

Preventing Flute Playing-related Musculoskeletal Disorders: Applying Ergonomic Principles in Individual and Ensemble Settings

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Abstract

Concerning levels of playing-related musculoskeletal disorders (PRMD) among flute players have been reported over a number of decades. However, recent research indicates that many flute players do not receive sufficient training in injury prevention during their studies. Identifying risks and preventing injuries is central to occupational, health and safety, yet there is little emphasis on this topic in instructional flute books and methods. Improving the ergonomic set-up of musicians is one way of minimising the risk of playing-related injuries occurring. This article recommends six injury prevention strategies based on ergonomic principles that flute teachers and band directors can apply in individual and ensemble teaching settings.

Keywords *Flute, injury prevention, ergonomics, playing-related musculoskeletal disorder (PRMD), occupational health and safety.*

Concerning levels of playing-related pain among flute players have been reported in numerous studies over several decades (Fain, 2009; Fortune, 2007; Fry, 1988b, 1988c; Lonsdale, 2011b; Matejka, 2009; Nemoto, 2007; Norris, 1996; Spence, 2001; Thompson, 2008). Despite this, instructional flute books and methods provide little information on how to prevent physical problems occurring from flute playing, and available advice on technique and posture can be inconsistent among authors. This paper discusses injury risk factors and examines how basic ergonomic principles can be applied to flute playing towards the prevention of playing-related musculoskeletal disorders (PRMDs).

Aim

The aim of this paper is to recommend six strategies that flute teachers and band directors can implement in their music teaching studios and rehearsal rooms to create safer playing conditions for young flute players.

Methods

A review of the literature regarding musician health and flute specific PRMDs highlights the need for effective prevention strategies in individual and ensemble teaching settings. Recommendations will be made regarding the effective application of basic injury prevention principles in a flute teaching situation based on the author's teaching experiences over 30 years and the fields of ergonomics, performing arts medicine and occupational health and safety.

Literature

Musician Health

Many studies on musician health have been conducted since the 1980s with the prevalence of playing-related pain in musicians ranging from 39-97% across various studies (Paarup et al., 2011; Wu, 2007; Zaza, 1997). In the seminal study by Fishbein et al. (1988, p.7) 76% of musicians in 48 orchestras in the USA "reported at least one medical problem that was severe in terms of its effect on performance". A review of recent studies on the prevalence of pain associated with playing musical instruments indicates that pain remains high among professional musicians. In a study of 342 musicians from six Danish symphony orchestras (Paarup, 2011), 97% of women and 83% of men experienced musculoskeletal symptoms in "at least one of nine anatomic regions (neck, upper and lower back, shoulders, elbows, and hands and wrists). Leaver et al. (2011) reported that 86% of full-time professional orchestral musicians (n=243) in Britain had experienced musculoskeletal pain in the 12 months prior to the study. In a study of professional orchestral musicians in Greece it was reported that 81.6% (n=147) had experienced playing-related pain at least once during their professional career (Fotiadis et al., 2013). Similarly Ackermann et al. (2012) found that 84% of professional orchestral musicians surveyed in Australia (n=377) had experienced "pain or injuries that had interfered either with playing their instrument, or participating in normal orchestral rehearsals and performances" (p.181).

These studies represent a broad range of orchestral musicians, however, little flute-specific data is available with studies of orchestral flute players often limited, due to:

1. The grouping of the flute statistics with other instruments in the woodwind family such as oboe, clarinet and bassoon, which are held very differently to the flute (e.g., Ackermann, 2012; Engquist et al., 2004; Fishbein, 1988; Fotiadis, 2013; Fry, 1986; Leaver, 2011; Paarup, 2011);
2. A relatively small sample of flute players in the overall group (typically a symphonic flute section has three to four players) (e.g. Ackermann, 2012);
3. Orchestral flute players representing only some of the total group of working flutists which includes those who perform in recording studios, military bands, pop, rock and jazz bands, pit bands (e.g. for musicals), chamber music ensembles, contemporary music ensembles, churches and as soloists and recitalists (Lonsdale, 2011b).

Flutist Health

Several major studies focusing on flutist health have been undertaken since the 1990s. In a survey of 420 participants at the National Flute Association (NFA) convention in 1991, Norris (1996) found that the largest number of complaints (31.5%) were in the neck and upper back, as well as the fingers, wrists and shoulders. Spence (2001) compared the results of the University of North Texas (UNT) Musician Health Survey (n=329 flutists) with the Flute Health Survey at the 1999 National Flute Association Convention (n=40). In this study, flutists reported pain in hands, wrists, forearms, elbows, shoulders and neck, as well as the upper and middle back.

