Injury Prevention for Conductors:
Risk Factors, Exercise Interventions, and Ergonomic and Curricular Recommendations

Caron Daley, Greg Marchetti, and Matthew Ruane

Abstract

Although conductors are professional movers, injury prevention for conductors is largely unexplored in empirical studies of musician injury and pedagogical literature. Several unique factors may increase a conductor's risk for playing-related musculoskeletal disease, including the facilitative nature of the conducting instrument, the need for adaptable movement patterns, and the environmental and occupational stresses inherent in the role. Preventing conductor injury begins with increased somatic awareness of the body and attention to postural alignment and stability. Conductors are advised to develop increased upper body fitness, and five representative stretching and strengthening exercises are described and illustrated. Ergonomic considerations are also essential, including placement of the music stand and podium, choice of standing or sitting posture while conducting, and use of appropriate eyewear and footwear. Conductor educators are encouraged to take a frontline stance on injury prevention at all levels of instruction. This includes a greater emphasis on embodied learning, gestural practice habits, and self-care/body-conditioning for a career as a professional mover.

The conductor is a conspicuous figure in music. As a professional mover, teacher, researcher, psychologist, and arts advocate, a conductor displays myriad musical and non-musical competencies in what Demaree and Moses call an "intricate vocation."[1] Although archetypical concepts of a music conductor reveal a degree of gender and racial homogeneity, the role of a conductor is rapidly embracing new definitions and expressions. The complexities of the craft of conducting have likewise been demystified. Historically considered to be unteachable, courses in conducting are now an integral component of undergraduate music curricula and amply described in textbooks and instructional materials.[2,3] Currently, pre- and in-service conductor training is widely available in the United States, with programs tailored to all levels of and types of conducting.

[1] Robert Demaree and Don Moses, *The Complete Conductor: A Comprehensive Resource for the Professional Conductor of the Twenty-First Century* (Englewood Cliffs: Prentice Hall, 1995), 2.

[2] National Association of Schools of Music Handbook, 2019–20, 102.

[3] Alan Lee Baker, "Creating Conductors: An Analysis of Conducting Pedagogy in American Higher Education" (PhD diss., Stanford University, 1992), 22, ProQuest Dissertations & Theses Global.

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One dimension of conducting that needs more focused attention in education and training is injury prevention.[4] Repetitive bodily movement places conductors, as well as all musicians, at risk for injury. The cognitive and psychological stressors inherent in the role may compound the effects of dysfunctional movement patterns and postures, increasing the risk of injury. The role of a conductor, traditionally framed as decision-maker or "knower," may actually prevent a conductor from admitting to a physical concern or from seeking additional education or training in the vital subject of injury prevention. Traditional approaches to conductor education may likewise be a contributing factor. With an emphasis on learning via technical or pictorial description, observation of other conductors, and apprenticeship under a master conductor, conductor education has historically favored a disembodied approach to an embodied art form.

How then can a conductor prepare for a professional mover role in a holistic and healthy fashion, balancing the physical and mental demands of the profession? The purpose of this article is to:

(1) provide an overview of general risk factors for musicians and unique risk factors for conductors,

(2) review common injuries or other physical issues evident in conductors,

(3) introduce a sample set of preventive exercises to develop upper body muscular flexibility and strength in conductors,

(4) make recommendations regarding the ergonomics of rehearsal and performance, and

(5) advocate for the inclusion of injury prevention education in all levels of conducting instruction.

[4] Robert Sataloff, "Arts Medicine: An Overview for Choir Conductors," *Choral Journal* 49, no. 5 (Nov 2008): 31.

Risk Factors Playing-Related Injuries

The term injury is used to describe the application of energy (amount, duration, and frequency) to a body tissue that exceeds its physiological tolerance and capacity to resist the energy input, impairing normal function. Injuries that most commonly affect music performers are caused by prolonged exposure to the gradual effects of repetitive activities. The term "playing-related musculoskeletal disorder" (PRMD) was proposed by Zaza to describe any health condition where pain and other symptoms present a barrier to playing or performing at the performer's accustomed level.[5] Pain or other symptoms such as muscular weakness and sensations of numbness/tingling can indicate impairment of muscle tissues, joints, nerves, blood vessels, or any combination of these structures.[6] Combined estimates suggest that upwards of 50% of performers will sustain a PRMD at some point in their career,[7,8] with women at higher risk for PRMDs than men.[9]

In injury epidemiology, the term risk factor is applied to any characteristic associated with an increased likelihood of creating injury occurrence. Typically, risk factors are classified into two categories: modifiable risk factors and nonmodifiable risk factors. In both categories, a risk may be intrinsic to the person (e.g., body-

[5] Christine Zaza, "An Operational Definition of Musicians' Pain Problems [abstract]," in *Abstracts: 8th World Congress on Pain (International Association for the Study of Pain)* (Seattle: IASP Press, 1996): 69.

[6] Christine Zaza and Vernon T. Farwell, "Musicians Playing-related Musculoskeletal Disorders. An Examination of Risk Factors," *American Journal of Industrial Medicine* 32, no. 3 (1997): 292.

[7] Zaza, "An Operational", 292.

[8] P.T. Schaeffer and J. Speier J, "Common Medical Problems of Instrumental Athletes," *Current Sports Medicine Reports*, 11, no. 6 (2012): 316.

