragm mobility and strength (Zafar, Albarrati, Alghadir, & Iqbal, 2018). Poor posture can also affect the singers' ability to inhale to their fullest potential. For example, A kyphotic posture can lead to shortening of the rib cage and abdominal muscles, reducing the range of motion of the rib cage during inhalation (Wilk et al., 2002). The ribcage is directly attached to the spine; therefore, a misaligned spine will impact voice production. Though the singers' overall vocal quality may not be affected, it will not be as efficient as it could be if the body were aligned optimally.

Possible Corrective Methods

I have found that most vocal pedagogy books place significant emphasis on good alignment and its relevance in the development of good vocal technique. Some of these texts contained in-depth physiology descriptions or detailed drawings and photos of what good posture should look like, while others just listed a particular way in which to hold each part of the body. These texts often contain limited to no corrective procedures for singers (McKinney, 2005; Ware, 1998; Miller, 2004). The question that then naturally arises is 'Is a verbal or written description of optimal posture enough to improve a singer's postural awareness?'

Preventive measures must be taken to avoid the risks mentioned above of postural misalignment. Though the effectiveness of the following methods in improving posture and voice quality has not been sufficiently proven, evidence shows that each method can positively impact postural alignment indirectly.

Possible corrective methods that can be safely used in the studio include:

Myofascial Release

Myofascial release refers to "a technique used to address and treat the connective tissue, fascia, that mediates the muscles and bones of the body(Leborgne & Rosenberg, 2018)." According to research, misaligned posture can result in excessive muscle tension, joint strain, ligamentous instability, cartilage damage, and mechanical stresses of the myofascial region(Schneider, Dennehy, & Saxon, 1997)." Evidence suggests that manual techniques such as myofascial release may reduce pain, improve circulation, correct spinal alignment, facilitate joint movements, stretch shortened muscles, and release joint adhesions (Jung, Hwang, Ahn, Kim, & Kwon, 2020). Kamali et al. (2016) conducted a study in which a program of manual therapy consisting of massage, mobilization, and myofascial release techniques was applied for a period of eight weeks. The results of this study indicated significant improvement in spinal

alignment and extension range of motion in the subjects. No follow-up information was obtained; hence, the long-term effects could not be determined.

Foam rolling is a form of self-myofascial release performed by individuals rather than by a clinician (Beardsley and Skarabot, 2015). An 8-week study demonstrated that foam rolling could be applied as an effective technique for increasing range of motion without an associated decrease in core strength, physical endurance, and balance (Junker & Stöggl, 2019). Another study done in 2013 by Roylance et al. showed that acute treatment of foam rolling increased joint range of motion in participants with below-average joint range of motion significantly when combined with either postural alignment exercises or static stretching. One limitation in many of the articles I came upon during the course of this study was that the subjects in the research study had a pre-existing medical condition such as scoliosis, chronic pain, dysphonia, or other pathologies. Another limitation is that previous studies are varied regarding the duration, frequency, and intensity of the techniques (Boff et al., 2020). Though there is not much support suggesting that myofascial release may directly affect postural alignment, it is evident from the data that it can affect posture indirectly. By using tools such as foam rollers, massage balls, or an electronic massage gun, students would be able to perform self-myofascial release techniques in the studio. The potential effects on vocal production may include an increase in the ease of singing, improved resonance, and perceptual sound quality, and an increase in overtones and (Jones, 1972).

Static Stretching

Stretching is frequently done before sports performance or rigorous exercise with the intention of enhancing performance and reducing the risk of injury. As previously stated, each of our body systems is interconnected and dependent on each other; thus, it can be argued that tight muscles can potentially pull a bone out of alignment. It is advisable for the student to include physical exercises to improve posture and strengthen support muscles (Sataloff, 1991). Various flexibility training programs have positively affected postural realignment, especially in the spinal column and pelvic position, with visible effects immediately following the achievement of stretching exercises (Da Silva Filho, Gurgel, & Porto, 2014).

