

Importance of Issue

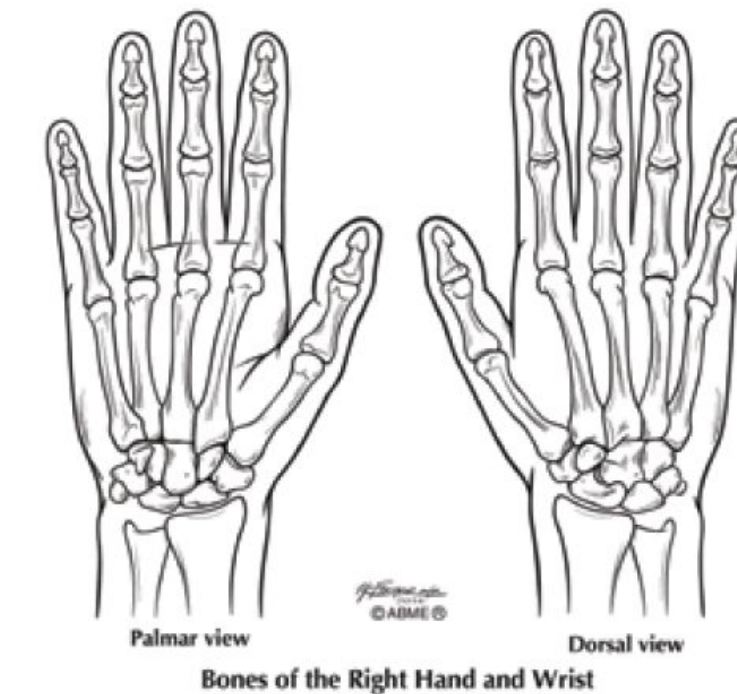
Injuries Incurred by Musicians in General - Hypothesized Causes, Statistics

Need for Further Research

Studying performance-related injuries in musicians is important to the musical and medical fields because these types of injuries are career-threatening to musicians, and understanding how repetitive motion and inefficient ergonomics lead to injury can help other fields and industries with their physical tasks. For violinists, sustaining an injury induces pain and discomfort and leads to lost earnings, so musicians have looked for ways to continue performing. For medical professionals, understanding the causes of injuries, how they can be prevented, and how they can be mitigated allows them to take what they've learned and apply it to other patients.

Why Musicians are at Risk

Musicians are highly prone to injuries caused from playing their instrument. Increases in the complexity of music over time and the inherent physical challenges of performing -- repetitive motions requiring high precision and agility -- make performing music one of the most likely occupations to sustain work-related injuries.



Sanchez Diaz, Gabriela. "Body Mapping: An Approach to Understand and Reduce Common Injuries in Musicians," fig. 1.

Proposed Causes of Musician Injuries

Although music performance does not necessarily end with injury, several practices and causes are thought to be causes. For example, several causes rated by musicians and health experts include, but are not limited to:

Musician Ranking	Offered Causes	Expert Ranking
1	Long hours of practice	4
2	Sudden increases in practice time	2
3	Poor posture	1
4	Technique flaws	5
5	Insufficient rest breaks	3
6	Lack of understanding of physical strain	9
7	Insufficient warm-up	7
8	Inadequate chairs	10
9	Travel strains	13

Ackerman and Adams. "Perceptions of Causes of Performance-Related Injuries by Music Health Experts and Injured Violinists," fig. 1.

There is a clear need for further research in this field. Better understanding of the causes and contributing factors of performance-related injuries will help physicians better understand other injuries caused by repetitive stress and poor ergonomics, which exist in all industries. Additionally, additional research will allow for the development of treatments and mitigations to these injuries, which will help current musicians, some of whom are struggling with injuries, to perform at their best. Finally, more research in musician knowledge of physiology and wellness practices are needed because determining education gaps is important since better self-care will reduce the incidence of performance-related injuries.

Broad Overview of Past Research

Berezutsky and Berezutskaya summarize the history of scientific study in performance-related injuries by musicians. From their research, they roughly divide the history of this field into three main periods.