[9] Laura M. Kok, Bionka M. A. Huisstede, Veronique M. A. Voorn, Jan W. Schoones and Rob G. H. H. Nelissen, "The Occurrence of Musculoskeletal Complaints Among Professional Musicians: A Systematic Review," *International Archives of Occupational and Environmental Health* 89, no. 3 (April 2016): 377.

related) or extrinsic in the environment (e.g., venue or instrument).[10] Surveys of the general community of musicians and in those seen in health care settings have identified factors that can contribute to the development of PRMDs. The factors predisposing musicians to injury are similar to other occupational groups: (1) factors related to a person's body (age, body build, level of fitness and rehabilitation of previous injuries), (2) factors related to the physical act of playing or singing (quality of the instrument, musical technique, and practice habits) and (3) factors related to the performing environment (playing-related or personal stress and occupational demands).[11] In interpreting risk factors, associations (or correlations) are not synonymous with causation. For example, while injury is not correlated to age alone, an increased likelihood of injury due to other age-related factors can be identified; factors such as years of playing, level of fitness, or other age-related conditions (e.g. osteoarthritis).

Research studies involving instrumentalists reveal the nature and prevalence of PRMDs in specific musician groups. Most studies report that string playing of shoulder-mounted instruments poses the most significant risk, with upper arm, shoulder and neck pain complaints being the most prevalently reported conditions.[12] Shoulder, arm, wrist, and hand pain complaints predominate among players of other instruments.[13,14] The general population of performers and teachers report upper/lower back and neck pains, considered by many to be a natural consequence of the rigors of practice and performance.[15] While significant clinical conditions such as inflamed muscles/tendons, ligament sprain, nerve compression, and focal neurological conditions do present in performers, the most common complaints observed in musicians seen for clinical care involve widespread pain throughout the upper extremity region.[16]

As pain due to overuse is a common diagnosis in many forms of PRMD, a full description of the complexity and interaction among risk factors is beyond the scope of this article. However, it can be noted that it is not difficult to envision when considering the multiplicity of personal, performance-related, and environmental factors confronting musicians, the likelihood that pain can become a common reality in the pursuit of artistic excellence and economic stability. The performer may also come to view pain as a natural consequence of high-level performance, especially in the early stages of injury. As a result, the performer may be motivated to push the tissue tolerance limits in practice, rehearsal, and performance without allowing adequate time for recovery. This behavioral drive can serve as a foundation for conditions that will eventually prevent a performer from making music at the accustomed level of artistic quality.

Unique Risk Factors for A Conductor

The occurrence of PRMDs among singers and conductors is less reported compared to instrumentalists, leading to inadequate data

[10] National Association of Schools of Music and Performing Arts Medical Association, *Basic Information on Neuromusculoskeletal and Vocal Health Information and Recommendations for Administrators and Faculty in Schools of Music* (2014): II–11.

[11] Richard Norris, *The Musician's Survival Manual: A Guide to Preventing and Treating Injuries in Instrumentalists* (St. Louis, MMB, 1993), 2–6.

[12] Patricia Blanco-Pineiro P, M. Pino Diaz-Pereria M and Aurora Martinez, "Musicians, postural quality and musculoskeletal health: A literature review," *Journal of Bodywork and Movement Therapies* 21, no. 1 (January 2017) (2017), 161–163.

[13] Blanco-Pineiro, "Musicians", 161–163.

[14] Frederico Barreto Kochem and Silva Julio Guilherme, "Prevalence of Playing-related Musculoskeletal Disorders in String Players: A Systematic Review," *Journal of Manipulative and Physiological Therapeutics* 41, no. 6 (2018): 546.

[15] Cecilia Wahlström Edling and Anncristine Fjellman-Wiklund, "Musculoskeletal disorders and asymmetric playing postures of the upper extremity and back in music teachers: A pilot study," *Medical Problems of Performing Artists* 24, no. 3 (September 2009): 115.

[16] Christopher B. Wynn Parry and Raoul Tubiana, "Dystonia", in *The Musicians Hand: A Clinical Guide*, ed. Ian Winspur and Christopher B. Wynn Parry (London: Martin Dunitz, 1998): 5.

regarding the nature of the injury in these groups. Brandfonbrener suggests that conductors may be susceptible to musculoskeletal injury involving the back, neck, and shoulders, as well as possible injuries associated with misuse of the baton.[17] Kella suggests that specific conducting activities, such as strongly accented marcato conducting or slow conducting with an overabundance of muscular tension, could lead to muscular overuse. When gesturing, conductors should always use the rebound of the beat to dispel physical tension, counteracting the possible damaging effects of excessive kinetic force.[18] Several common podium habits may also be to blame, including a forward-leaning posture, twisting the upper body without moving the lower body, locking the knees, raising the shoulders, excessive flexion of the joints, and vocal misuse. The intensity of a conductor's performance, as well as hectic travel schedules that do not allow for physical rest, may also serve to create uniquely "tension-inducing lifestyles."[19]

Revisiting the nature of the conducting instrument underscores a plan for prevention and intervention. Musicians typically begin their conducting study after gaining proficiency in instrumental or vocal performance. As such, conducting is considered a secondary instrument and technique generally acquired as an adult. Conducting requires a new set of physical and aural proficiencies that relate only tangentially to instrumental and vocal techniques. Even though most emerging conductors have performed in an ensemble led by a conductor, their knowledge and experience of conducting is rarely firsthand. For some students, prior experiences in athletics, martial arts, or dance provide a foundation for conducting movements, while for others, conducting instruction is an initial experience in coordinated body movement. This new physical education requires addressing preexisting dysfunctional movement patterns, structural issues in posture, and perception of body image—factors that may slow conducting learning. Identifying these types of limiting factors may be beyond the scope of the course or the conductor-educator's comfort level and expertise—a rationale for an interdisciplinary approach to conductor well-being.