Although numerous muscles may be involved in the body's movement, the primary muscle involved is called the agonist. In order to move a part of the body, agonist muscles must contract and shorten. The antagonist muscle acts as an opposing force to agonists. This type of muscle contracts as a means to return the body part moved by the agonist to its original resting

position. Antagonists maintain body or limb position as well as control rapid movement (*How Skeletal Muscles Produce Movements*, 2020). "It is important to maintain a balance of tension and length of agonist/ antagonist pairs, avoiding a chronic stretch of the antagonist muscle, as the muscle can eventually succumb to a stretch weakness (DeDeyne, 2001; Dennehy, 1997)." The sedentary postures in which we habitually hold ourselves are often static, thus, chronically stretching the antagonist muscle and shortening the agonist muscles.

Along with weakening and overstretching of the back muscles, static postures may also reduce the flexibility of the upper back muscles (Pfab, 2016). Inadequate blood flow to the muscles caused by prolonged static posture can result in stiffness that is chronically contracted in the antagonist muscle that has been reactively stretched (Kostopoulos, 2001). Correcting these types of problem involves relaxing and stretching the hyper-functional agonist muscles and re-strengthening the lengthened antagonist muscle (McDonnell, 2005).

A study on the effects of a muscle stretching exercise program on nurses' posture and flexibility promoted positive changes in the curvatures of the vertebral column in the cervical and thoracic spine. There was an improvement in the alignment of the cervical and lumbar spine as well as a reduction in scapulae deformity just after the eight weeks muscle stretching exercise program session. The muscle stretching exercise program increased the flexibility of the participants soon after one session and after eight weeks of training (Silva, Gurgel, Silva, & Porto, 2017). Though static stretching has been proven to improve pain and functional capacity (Lawand et al., 2015), there is a lack of standardization in postural assessment and prescription of static stretches (Da Silva Filho, Gurgel, & Porto, 2014b). More evidence is needed to prove that static stretching can improve postural habits directly; However, evidence suggests they can positively affect the muscles surrounding the spinal column through functional improvement and increased mobility.

Kinesthetic Awareness

Kinesthetic awareness refers to a person's ability to use sensory feedback via the nervous system to sense what each body part is doing relative to the environment in which it resides (Gilman, 2014). In my teaching, I have found that helping students become more kinesthetically aware of their bodies can help them achieve a better sense of physical alignment. I found that students have varying ideas about how their bodies are structured. For example, I have taught students as old as 12 years who did not know where the rib cage was located or the function of the lungs. I have also taught students who worked in a medical profession that possessed an

extensive knowledge of anatomy and physiology. "Having a solid understanding the anatomy and physiology of the entire musculoskeletal system is an important part of learning good technique and the impact that postural changes may have on vocal output (Leborgne & Rosenberg, 2018)." For this reason, I have found it beneficial to keep a model skeleton and anatomical rendering of the human body in my studio to use as a visual aid for students with little or no understanding of their bodies' inner workings. Gauthier (2002) stated that "when students understand physically and intellectually how to use their bodies efficiently, they may be more likely to monitor and adjust their own posture."

There are methods such as the Alexander Technique, The *Feldenkrais* Method, and yoga that incorporate awareness and attentiveness to the subtleties of movement. It has been suggested that the type of movement awareness taught in these methods may help students become more kinesthetically aware of the functional movements, which may aid in pain, muscular imbalances, postural misalignments, and many other ailments (Gil, 2018). I feel that I have gained a better body awareness in my own person practice of yoga.

Awareness of specific muscle tension in the body may also help students relax overly tighten muscles in the neck and back. Muscle relaxation has been found to increase mental performance in attention, memory, and thinking (Legostaev, 1996). The act of singing requires significant attentional resources; thus, it can be argued that the potential increased mental performance achieved from muscle relaxation would be beneficial for vocal production.