Phase One

Origins to Late 1800s

In the first phase, the plight of musicians had virtually no interest from the scientific community, so musicians were involved in developing anecdotal treatments. It has been known that musicians have suffered performance-related injuries since at least the Greeks, but serious thought into this subject is not known to exist until at least the 1800s with the writings of Louis Spohr, a violin pedagogue. His theory was that poor ergonomics (which focuses on how people interact with physical interfaces) caused by both poor posture from incorrect training and incompatible instrument design. Further musician-driven research would follow, though these often only focused on violinists and pianists.

Phase Two

Late 1800s to Early 1900s

In the second phase, musicians and physicians began interacting and attempting to apply the opposing field's concepts toward addressing this problem, but all attempts were still clouded by poor understanding. Physicians such as George Vivian Poore began applying medical knowledge to musical performance issues such as the "Stuttgart piano method", which was problematic due to what Poore cited as excessive strain exacerbated by the musician's underlying weakness. Musicians likewise began making more medically-informed suggestions: Leopold Auer, a famed instructor and performer, made specific recommendations to prevent injury, and Ivan Ivanovich Kryzhanovskiy, another violinist and physiologist, who contributed to the development of a piano method by Anna Schmidt-Shklovskaya that minimized strain. However, poor interdisciplinary cooperation led to inaccurate suggestions to be popularized. This included the popularity of William Forbes's "ring finger liberating" surgeries and their derivatives.

Phase Three

Early 1900s to Present

The third and current phase is exemplified by tight cooperation between the musical and physiological disciplines to understand the nature of the opposing field of study and the problem of performance-related injuries. Research into this field is active, and many scholars today are attempting to analyze causes of these injuries and propose possible mitigations.

Injuries Incurred by Violinists Specifically - Hypothesized Factors, Current Research Methods

Aggravating Factors

Violinists specifically face several additional factors that make them even more likely to sustain injury than other musicians on average. These factors include, but are not limited to:

- Asymmetric use of the left and right arms and forearms; and
- Maintenance of an elevated arm position.

Specific techniques and playing styles that violinists perform that place more strain on a player's muscles include:

- Playing faster,
- Playing louder,
- Playing on a lower string, and
- Playing with a lighter bow.

Research Tools

To observe muscle activity, configuration, and use, researchers use tools such as electromyography and optoelectronic systems (motion tracking). Data collected from these tools is then analyzed and compared with reference data and control groups to draw conclusions.

Summary Statistics

65-88% Percent of violinists who will be injured sometime in their career

65.2% Percent of musicians with pain in their wrist/hands at any time

8.3/100 Number of upper-extremity injuries in musicians per 100 performances

Common Injuries

Common injuries among musicians include:

- Tendonitis: the inflammation of the tendons;
- Tenosynovitis: the inflammation of the sheath around the tendons;
- Dystonia: involuntary muscle contractions; and
- Temporomandibular disorders (such as TMJ); the disfunction of the joint connecting the jaw to the skull

Violinists are especially prone to injuries in the neck, shoulders, and arm area due to significant muscle activity in that area.

Muscles Impacted and Functions

Violinists use the following muscles to play their instrument, and any of these could be compromised by a performance-related injury:

- Biceps: allows flexing of elbow and outward arm rotation (used to extend and contract right arm for bowing);
- Triceps: facilitates elbow extension (used to extend and contract right arm for bowing);
- Trapezius: facilitates rotation of neck and shoulders (used to support violin and engage right arm for bowing);
- Sternocleidomastoid: facilitates head tilt and rotation (used to support violin);
- Deltoids: facilitates arm movement (moves left fingering arm and right bow arm); and
- A variety of extensors, flexors, and other muscles in the forearm that actuate the fingers (such as the flexor digitorum superficialis).