In addition to acquiring new technical skills, conducting involves learning other skills such as leadership, making decisions about the score, diagnosing errors in rehearsal, and planning a rehearsal sequence. For many emerging conductors, these new and broad-reaching skills can introduce anxiety. The public nature of practicing conducting puts the individual conductor's personality and body shape fully on display. The stress only intensifies when a podium experience (a public demonstration of a conductor's emerging skill set) is evaluated and graded.[20] These stressors can compound as a conductor moves into dress rehearsal and performance, where a new venue, different acoustics, the positioning of performers, and ensemble collaborations may result in the need for a conductor to use movement patterns that are reactionary to the new environment.

It is also important to consider the facilitative nature of the conductor's body. Unlike instrumentalists, a conductor does not hold or touch a physical object (other than a baton). The conductor does not emit sounds, but rather uses arm and body movements to evoke sounds from others. For this reason, a conductor engages in "free" versus "fixed" use of the extremities. Free extremity use can make regulation of muscle activity more challenging and highly variable.[21]

[17] Alice Brandfonbrener, "The Etiologies of Medical Problems in Performing Artists in Performing Arts Medicine," in *Performing Arts Medicina*, ed. Robert T. Sataloff (San Diego: Singular, 1999), 40–41.

[18] Kella, "Medicine", 60.

[19] Brandfonbrener, "Etiologies", 40–41.

[20] Baker, "Creating Conductors", 18.

[21] Federicko Pozzi, Hillary A. Plummer, Natalia Sanchez, Yunai Lee, I and Lori A. Michener, "Electromyography Activation of Shoulder and Trunk Muscles is Greater During Closed Chain Compared to Open Chain Exercises," *Journal of Electromyography and Kinesiology* (in press).

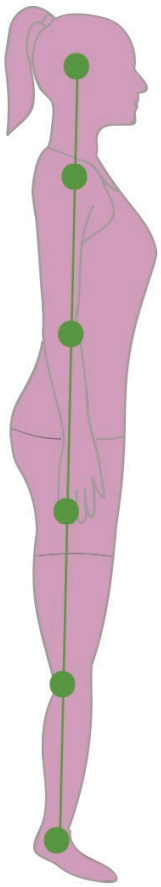
In order to acquire the skilled, controlled movements required in conducting, there must be an interaction between stored physical memories and real-time consciousness of movement. An instrumentalist relies on previously-stored movements learned through repetition on any given instrument. As these movements are refined and improved, less physical effort is required. On the contrary, a conductor relies less heavily on stored movements, reacting to changes in the ensemble's performance to dictate gesturing. A conductor can self-monitor movement through listening to the ensemble and regulating the somatic sensations of the moving body, which requires a strong integration of body and mind. A conductor, unaware of his/her movements, can compromise communication with other musicians or subconsciously model postures and movements that can produce harmful effects on ensemble members.

Common Physical Issues in Conductors
Postural Alignment

Injury prevention begins with an understanding of postural alignment. The term postural alignment refers to the total coordination of all joints of the body while assuming any position. Optimal postural alignment provides the foundation for the performer to remain stable and balanced while executing the required movements, expending minimal energy and stress on body structures (joints, muscles, and supporting tissues). Postural stability and balance with minimal muscular effort afford two benefits: (1) a stable foundation allowing the arms to smoothly perform the varied and repeated complex upper body motions required for conducting for the duration of a performance, and (2) flexibility to move smoothly and adjust efficiently in response to changing aural and physical stimuli. Postural alignment for effective conducting requires the ability to execute a variety of smoothly coordinated upper body movements while maintaining stability throughout the trunk and legs to balance the body's weight.

Standing static posture is generally defined by vertical alignment of the ears, shoulder, hips, and ankles, with weight equally supported by the feet (Figure 1). The anatomical landmarks in Figure 1 denote typical neutral standing postural alignment and should be considered a reference point. Variations in neutral static postural are common between individuals and do not necessarily indicate a source of conducting-related dysfunction. These variations can be caused by many factors: body type, joint flexibility, muscle compensations, and existing health conditions. While it is during conducting movements (i.e. dynamic postures) that problems can be realized, alterations in static postural alignment may be indicative of potential sources of dysfunctional movement throughout the upper body and spine.