Conclusion

In conclusion, there are innumerable ways in which postural alignment can be affected. As a voice teacher, I believe that it is crucial to promote habits, such as good posture, which are beneficial for the overall musculoskeletal health of my students. Optimal posture is essential for our bodies and voices to function as efficiently as possible. Contrarily, poor posture does not allow our bodies to function efficiently and can eventually lead to more severe health issues if it is not addressed. Though the information touched on in this study may seem rudimentary to the veteran pedagogue, it has given me a solid foundation on which to build my future studies. Even though I am still absorbing this new knowledge, I feel it has helped me become acutely aware of my students' postural habits while teaching. When I first started teaching, my strategies were all based on guesswork. Since then, it has been my goal to enrich my knowledge of any relevant pedagogical subject matter to implement scientifically informed teachings. This study has brought me one step closer to achieving that goal by giving me the knowledge base to teach

posture in a scientifically informed way. Therefore, I conclude that assessing and optimizing postural alignment is necessary to cultivate a dynamically stable spine and, subsequently, efficiently functioning voice.

References

Asher, V. K. (2009). *The Olympic Singer: Integrating Pilates Training into the Voice Studio*. University of Nevada, Las Vegas.

Aura, M., Geneid, A., Bjørkøy, K., Rantanen, M., & Laukkanen, A. M. (2020). A Nasoendoscopic Study of “Head Resonance” and “Imposto” in Classical Singing. *Journal of Voice*.

<https://doi.org/10.1016/j.jvoice.2020.04.013>

Beardsley, C. and Skarabot, J. (2015) Effects of self-myofascial release: A systematic review. *Journal of Bodywork & Movement Therapies* 19(4), 747-758.

Berkeljon, A., & Baldwin, S.A. (2009). An introduction to meta-analysis for psychotherapy outcome research. *Psychotherapy Research*, 19 (4–5), 511–518.

Boff, T. A., Pasinato, F., Ben, Â. J., Bosmans, J. E., van Tulder, M., & Carregaro, R. L. (2020). Effectiveness of spinal manipulation and myofascial release compared with spinal manipulation alone on health-related outcomes in individuals with non-specific low back pain: randomized controlled trial. *Physiotherapy (United Kingdom)*, 107, 71–80.

<https://doi.org/10.1016/j.physio.2019.11.002>

Bulman, C. (2013). An Introduction to Reflection. In *Reflective Practice in Nursing*.

<https://doi.org/10.2307/466183>

Cardoso, R., Lumini-Oliveira, J., & Meneses, R. F. (2019). Associations between Posture, Voice, and Dysphonia: A Systematic Review. *Journal of Voice*, 33(1), 124.e1-124.e12.

<https://doi.org/10.1016/j.jvoice.2017.08.030>

Carlberg, E. B., & Mijna, H.-A. (2005). Postural dysfunction in children with cerebral palsy: Some implications for therapeutic guidance. *Neural Plasticity*, 12(2–3), 221–228. Retrieved from <http://www.hindawi.com/journals/np/%5Cnhttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed7&NEWS=N&AN=2005362074>

Conn, V. S., Valentine, J. C., Cooper, H. M., & Rantz, M. J. (2003). Grey literature in meta-analyses. *Nursing research*, 52(4), 256–261. <https://doi.org/10.1097/00006199-200307000-00008>

Cooper, H.M. (1988) Organizing knowledge syntheses: A taxonomy of literature reviews. *Knowledge in Society* 1, 10. <https://doi.org/10.1007/BF03177550>

Cooper, K., Marsolek, W., Riegelman, A., Farrell, S., & Kelly, J. (2019). Grey Literature: Use, Creation, and Citation Habits of Faculty Researchers across Disciplines. *Journal of Librarianship and Scholarly Communication*, 7(1), 0–25. <https://doi.org/10.7710/2162-3309.2314>

Czaprowski, D., Stoliński, L., Tyrakowski, M., Kozinoga, M., & Kotwicki, T. (2018). Non-structural misalignments of body posture in the sagittal plane. *Scoliosis and Spinal Disorders*, 13(1), 1–14. <https://doi.org/10.1186/s13013-018-0151-5>

Da Silva Filho, J. N., Gurgel, J. L., & Porto, F. (2014a). Effects of stretching exercises for posture correction: systematic review. *Manual Therapy, Posturology & Rehabilitation Journal*, 12(September), 200. <https://doi.org/10.17784/mtprehabjournal.2014.12.200>

Da Silva Filho, J. N., Gurgel, J. L., & Porto, F. (2014b). Effects of stretching exercises for posture correction: systematic review. *Manual Therapy, Posturology & Rehabilitation Journal*, 12, 200. <https://doi.org/10.17784/mtprehabjournal.2014.12.200>

Dayme, M. B. (2009). *Dynamics of the Singing Voice* (Fifth). London: Springer.