Possible Practicing and Engineering Mitigations

Practicing Mitigations

As there has been little medical research into musicians' physical wellness, musicians have come up with several strategies to mitigate or prevent injury. Several violin pedagogues such as Auer and Spohr emphasize the importance of both instructor education in the physiological demands of violin playing and taking rest breaks between playing. Another strategy musicians have employed is the use of body mapping and Alexander Technique, which aims to help practitioners more precisely, gracefully, and efficiently execute physical movements.

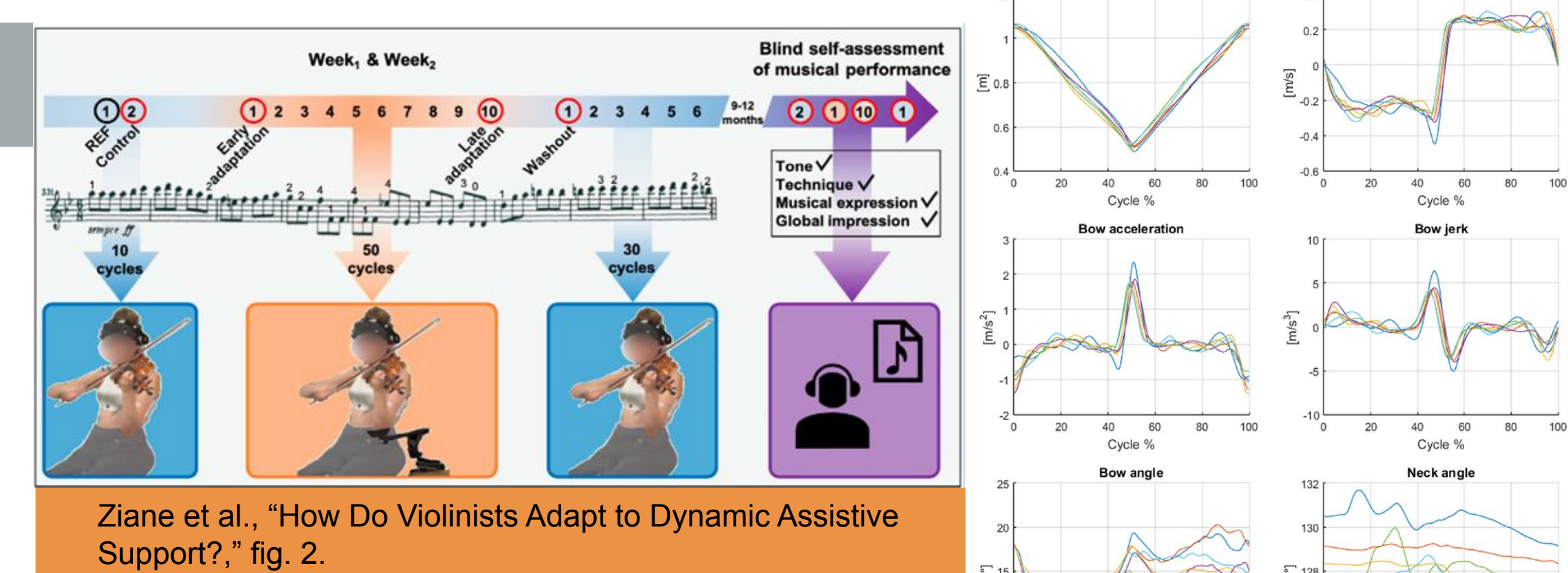
Engineering Mitigations

Engineering solutions have also been proposed to help prevent and mitigate performance-related injuries. For example, William H. Brady's 1881 invention of an "[a]rm-rest for violinists" (US Patent No. 247,796) seems aimed to reduce tension in the left arm. Today, research into solutions such as dynamic assistive support (DAS) hope to find ways musicians can address this challenge. Although research has found DAS initially impacts a performer's playing sense,