Figure 1: Typical Alignment



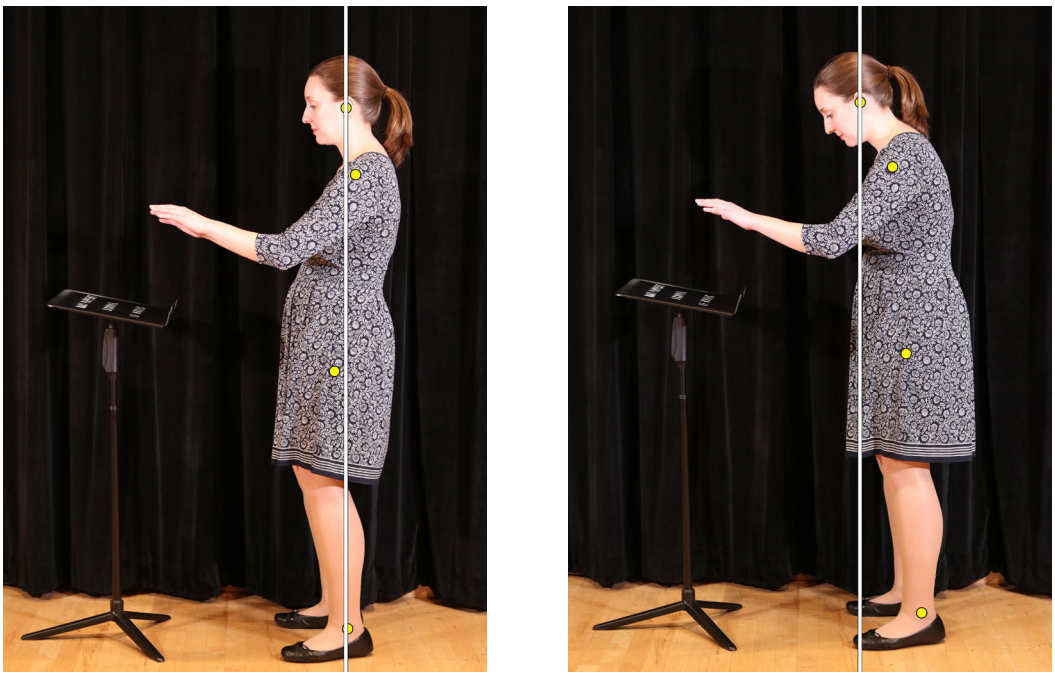
Two common variations in postural alignment can be observed in a conductor: lordosis (excessive low back curvature) and kyphosis (excessive forward mid-back curvature). Figure 2a illustrates lordotic posture, an excessive backward curvature in the lumbar spine, with a compensatory curve in the upper back and neck. This posture can promote the development of areas of alternating excessive tension and laxity throughout the spine. The second postural variation (Figure 2b), illustrates reduced trunk stability, a flattened lumbar spine, and excessive thoracic kyphosis. The head and shoulders are positioned forward and downward in both variations, resulting in reduced foundational arm stability, creating possible muscle overuse. Over time, pain throughout the upper body and shoulder joint dysfunction can further impair a conductor's ability to execute smooth and varied movements needed to guide musical performance.

A key element of a conductor's dynamic posture relates to the sense of sight. Constantly alternating eye contact between an ensemble and a score is accomplished by head, shoulder, and upper body movements. The musical score is generally positioned low in the visual field, while the performers are generally positioned at eye-level or above. The varied head and neck movements of a conductor, if performed on a faulty postural base or with a persistent forward head (Figure 2b) can result in a cyclical pattern of pain and movement compensation. This may be manifested most significantly in the upper back and scapula muscles, as they must work harder to provide stability in increasingly dysfunctional positions.

Injury Prevention Exercises: Postural Alignment, Stretching and Strengthening

The following exercise suggestions have been selected by the authors to address strength and flexibility deficits that can affect a conductor's upper-body posture. Completing regular strengthening and stretching exercises enables a conductor to maintain optimal alignment and

Figures 2a and 2b: Common Postural Variations



posture on the podium, putting less stress on vulnerable anatomical structures. All exercise, set, repetition, and resistance guidelines presented are suggestions. Prior to starting this or any exercise regimen, a discussion with a physician, physical therapist, or other healthcare professional is advised.

Stretching routines aid a conductor in increasing muscle length and joint range of motion and promoting smoothly coordinated movement. Not all types of stretches are equal in outcome. Static stretching or holding a position in which a stretch can be "felt" for a set amount of time, will result in an increase in joint range of motion. Importantly, research has shown that static stretches immediately preceding a physical activity, such as conducting, can temporarily decrease muscle performance. Dynamic stretches, by contrast, are carried out by slowly moving back and forth through a joint's range of motion, and do not decrease muscle performance. In fact, some research has found that muscular performance is slightly increased following dynamic stretching. Additionally, blood flow to involved muscles is increased, resulting in greater oxygen transfer.[22] Thus, dynamic stretching should be performed prior to rehearsal and performance, while static stretching should only be completed on non-rehearsal and non-performance days or after completing rehearsals and/or performances.[23,24] Joint range of motion improves immediately following stretching, with a permanent improvement appearing three to four weeks after a regular stretching is established (at least 2–3 times per week). All stretches should be performed so that tightness or minor discomfort is felt, although care should be taken to avoid stretching to the point of pain.[25]

Shoulder Raising and Lowering with Coordinated Breathing

This first exercise strengthens back musculature to help hold the scapulae in an ideal position. During conducting, the scapula must remain stable in order to support arm movements. Paradoxically, at the same time, the scapula must be allowed to freely move against the back in a well-coordinated movement with the arm, especially when the arm is elevated above shoulder level. This exercise also cues proper upper body posture, avoiding a biomechanically-harmful "rounded shoulder" position because the anterior chest muscles are stretched during the elevation phase of the exercise. Additionally, the coordinated breathing aspect of this exercise can promote relaxation prior to a performance. This exercise is demonstrated in Figures 3a and 3b with a resistance band but can be performed without one as well. Both variations are described below.