DeDeyne, P. (2001). Application of passive stretch and its implication for muscle fibers. *Physical Therapy*, 81, 819–827. Dennehy, C., Saxon, K., & Schneider, C. (1997). Exercise physiology principles applied to voice performance: The improvement of postural alignment. *Journal of Voice*, 11, 332–333.

Dunst, C. J., Trivette, C. M., & Cutspec, P. A. (2002). Toward an operational definition of evidence-based practices. *Centerscope*, 1 (1), 1–10.

Ebersole, B. (2018). *How Does My Voice Work?* <https://www.templehealth.org/about/blog/how-does-my-voice-work>.

Fachinatto, A. P. A., Duprat, A. D. C., Silva, M. A. E., Bracher, E. S. B., Benedicto, C. D. C., Luz, V. B. C., ... Fonseca, B. S. G. (2015). Effect of Spinal Manipulative Therapy on the Singing Voice. *Journal of Voice*, 29(5), 645.e33-645.e39. <https://doi.org/10.1016/j.jvoice.2014.10.005>

Franco, D., Martins, F., Andrea, M., Fragoso, I., Carrão, L., & Teles, J. (2014). Is the sagittal postural alignment different in normal and dysphonic adult speakers? *Journal of Voice*, 28(4), 523.e1-523.e8. <https://doi.org/10.1016/j.jvoice.2014.01.002>

Freese, J., Klement, R. J., Ruiz-Núñez, B., Schwarz, S., & Lötzerich, H. (2017). The sedentary (r)evolution: Have we lost our metabolic flexibility? *F1000Research*, 6(0). <https://doi.org/10.12688/f1000research.12724.1>

Friedlander, C. (2018). Complete vocal fitness: a singer's guide to physical training, anatomy, and biomechanics. In *Theatre, Dance and Performance Training* (pp. 1–22). <https://doi.org/10.1080/19443927.2019.1640783>

Gauthier, D. R. (2002). Stand up straight ! Posture for singers. *Teaching Music; Reston*, Vol. 10, pp. 44–48. <https://doi.org/10697446>

Gil, I. (2018). A New Educational Program to Improve Posture and Quality of Life Among Students by Means of the Feldenkrais Method and a New Program: MAP-Motion and Posture. *Journal of Education and Training Studies*, 6(11), 1. <https://doi.org/10.11114/jets.v6i11.3582>

Gilman, M. (2014). *Body and voice: Somatic re-education*, San Diego, CA: Plural Publishing. Gossman,

Gould WJ. Effect of respiratory and postural mechanisms upon action of the vocal cords. *Folia Phoniatri (Basel)*. 1971;23:211–224

Heneghan, N. R., Baker, G., Thomas, K., Falla, D., & Rushton, A. (2018). What is the effect of prolonged sitting and physical activity on thoracic spine mobility? An observational study of young adults in a UK university setting. *BMJ Open*, 8(5). <https://doi.org/10.1136/bmjopen-2017-019371>

Ingraham, P. (2019). Does Posture Correction Matter?<https://doi.org/10.1056/NEJMct0806114>

Irving, R. M., Epstein, R., & Harries, M. L. L. (2004). Care of the professional voice. *Journal of Singing - The Official Journal of the National Association of Teachers of Singing*, 60(3), 271–275. <https://doi.org/10.1046/j.1365-2273.1997.00013.x>

Iwarsson J. (2001). Effects of inhalatory abdominal wall movement on vertical laryngeal position during phonation. *Journal of Voice*, 15, 384–394

Johns, C. (2009) *Becoming a Reflective Practitioner*, 3rd edn. Wiley-Blackwell, Oxford.