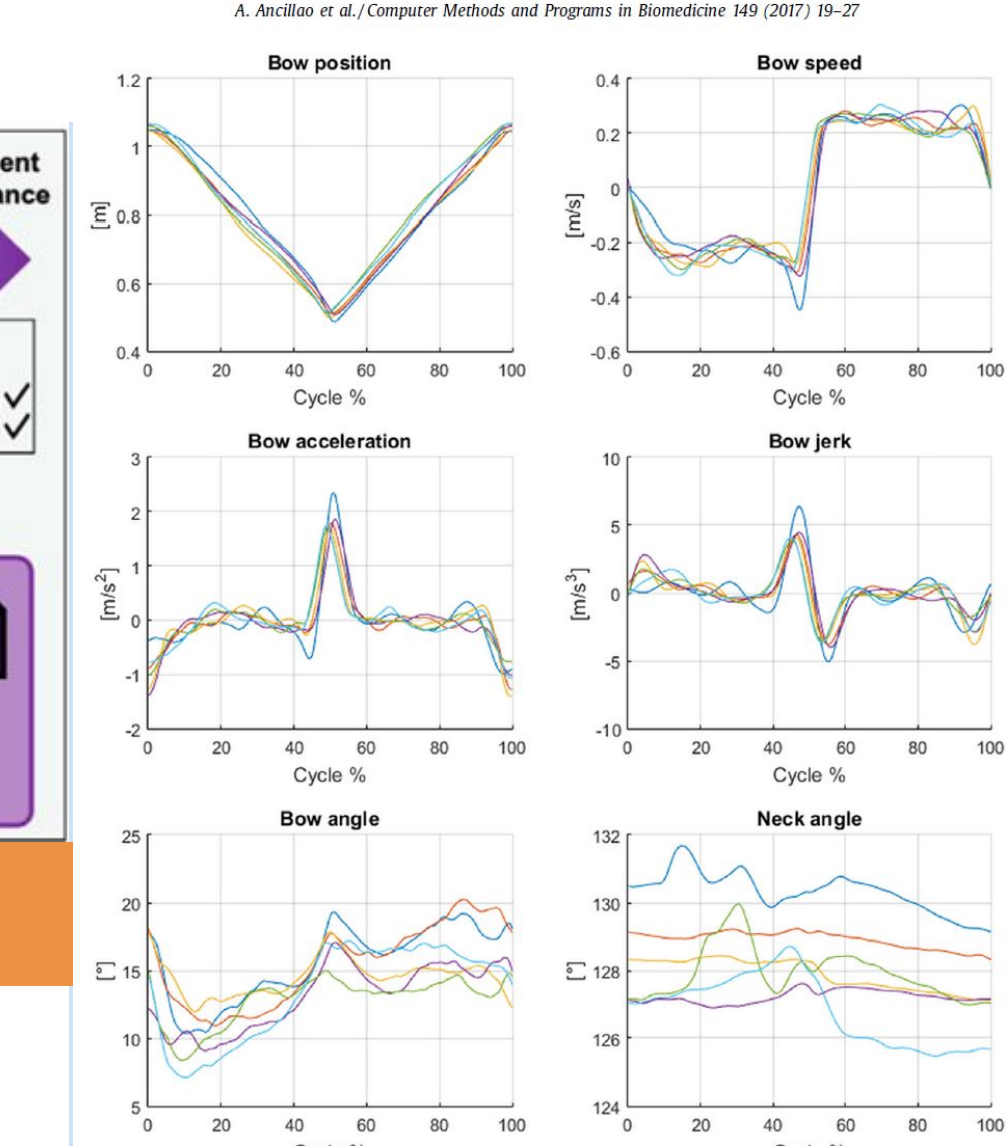
Impacts of Injuries

Musicians who suffer a performance-related injury may face consequences other than expected pain and discomfort. Other impacts of injuries include, but are not limited to:

- Difficulty playing an instrument,
- Long-term health consequences for muscles involved, such as the neck for violinists
- Lost revenue from being unable to play
- Lost time from rehabilitation and possible re-learning of instrument



Ziane et al. "How Do Violinists Adapt to Dynamic Assistive Support?," fig. 2.



Duprey, S., B. Michaud, and M. Begon. "Muscular Activity Variations of the Right Bowing Arm of the Violin Player," fig. 7.