- Begin with the neck bent forward, shoulders rotated inward, forearms crossed, palms facing the floor, and hands held in fists resting on the front of the hip bones (Figure 3a).
- Inhale deeply, lift and uncross arms, rotate shoulders outwards, turn palms to face behind the body, open fists, and extend neck upward until facing forward (Figure 3b).
- Pull shoulder blades towards each other and down.
- Hold this pose and inhale.
- Next, exhale, returning to the starting position at a controlled speed.

[22] David G. Behm, Anthony J. Blazevich, Anthony D. Kay, and Malachy McHugh, "Acute Effects of Muscle Stretching on Physical Performance, Range of Motion, and Injury Incidence in Healthy Active Individuals: A Systematic Review," *Applied Physiology, Nutrition, and Metabolism* 41, no. 1 (2016): 1–11.

[23] Riebe, *American College*, 169.

[24] Phil Page, "Current Concepts in Muscle Stretching for Exercise and Rehabilitation," *International Journal of Sports Physical Therapy* 7, no. 1 (2012): 110.

[25] Deborah Riebe, Jonathan K. Ehrman, Gary Liguori, and Meir Magal, *American College of Sports Medicine's Guidelines for Exercise Testing and Prescription* (Philadelphia: Wolters Kluwer, 2018): 170.

- A resistance band can be used to make this exercise more challenging. Hold the resistance band in the palms of both hands with as little slack as possible to allow for full movement through the exercise (Figures 3a and 3b).
- Perform 2–3 times per week. Each repetition should take 5–8 seconds.
- Complete 10 repetitions total, stretching to the point of feeling tightness or mild discomfort.

Doorway Chest Stretch

Rounded shoulder posture can increase the likelihood of shoulder injury.[26] One purported cause of rounded shoulder posture is a characteristic pattern of shortened chest and shoulder muscles and weakened neck and mid-back musculature that leads to postural dysfunction.[27] The muscles of the anterior chest are commonly shortened in individuals displaying this pattern. Stretching anterior chest structures and strengthening back and scapular musculature can aid in maintaining optimal upper body posture.

Developing muscular endurance should be prioritized because the act of conducting involves prolonged episodes of repetitive movement. A higher repetition of low resistance strengthening exercises has been shown to produce the most significant improvements in achieving increased muscle endurance. Muscle strengthening exercises improve posture, promote smoothly coordinated movement, correct imbalances in muscle strength, and increase muscular endurance.

Figures 3a and 3b: Shoulder Raising and Lowering with Coordinated Breathing

[26] Omid Alizadehkhaiyat, Margaret M. Roebuck, Ahmed T. Makki, and Simon P. Frostick, "Postural Alterations in Patients with Subacromial Impingement Syndrome," *International Journal of Sports Physical Therapy*, 12, no. 7 (2017): 1111.

[27] Eun-Kyung Kim and Jin Seop Kim, "Correlation Between Rounded Shoulder Posture, Neck Disability Indices, and Degree of Forward Head Posture," *Journal of Physical Therapy Science* 28, no. 10 (2016): 2929.

Perform each of these exercises 2–3 times on non-performance days of the week, completing 2 sets of 10 repetitions with a 2-minute rest in between sets. Strengthening workouts should be a minimum of 48-hours apart. In addition, strengthening workouts should not be performed on the same day as a performance to avoid muscular fatigue.

Chest Stretch Exercise

- Stand at an open doorframe.
- Extend upper arms out to the side and parallel to the floor, with both elbows flexed to 90° and forearms resting vertically on the doorframe (palms touching the frame). The elbows should be slightly below the level of the shoulders.
- With arms anchored on the frame, step into the doorway with the right leg. The stretch should be felt across the front of the chest.
- Stretch to the point of feeling resistance. This should not be painful.
- On performance days, perform dynamically, slowly moving through the range of motion, stopping at the end for 1–2 seconds before returning to the starting position. Each repetition should take 5–8 seconds. Complete 10 repetitions total.
- On non-performance days, hold the stretch for 20 seconds for 3 repetitions (total 60 seconds). Repeat with the left leg stepping into the doorway, alternating leading leg between repetitions (Figure 4a and 4b).

Figures 4a and 4b: Doorway Chest Stretch

As the act of conducting involves prolonged episodes of repetitive movement, developing muscular endurance should also be prioritized. To achieve increased muscle endurance, higher repetition of low-resistance strengthening exercises has been shown to produce the most significant improvements. Muscle strengthening exercises improve posture, promote smoothly-coordinated movement, correct imbalances in muscle strength, and increase muscular endurance. Perform each of these exercises 2–3 times on non-performance days of the week, completing 2 sets of 10 repetitions with a 2-minute rest in between sets. Strengthening workouts should be a minimum of 48-hours apart. In addition, strengthening workouts should not be performed on the same day as a performance, to avoid muscular fatigue.