Jones, F. (1972). Voice production as a function of head balance in singers. *Journal of Psychology*, 82, 209–215.

Jung, S., Hwang, U., Ahn, S., Kim, J., & Kwon, O. (2020). Effects of Manual Therapy and Mechanical Massage on Spinal Alignment , Extension Range of Motion , Back Extensor Electromyographic Activity , and Thoracic Extension Strength in Individuals with Thoracic Hyperkyphosis : A Randomized Controlled Trial. *Evidence-Based Complementary and Alternative Medicine*, 1–10.

Junker, D., & Stöggl, T. (2019). The training effects of foam rolling on core strength endurance, balance, muscle performance and range of motion: A randomized controlled trial. *Journal of Sports Science and Medicine*, 18(2), 229–238.

Kamali,F., Shirazi, S. A., Ebrahimi, S., Mirshamsi, M., & Ghanbari,A., (2016) Comparison of manual therapy and exercise therapy for postural hyperkyphosis: a randomized clinical trial, *Physiotherapy Theory and Practice*, vol. 32, no. 2, pp. 92–97.

Kauffman, T.L.(2007) *Geriatric Rehabilitation Manual* (Second Ed.)

Kendall F, McCreary E, Provance PG, Rodgers M, Romani WA. *Muscle testing and function with posture and pain*. Baltimore: Lippincott Williams & Wilkins; 2005.

Knaapen, L., Cazeneuve, H., Cambrosio, A., Castel, P., & Fervers, B. (2010). Pragmatic evidence and textual arrangements: A case study of French clinical cancer guidelines. *Social Science and Medicine*, 71(4), 685–692. <https://doi.org/10.1016/j.socscimed.2010.05.019>

Knopf, J. (2006). Doing a Literature Review. *PS: Political Science and Politics*, 39(1), 127-132. Retrieved December 23, 2020, from <http://www.jstor.org/stable/20451692>

Kostopoulos, D., & Konstantine, R. (2001). *The manual of trigger point and myo- fascial release*. Thorofare, NJ: Slack Incorporated.

Kovač, S., Imamović-Turković, D., & Merdan, M. (2019). The Playgame Role in Prevention of Proper Posture in Elementary School Students. *Homo Sporticus*, (2), 45–50. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,shib,uid&db=s3h&AN=143515512&site=ehost-live&scope=site&authtype=shib&custid=s8000044>

Lawand, P., Lombardi Júnior, I., Jones, A., Sardim, C., Ribeiro, L. H., & Natour, J. (2015). Effect of a muscle stretching program using the global postural reeducation method for patients with

chronic low back pain: A randomized controlled trial. *Joint Bone Spine*, 82(4), 272–277.
<https://doi.org/10.1016/j.jbspin.2015.01.015>

Legostaev, G. N. (1996). Changes in mental performance after voluntary relaxation. *Human Physiology*, 22, (5), 637-638.

Lia, P. (1988). Using Gibbs ' Reflective Cycle. Learning Support Tutor: Disability Advisory Service: KCL, 1–5. Retrieved

from <https://www.kcl.ac.uk/campuslife/services/disability/service/Using-Gibbs-Reflective-Cycle-in-Coursework.pdf>

Leborgne, W. D., & Rosenberg, M. (2018). The Vocal Athlete. In *Plural Publishing Inc.* (2nd ed.). Plural Publishing Inc.

Lomax, J. W. (2010). Building the foundation. *Journal of Singing*, 67(1), 43–46.
<https://doi.org/10.1521/psyc.2007.70.3.209>

Luck, G., & Toiviainen, P. (2007). Ideal singing posture: evidence from behavioural studies and computational motion analysis. *Proceedings of the Third Conference on Interdisciplinary Musicology (CIM07) Tallinn, Estonia*, 15–19.

Malanga, G. (2019). *Sitting Disease and Its Impact on Your Spine*. Spine Universe.
<https://www.spineuniverse.com/wellness/ergonomics/sitting-disease-its-impact-your-spine>.