References

Ackerman, Bronwen J., and Roger D. Adams. "Perceptions of Causes of Performance-Related Injuries by Music Health Experts and Injured Violinists." *Perceptual and Motor Skills* 99, no. 2 (October 2004): 669-78. <https://doi.org/10.2466/pms.99.2.669-678>.

Ancillao, Andrea, Bernardo Savastano, Manuela Galli, and Giorgio Albertini. "Three Dimensional Motion Capture Applied to Violin Playing: A Study on Feasibility and Characterization of the Motor Strategy." *Computer Methods and Programs in Biomedicine* 149 (October 2017): 19-27. <https://doi.org/10.1016/j.cmpb.2017.07.005>.

Berezutsky, V.I., and M.S. Berezutskaya. "«Переигранная Рука» Как Междисциплинарная Проблема: Вчера, Сегодня, Завтра. Часть I." *PAIN, JOINTS, SPINE* 10, no. 2 (September 24, 2021): 81-89. <https://doi.org/10.22141/2224-1507.10.2.2020.206944>.

Duprey, S., B. Michaud, and M. Begon. "Muscular Activity Variations of the Right Bowing Arm of the Violin Player." *Computer Methods in Biomechanics and Biomedical Engineering* 20, no. sup1 (October 30, 2017): S71-72. <https://doi.org/10.1080/10255842.2017.1382866>.

Mann, Stephanie, Helene M. Paarup, and Karen Søgaard. "Effects of Different Violin Playing Techniques on Workload in Forearm and Shoulder Muscles." *Applied Ergonomics* 110 (July 2023): 103999. <https://doi.org/10.1016/j.apergo.2023.103999>.

Ozdemir, Filiz, Nisanur Tutus, Sakir Akgun, and Melek Kilcik. "Evaluation of Work-Related Musculoskeletal Disorders and Ergonomic Risk Levels among Instrumentalist Musicians." *Annals of Medical Research* 26, no. 11 (2019): 2630. <https://doi.org/10.5455/annalsmedres.2019.08.454>.

Poncela-Skupien, Carolina, Elena Pinero-Pinto, Carmen Martínez-Cepa, Juan Carlos Zuñi-Escobar, Rita Pilar Romero-Galisteo, and Rocío Palomo-Carrión. "How Does the Execution of the Pilates Method and Therapeutic Exercise Influence Back Pain and Postural Alignment in Children Who Play String Instruments? A Randomized Controlled Pilot Study." *International Journal of Environmental Research and Public Health* 17, no. 20 (October 13, 2020): 7436. <https://doi.org/10.3390/ijerph17207436>.

Sanchez Diaz, Gabriela. "Body Mapping: An Approach to Understand and Reduce Common Injuries in Musicians." *Canadian Winds / Vents Canadiens* 19, no. 2 (Spring 2021): 43-47. <https://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=153645346&site=ehost-live&scope=site>.

Sonnek, Abigail, Nina Lautz, Ann Dahl, and Jennifer Holbein. "Effects Of A Chronic Warm-up Exercise Routine For Violinists: 1378." *Medicine & Science in Sports & Exercise* 53, no. 8S (August 2021): 452-452. <https://doi.org/10.1249/01.mss.0000764496.69635.ec>.

Steinmetz, Anke, Andrew Claus, Paul W. Hodges, and Gwendolen A. Jull. "Neck Muscle Function in Violinists/Violists with and without Neck Pain." *Clinical Rheumatology* 35, no. 4 (April 2016): 1045-51. <https://doi.org/10.1007/s10067-015-3000-4>.

Ziane, Clara, Benjamin Michaud, Mickaël Begon, and Fabien Dal Maso. "How Do Violinists Adapt to Dynamic Assistive Support? A Study Focusing on Kinematics, Muscle Activity, and Musical Performance." *Human Factors: The Journal of the Human Factors and Ergonomics Society* 65, no. 5 (August 2023): 923-41. <https://doi.org/10.1177/00187208211033450>.