Isometric Internal and External Shoulder Rotation

The muscles of the rotator cuff function to hold the humeral head (the ball of the bone in the upper arm) against the joint surface of the scapula during active shoulder movement. When these muscles are weak, the humeral head can be pulled upwards by the deltoid muscle, impinging on tissues that lie between the humeral head and acromion (the roof of the shoulder complex). The muscles of the rotator cuff also act as internal and external rotators of the shoulder. Strengthening the rotator cuff musculature through resisted internal and external rotation training will improve their overall function during overhead activities, including any conducting gestures that rise above the head.

This first variation works to strengthen shoulder internal rotation.

- Bend the right elbow to 90º and position it so that it is touching the side of the torso.
- Place the right palm on a wall or other sturdy surface. The forearm should be perpendicular to your chest.
- Next, attempt to rotate the right hand in towards the belly button. The wall will provide enough resistance so that the right forearm does not shift.
- The right elbow should remain in its starting position throughout this exercise.
- Hold the muscle contraction for 5 seconds. Repeat on the left side.

This second variation will strengthen shoulder external rotation.

- Begin with the right arm in the same starting position as with internal rotation but reposition so that the wall is providing resistance to the outside of the right hand.
- To perform the exercise, rotate the right forearm away from the torso and into the wall. Again, the wall should prevent your forearm from moving; the focus is on contracting the muscles.
- Hold for 5 seconds.
- Repeat on the left side (Figure 5a and 5b).

Figures 5a and 5b shown on next page.

Figures 5a and 5b: Isometric Internal and External Shoulder Rotation

Wing-arm Breathing with Scapular Retractions

This exercise serves three purposes. First, it strengthens the upper back muscles, which hold the scapulae in ideal posture to decrease the likelihood of shoulder injury resulting from upper extremity activity. Second, it stretches the muscles of the anterior chest, which can become tight secondary to sustaining a nonoptimal posture in which the thoracic spine is excessively curved forward. Finally, the encouragement of slow, deep breathing can help to decrease stress.

- Begin standing with both arms resting at either side.
- Bend elbows to 90° and turn both palms, so they face upwards.
- Inhale deeply, rotating both forearms outward from the torso. The elbows should remain in their starting position, in contact with the torso.
- While inhaling, focus on using the muscles in the upper back to pull both shoulder blades together. Hold this position until ready to exhale.
- Upon exhaling, slowly return to the starting position (Figures 6a, b, c, and d).

A resistance band can be used to provide resistance to make this exercise more challenging. Hold the resistance band in the palms of the hands, with as little slack as possible to allow for full movement through the exercise.

Figures 6a, 6b, 6c, and 6d shown on next page.

Figures 6a and 6b: Wing-arm Breathing with Scapular Retractions

Figures 6c and 6d: Wing-arm Breathing with Scapular Retractions

Chin Tucks

This exercise works to strengthen the intrinsic muscles of the anterior neck, which can help to hold the head in optimal posture. The head is fairly heavy, at up to 1/7 of the total body weight. When the head is leaning forward, the neck and upper back musculature are placed under significant stress compared with a neutral head position.[28] This can lead to the unfavorable postures that increase the likelihood of shoulder injury given the motions in conducting. The muscles at the posterior neck are also stretched when performing this exercise, increasing their available range of motion.

- Rest the dominant hand on the chin to begin the exercise, applying no force.
- Without moving the hand, pull the head directly backward. To keep the head moving straight back and not pivoting up or down, focus the eyes on a spot on the wall, which is at eye-level. The desired sensation is a contraction of the muscles on the front of your neck and a stretch in the back of the neck.
- Hold this position for 3–5 seconds, and then relax slowly back to the starting position (Figure 7a and 7b).

Ergonomic Considerations of Rehearsal and Performance

A comprehensive musculoskeletal wellness program addresses the ergonomic factors that can impact conducting. Prior to leading rehearsals, conductors should complete a physical warm-up. Conductors are well-versed in the use of warm-ups for singers but may be less familiar with the notion of warming-up the body for conducting. After a dynamic warm-up, rehearsals should be structured with less physically demanding pieces toward the beginning, progressing to

Figures 7a and 7b: Chin Tucks

[28] Kim, "Correlation", 2929.

more challenging work at the mid-point of the rehearsal. Rehearsal breaks should be implemented before the onset of any physical discomfort. A conductor is well-served to observe the temporal relationship between conducting and the onset of any discomfort and attempt to structure breaks to keep discomfort at bay.

To minimize physical disruption to conducting activities, a conductor may find it beneficial to proactively plan adjunct activities such as page-turning. Sudden and rapid changes in movement patterns can increase stress and discomfort. The potential for injury can also increase during preparation for events such as recitals, concerts, or tours. These changes in workload and associated psychological demands can create rapid increases in length, complexity, and effort on the podium. In these cases, a conductor should increase rehearsal frequency rather than duration, and take frequent breaks.

Returning to Conducting After Injury

The following suggestions are meant to serve as general principles for post-injury return to full conducting function, and with optimal individualized guidance from an injury management professional to prevent re-injury.