McDonnell, M., Sahrmann, S., & VanDillen, L. (2005). A specific exercise program and modification of postural alignment for treatment of cervicogenic headache: A case report. *Journal of Orthopedic Sports Physical Therapy*, 35, 3–15.

McKinney, J. C. (2005). Posture. In *The Diagnosis and Correction of Vocal Faults: A Manual for Teachers of Singing and for Choir Directors* (pp. 33–45). Waveland Press, Inc.

Miller, R. (2004). Posture. *Solutions for Singers: Tools for Performers and Teachers*. United States: Oxford University Press. 35-45

Morris, M. L., Nicosia, S. V., & Lee, S. (2020). *Perspectives in performing arts medicine practice: A multidisciplinary approach*. Cham, Switzerland: Palgrave Macmillan. doi:4 December 2020.

Otayek, J., Bizdikian, A. J., Yared, F., Saad, E., Bakouny, Z., Massaad, A., ... Assi, A. (2020). Influence of spino-pelvic and postural alignment parameters on gait kinematics. *Gait and Posture*, 76(July 2019), 318–326. <https://doi.org/10.1016/j.gaitpost.2019.12.029>

Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W. (2010). Too much sitting: The population health science of sedentary behavior. *Exercise and Sport Sciences Reviews*, 38(3), 105–113. <https://doi.org/10.1097/JES.0b013e3181e373a2>

Paterson, J. (2009). Good posture and how it can be achieved. In J. Paterson (Ed.), *Teaching Pilates for Postural Faults, Illness & Injury* (pp. 1–49). <https://doi.org/10.1016/b978-0-7506-5647-4.50008-1>

Paul Ingraham. (2019). Does Posture Correction Matter?
<https://doi.org/10.1056/NEJMct0806114>

Pfab, I. (2016). *A Wearable Intervention for Posture Improvement*. Retrieved from
<http://www.isa-pfab.com/>

Proper Body Alignment. (2020). Retrieved from
<https://www.nof.org/patients/treatment/exercisesafe-movement/proper-body-alignment/>

Randolph, J. J. (2009). A Guide to Writing the Dissertation Literature Review. *Practical Assessment, Research & Evaluation*, 14(13). <https://doi.org/10.26802/jaots.2018.09189>

Rantala, L., Sala, E., & Kankare, E. (2018). Teachers' Working Postures and Their Effects on the Voice. *Folia Phoniatrica et Logopaedica*, 70(1), 24–36. <https://doi.org/10.1159/000487593>

Riskind J. H. & GotayC. C. (1982) "Physical posture: Could it have regulatory or feedback effects on motivation and emotion?" *Motivation and Emotion*, vol. 6, no. 3, pp. 273–298.

Roylance, D., George, J. D., Hammer, A. M., Rencher, N., Gellingham, G. W., Hager, R. L., & Myrer, W. J. (2013). Evaluating acute changes in joint range-of-motion using self-myofascial release, postural alignment exercises, and static stretches. *International Journal of Exercise Science*, 6(4), 310–319. Retrieved from <http://digitalcommons.wku.edu/ijes/vol6/iss4/6/>

Ruiz, J. R., Ortega, F. B., Martínez-Gómez, D., Labayen, I., Moreno, L. A., De Bourdeaudhuij, I., ... Sjöström, M. (2011). Objectively measured physical activity and sedentary time in european adolescents. *American Journal of Epidemiology*, 174(2), 173–184.
<https://doi.org/10.1093/aje/kwr068>

Salkind, N. J. (2010). *Encyclopedia of research design* (Vols. 1-0). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288

Sataloff, R.T. (1991) *Professional Voice: The Science and Art of Clinical Care*, New York: Raven Press, 385

Schneider, C. M., Dennehy, C. A., & Saxon, K. G. (1997). Exercise physiology principles applied to vocal performance: The improvement of postural alignment. *Journal of Voice*, 11(3), 332–337. [https://doi.org/10.1016/S0892-1997\(97\)80012-4](https://doi.org/10.1016/S0892-1997(97)80012-4)

Shewell, C. (2009). *Voicework: Art and science in changing voices*. Chichester, UK: Wiley-Blackwell.