Thompson (2008, p.11) surveyed 30 high school and college age flutists, reporting that “an average of 42.77% of subjects experienced pain while playing, 33.68% experienced pain after playing, and 29% reported pain that caused them to stop playing flute”. Thompson found that the main sites of pain were the hands, wrists, neck, shoulder, and forearms. Similarly, in Fain’s (2009) survey of 181 flute players, the highest rates of playing-related pain were found to be in the neck (41%), shoulders (right 26.7%; left 29.2%), left upper back (28.6%), right upper back (24.8%), as well as the wrists (right 25.5%; left 21.2%).

The most recent study on flute playing-related health (Lonsdale, 2011b) found that half of the respondents (192/386 or 49.7%) had experienced flute playing-related discomfort or pain that was severe enough at some time to distract them while performing. One-quarter of the total respondents (99/384 or 25.8%) reported that they had taken an extended period of time off from flute playing because of flute playing-related discomfort or pain. Over a quarter of the total group (103/386 or 26.7%) were suffering from flute playing-related discomfort or pain at the time of completing the survey. Consistent with earlier studies, the main pain sites reported were the fingers and hands, shoulders, neck, as well as the upper and middle back. In this survey, there were a wide range of flute playing respondents, including professional performers (22.3%), semi-professional performers (22.5%), university professors or teachers (8.8%), school flute teachers (15.2%), private studio flute teachers (38.7%), and multi-instrumental teachers (13.5%). Approximately one-third of the total group of respondents (33.8%) performed at ‘gigs’ such as weddings, functions, and restaurants.

Music Student Health

Playing-related pain in student musicians has been reported in a number of studies since the 1980s (e.g. Fry, 1987, 1988a, 1989; Larsson et al, 1993; Zaza, 1992). Recent studies indicate that playing-related pain remains prevalent among primary, secondary and tertiary students. Brandfonbrener (2009) reported that 79% (n=330) of incoming university freshman students had a history of pre-existing, playing-related pain with the implication that playing-related problems appeared during the school age years supported also by several other studies. For example, Ranelli (2011) found that 67% of primary and secondary school children in Western Australia (n=731) who were enrolled in government school instrumental programmes had experienced playing-related musculoskeletal symptoms at some time. Nawrocka et al. (2014) surveyed 225

instrumentalists aged 10-18 years and found that the most common musculoskeletal complaints were in the neck (60.4%), wrists (44.4%), upper back (41.7%) and lower back (38.2%). Nawrocka reported that string-players experienced more musculoskeletal complaints than other instrumentalists including keyboard and wind players. However, no flute specific data was reported in this study, as the woodwind instrument statistics were grouped together.

Relationship of Pain, Playing Position and Associated Risk of Injury

Several studies indicate that the types of pain which musicians experience can be attributed to their specific playing position. Cayea et al (1998) examined instrument-specific injury rates and reported that playing piano, guitar and harp was associated with a high risk of injury, while playing bowed string instruments, saxophone, clarinet, organ, flute, and percussion was associated with a medium risk of injury. Nemoto (2007) found that half of players (n=235) in Japanese military bands experienced playing-related medical problems in various body sites, and that “the frequency of problems was highest among oboe, clarinet and flute players.” (p.69) Similarly, in Brandfonbrener’s 2009 study, “Pain frequency varied by instrument class, ranging from 61% among voice students to 100% for percussionists, but for strings, keyboards, woodwinds, and brass players, it was consistently 84 to 87%.” (p.30)

Some studies indicate that those who play in asymmetric positions, and/or with elevated arms (e.g. flute, violin, viola) are more likely to suffer from pain, particularly in upper body sites such as the neck, shoulder and upper back (Nyman et al, 2007; Roach et al., 1994; Wahlström, Edling & Fjellman-Wiklund, 2009). A study in Italy of 148 conservatory students aged 10 to 18 years found that, “To play an asymmetric instrument exposes musicians to an increased risk of non-optimal postures and to a worsened postural disorder when present.” (Ramella, Fronte & Converti, 2014, p.19) Fifteen transverse flute players were included in the asymmetrical group of musicians.

Other Causes of Musculoskeletal Pain

Playing-related pain can be attributed to a number of factors and is not necessarily related to a single cause. While the focus of this article is on ergonomic considerations, it is important to note that environmental, lifestyle, genetic, and psychological factors, such as stress and anxiety, as well as underlying medical conditions may contribute to musculoskeletal problems (Brandfonbrener, 2010). According to many studies, the prevalence of pain among musicians is higher in females (e.g. Abreu-Ramos & Micheo, 2007; Fishbein, 1988; Roach et al., 1994; Zaza, 1992).