Rest and Assessment

Essential to injury recovery from a conducting injury is rest and an assessment of symptoms and overall factors by a healthcare professional. If any nonconducting activities appear to be contributing factors to the injury, these activities should be avoided until symptoms disappear. In order to return to the podium, a conductor should focus on identifying the exact practice interval (time and effort) that allows the body to remain symptom-free. The next stage would be to introduce a gradual increase in exertional effort within that same time period. The final stage would be to gradually increase the duration of performance sessions (e.g., 20–30 minute increase per week) with a constant vigilance for symptom provocation. A conductor may also need to revisit conducting techniques, with a focus on reducing overly large and energetic gesturing.[29]

Line of Sight

In the rehearsal setting, a conductor's posture will be affected by the configurations of the rehearsal space, such as the placement of the music stand, conducting stool, podium, and ensemble. Ideal positioning of the music stand will allow a conductor to view the music at eye-level, but this would severely limit communication with the ensemble. Head, neck, and upper back postures will be driven by the need to alternately look at both the score and the ensemble. Positioning the stand as high as possible in the lower half of the field of vision will support a more neutral upper body position, thus freeing arm movement. To accomplish this, a conductor should position the stand further away from the body, to lessen the angle while looking at the score. If a conductor uses visual correction, positioning the stand at a height that optimizes the corrective prescription parameters will help, but conductors should also consider having dedicated eyewear for conducting activities. If it is within the artistic practice of the conductor, memorizing the score can facilitate upright posture and optimal communication with the ensemble.

[29] Kella, "Medicine", 54.

Sitting or Standing

Conductors should also weigh their choice of sitting versus standing while conducting. Standing allows for optimal breath function, compared to sitting.[30] Static standing postures will result in prolonged contraction of leg muscles, reducing blood flow. Muscle contractions help maintain blood supply to working muscles, reduce fatigue, and prevent the natural tendency for fluid to accumulate in the lower leg due to the effects of gravity. When a conductor must stand for a prolonged period of time, a well-balanced posture should be maintained as well as alternating between equal weight distribution and gentle weight shifting. Fatigue from prolonged standing can also be lessened by comfortable footwear that provides pressure reduction either in the soles or with the use of supplemental insoles. If a conductor rehearses in a consistent rehearsal space, the addition of pressure-reducing matting can improve the hardness of existing flooring surfaces. These mats allow for a gentle weight shift under the feet when standing in one place, creating alternative muscle activity to reduce fatigue and facilitate a blood flow return to the leg. Walking breaks can also be used to reduce the effect of prolonged muscle use in standing. If seated postures afford more comfort, conductors should choose adjustable-height seating options to vary their posture. Kella warns against "stool tilt" for conductors, a position with one leg on the ground and one leg wrapped around a stool rung. This tilting of the pelvis can result in asymmetry in the spine and back strain.[31]

Medical Management

Finally, it should be recognized that when injury symptoms become a problem, a conductor should seek interdisciplinary medical management with physicians and other personnel familiar with performance injuries, including referrals to service providers such as physical therapists. These professionals can provide individualized rehabilitation interventions to guide a conductor's return to optimal performance and help maintain that level of function upon recovery. Many programs housed in academic institutions have health and rehabilitation services that can provide such expert guidance and be integrated into music program curricula.

Curricular Recommendations for Educators of Conducting Students

A critical function of conductor education is to prepare conductors for the physical and mental demands of conducting, including the development of anatomical or somatic awareness and self-care/body conditioning for a career as a professional mover. While instrumental performers may receive formal instruction on injury awareness and prevention strategies in academic settings, the same cannot be said of educators of conducting students and their students. Injury prevention principles should be integrated early in conductor training as a part of skill development. The dynamic and changing stressors of a conductor's career (new jobs or ensembles, changing demands in repertoire) and the body's aging over time suggest that injury prevention must be an ongoing focus for a conductor.

Like other studio music teachers, conductor educators can play a front-line role in preventing performance injury. In studio, class, and podium settings, conductor educators should take every opportunity to draw attention to the embodied nature of the conducting instrument. Guiding students to sense how a movement feels, rather than how it looks, can increase internal awareness

[30] Shikma Katz, Nissim Arish, Ariel Rokach, Yacov Zaltzman, and Marcus Esher-Lee, "The Effect of Body Position on Pulmonary Function: A Systematic Review," *Pulmonary Medicine* 18, (2018): 170.

[31] Kella, "Medicine", 59.

and regulation of movement. Educators should also carefully evaluate their own bodies, including physique, history of injury, recurring problems with posture or tension, and gestural movement patterns. Injury can result when a conducting teacher imposes certain movement patterns on a conducting student, regardless of the student's physique or bodily experience (prior injuries, prior movement experiences, or body image). Additionally, conducting students may appropriate gestures from teachers that do not fit their bodies. In the event a student encounters discomfort or other difficulty executing conducting movements, it may be prudent to seek consultation with a provider familiar with posture/movement-based problems in performers.