Shön, D. (1983) *The Reflective Practitioner: How Professionals Think in Action*. New York: Basic Book

Sikes, C., & Westefeld, J. (2002). Therapists' Postures: Response to Spinal Alignment. *Journal of Chemical Information and Modeling*, 1(4), 57–68.

Silva, J. N. da, Gurgel, J. L., Silva, E. B. da, & Porto, F. (2017). Acute and chronic effect of stretching exercise on posture and flexibility of nurses and licensed practical nurses. *Manual Therapy, Posturology & Rehabilitation Journal*, 15(October).

<https://doi.org/10.17784/mtprehabjournal.2017.15.478>

Staes F, Jansen L, Villette A, Coveliers Y, Daniels K, Decosters WF. (2011). Physical therapy as a means to optimize posture and voice parameters in student classical singers: a case report. *JVoice*;25: 91–101.

Sunil Neupane, U T Ifthikar Ali, M. A. (2017). Text Neck Syndrome - Systematic Review. *Imperial Journal of Interdisciplinary Research*, 3(7), 141–148.

Tattersall, R. & Walshaw, M.(2003) "Posture and cystic fibrosis.," *Journal of the Royal Society of Medicine*. 96(43), p. 18.

Thérout, J., May, S. Le, Fortin, C., & Labelle, H. (2015). Prevalence and management of back pain in adolescent idiopathic scoliosis patients: A retrospective study. *Pain Research and Management*, 20(3), 153–157. <https://doi.org/10.1155/2015/674354>

Torraco, R. J. (2016). Writing Integrative Literature Reviews: Using the Past and Present to Explore the Future. *Human Resource Development Review*, 15(4), 404–428. <https://doi.org/10.1177/1534484316671606>

Vorperian, H. K., Kurtzweil, S. L., Fourakis, M., Kent, R. D., Tillman, K. K., & Austin, D. (2015). Effect of body position on vocal tract acoustics: Acoustic pharyngometry and vowel formants.

The Journal of the Acoustical Society of America, 138(2), 833–845.

<https://doi.org/10.1121/1.4926563>

Waddell, R. K. (2005). Chiropractic Care for a Patient with Spasmodic Dysphonia Associated with Cervical Spine Trauma. *Journal of Chiropractic Medicine*, 4(1), 19–24.

[https://doi.org/10.1016/S0899-3467\(07\)60108-6](https://doi.org/10.1016/S0899-3467(07)60108-6)

Wagner CS, Roessner JD, Bobb K, Klein JT, Boyack KW, et al. (2011) Approaches to understanding and measuring interdisciplinary scientific research (IDR): a review of the literature. *J Informetr* 5: 14–26

Ware, C. (1998). Efficient Body Alignment. In *Basics of vocal pedagogy: the foundations and process of singing* (pp. 49–50). essay, McGraw-Hill Education.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *Management Information Systems Quarterly*, 26,3.

(Wilk, K., Meister, K., & Andrews, J. (2002). Current concepts in the rehabilitation of the overhead athlete. *American Journal of Sports Medicine*, 30, 136–151.

Wong, W.Y., Wong, M. S. (2008) “Smart garment for trunk posture monitoring: A preliminary study,” *Scoliosis*, vol. 3, no. 7, pp. 1–9.

Wood, KW. (1991). Resolution of spasmodic dysphonia (focal laryngeal dystonia) via chiropractic manipulative management. *JMPT*;14: 376–378.

Woollacott, M., & Shumway-Cook, A. (2002). Attention and the control of posture and gait: A review of an emerging area of research. *Gait and Posture*, 16(1), 1–14.

[https://doi.org/10.1016/S0966-6362\(01\)00156-4](https://doi.org/10.1016/S0966-6362(01)00156-4)

Zafar, H., Albarrati, A., Alghadir, A. H., & Iqbal, Z. A. (2018). Effect of Different Head-Neck Postures on the Respiratory Function in Healthy Males. *BioMed Research International*, 1–4.

<https://doi.org/10.1155/2018/4518269>

Appendix 1

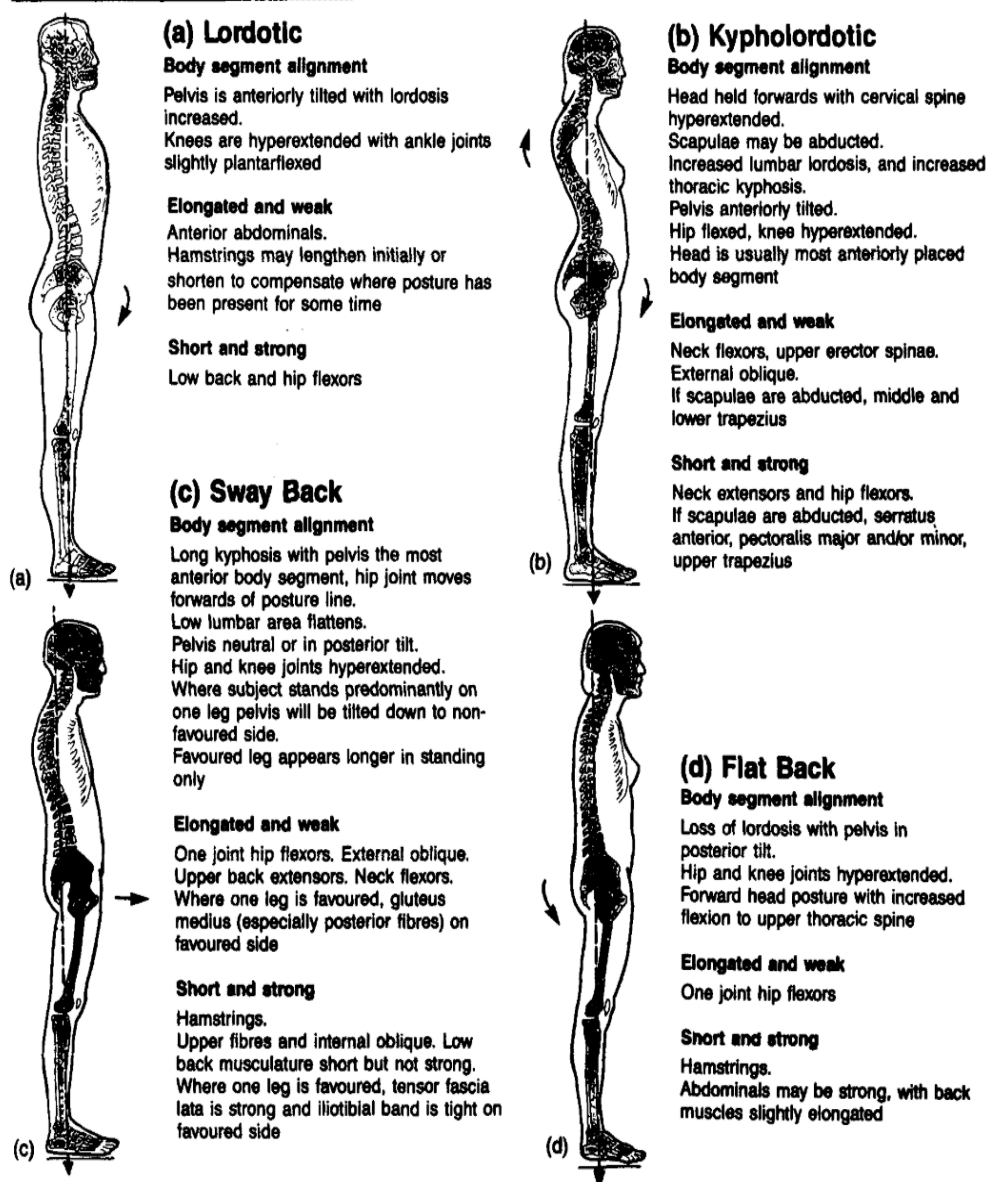


Fig 3: Posture types and muscle imbalance Kendall *et al*, 1993)

When a subject is viewed from the side and compared to a standard posture line (see text), four main posture types may be found. These are associated with shortened and lengthened muscles as shown.