A recent surge of interest in somatic pedagogies and movement methodologies in conducting education has drawn greater awareness of the interrelationship between the body and sound. Movement methodologies prioritize a conductor's somatic perspective, teaching body awareness before movement patterning to help conductors become "informed movers."[32] Tools such as the Swiss Exercise Ball may help conductors to combine somatic awareness with the body's movement through space, a type of awareness described as "kinclusive."[33] Pedagogies such as The Alexander Technique, Body Mapping, Feldenkrais Method®, Laban Movement Theory, Tai Chi, and Dalcroze Eurhythmics may aid in the development of expressivity for conducting, an aspect of a conductor's education that textbooks often fail to develop.[34] While these approaches are widely referenced in recent literature, it remains unclear how extensively these methods are currently integrated into practice by conductors and conductor educators, and what specific conducting functions they serve to develop.[35]

In addition to increased somatic awareness, a conducting student will benefit from healthy practice habits throughout the entirety of a conductor's process—from score study to performance. Score study—the stage in which a conductor prepares to conduct—is typically considered an analytical activity, involving visual analysis and score marking, playing and singing of parts, and background study. A conductor's movement expression, or gesture, is typically considered to be the outcome of that score preparation process. When a conductor waits to practice gesturing movements until rehearsal, the extemporaneous movement patterns may be less than physically optimal. A conductor needs practice skills for performance too, where flexible gesturing allows conductors to adapt to changing aural and environmental stimuli.

Dalcroze Eurhythmics has been proposed as a tool for merging a conductor's study of the music with their awareness of body movement.[36] Dalcroze games, such as stepping to the pulse of the music or travelling through space to show the shape of a phrase, may help to solidify a conductor's musical interpretation. Externalizing the music through whole-body movement also aids in the development of inner hearing of the music.[37] Dalcroze techniques integrate improvisation, a tool that Spaulding suggests can break habits of tension accrued through intense study of a score.[38]

[32] Lisa Billingham, *The Complete Conductor's Guide to Laban Movement Theory* (Chicago: GIA Publications, 2009), xvi.

[33] James Jordan, *Learn Conducting Technique with the Swiss Exercise Ball: Developing Kinclusive Conducting Awareness* (Chicago: GIA Publications, 2002), 23.

[34] Andrew Mathers, "How Theories of Expressive Movement and Non-Verbal Communication Can Enhance Expressive Conducting at All Levels of Entering Behaviour" (PhD diss., Monash University, 2008), 18, ProQuest Dissertations & Theses Global.

[35] Alan J. Gumm and Katherine L. Simon, "Investigation of the Effects of Movement Methods on Functions of Conducting," *Symposium on Music Teacher Education: Research Presentation* (September 2011), 3.

[36] Caron Daley, "Generating Gestures: Using Dalcroze Eurhythmics to Prepare to Conduct," In *The Choral Conductor's Companion*, ed. Brian J. Winnie. (Delray Beach: Meredith Music Publications, 2020).

[37] Caron Daley, "Reimagining Conductor Score Study through the Principles of Emile Jaques-Dalcroze's Eurhythmics," *Choral Journal 58, no. 8* (March 2018): 23.

[38] Crispin Spaulding, "Before Pathology: Prevention for Performing Artists", *Medical Problems of Performing Artists* 3, no. 4 (December 1988): 138.

Baker agrees that improvisation invites conductors out of their musical and physical comfort zones and halts "Immediate Results Syndrome", a desire to achieve a correct outcome on the first try.[39]

An improvisation exercise such conducting a passage three different ways can free the student from a strict musical and movement interpretation of the music, thereby reducing physical and mental tension.

Inclusion of body-based learning in the conducting curriculum is essential, but more than this, ongoing continuing education in body mechanics, stretching, and wellness are needed. Principles of healthy lifestyle and maintenance of overall aerobic and musculoskeletal fitness are also essential to the preparation for and continuation of a career in conducting. More specifically, conductors are well-advised to focus on upper body strength and flexibility for optimal body usage on the podium. In preparation for more intensive conducting schedules or extended works of repertoire, conductors should incorporate practice and rehearsal schedules that build endurance and stamina. Conductor educators should likewise introduce conducting concepts as if teaching a new sport, scaffolding learning and performance experiences to promote physical and mental health.

Injury Prevention Advocacy for the Conducting Professional

A conductor's gestures are ideally the result of a deep integration of mind and body, representative of a conductor's intellectual and artistic impulses, and free from physical hindrance or concern. Several unique risk factors may make conductors more susceptible to injury. These include the facilitative nature of the conducting instrument, the lack of practiced movement patterns, and the environmental and occupational stresses inherent in the role.

A distinct lack of available research on conductor injury prevention suggests that the field has yet to address the issue fully. More research and advocacy are needed. First, empirical research investigating the incidence and type of injuries sustained by conductors at all levels will provide a clearer picture of the issue. Second, prioritizing pedagogical materials and course designs that address injury prevention and body awareness early and often will facilitate a broad awareness of the topic and make an impact on future practice and teaching. Third, advocating for injury prevention as foundational to the body of skills needed for successful conducting among service organizations and accrediting bodies will ensure that injury prevention is thoroughly addressed.

The conducting profession is singular in its demands on the musician. As the profession grows in scope and popularity, an opportunity for conversation about injury prevention exists in diverse domains. The identification of unique risk factors for conductor injury has the potential to guide individual conductors and teachers of conducting in their methods and performance. Implementing appropriate exercise and ergonomic interventions will make a conductor physically prepared and mentally focused with an increased ability to dedicate their energies to delivering optimal musical rehearsals and performances. Inclusion of injury prevention at all levels of conductor education will ensure a healthy future path for the profession.

[39] Baker, "Creating Conductors", 97.

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