Additionally, biomechanical factors such as force of movement (Furuya et al., 2006), dimensions of body parts involved in playing (Ackermann & Adams, 2003) and pressure of the instrument against body contact points (Okner et al., 1997) have been shown to be contributors to injury in instrumentalists such as pianists and string players. However, apart from a small study by Thompson (2008) there are few studies which specifically address the biomechanical aspects of flute playing.

Advice on Playing Position in the Flute Pedagogy Literature

Taking into consideration the high incidence of pain symptoms experienced by flute players, overall, there is little attention given to the topic in the flute literature. Additionally, there is inconsistency between authors in defining good posture and playing position and advice is sometimes vague. For example, in *The Art of Playing the Flute, Volume III* (Mather, 1989), the instructions regarding posture are confusing and include the following suggestions: “Aim instead for allowing the maximum distance between your ears and shoulder tips. The shoulders are an exception to the rule of letting the body follow your head upward” (p.2). Similarly, “For your head to float freely upward it must also be balanced from side to side” (p.4). Another example of vague language is “With practice your shoulders will be able to relax, fall, and broaden and your chest expand in all directions” (p.4).

Soldan & Mellersh (1993, p.26) state that the “wrists must be slightly bent at an angle to the arms (players vary in the amount of wrist-bending; in this book we illustrate quite a steep angle.” Similarly, Putnik (1970, p.7) advises that the “left wrist should be somewhat bent and under the flute, while the right wrist is almost straight.” Hill (1995, p.2), on the other hand, concurs with ergonomists that by holding the wrists in an “angular” position, there is “a very high risk of incurring severe muscular problems”. A more recent publication (Moratz, 2010, p.124) encourages flutists to adopt as “neutral a position as possible” of the wrists, and not to bend more than necessary. Moratz states, “If you’re making a sharp angle between your hands and wrists, you’re setting yourself up for undue tension, discomfort, and possibly even overuse injury”. Moratz recommends using a Thumbport device if necessary to keep the wrist in neutral position. Fain (2009, p.219) agrees that the best position for the wrist is a neutral one. This is consistent with the advice of ergonomists who state that “a continuously bent wrist can lead to local nerves becoming inflamed and trapped, resulting in wrist pain and a tingling sensation in the fingers.” (Dul, 2008, p.24).

Similarly, there are conflicting suggestions about the position for the head and neck while playing, e.g. adopting a slight tilt with the flute sloping slightly downwards (Hill, 1995) or held straight (Mather, 1989). Regarding elbow positioning, Hill (p.4) recommends holding the left elbow close to the body and the right elbow a little further away from the body. Toff (1996, p.124) recommends that both elbows be held about six inches from the body, while Poor (1983, p.10) suggests the right arm “should be held almost horizontally, which allows the knuckles to be on a level with the flute”.

These represent just a few examples of the inconsistencies found in the flute pedagogy literature regarding recommendations for how to position the body when playing the flute. (Refer to Lonsdale, 2011b for a more in depth discussion on this topic.) With such inconsistencies, it is easy to understand why flute players and teachers may not be clear on how to prevent playing-related physical problems from occurring.

Concern among Flute Players about the Lack of Training in Injury Prevention and Management

The inconsistency in advice and confusion regarding playing position is reflected in

concerns expressed by flute players themselves. The majority of survey respondents (70.8%) in the study by Lonsdale (2011b) reported they did not feel they received sufficient information or advice on injury prevention and management during their flute studies. Table 1 shows a representative sample of comments received from survey respondents who felt strongly about the issue.

Table 1 Survey responses regarding the lack of information or advice about injury prevention and management during flute studies.

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|---|
| I received no instruction/ advice from flute teachers about injury of posture except where/ how to place my right thumb and where /how to rest my flute on what part of my left hand...I was lucky enough to figure a lot of the rest of it out. |
| I have learned a great deal about injury prevention as a result of my own pain . It would have been helpful, of course, to learn this information much sooner, as a child beginning the flute! I now make sure to talk to my beginners about good hand position, frequent breaks, stretching, etc. |
| Injury prevention advice is given to myself and fellow students only when posture begins to suffer e.g hunched forward whilst playing. When i informed my teacher of my painful clicking wrist I was told to take Nurofen. |
| I ended up wearing a plaster and medicated for over 6 month due to tendinitis and sciatic problems, for practising to many hours straight with no rest at all – 5 or 6 6 hours standing non-stop and practising even when feeling tired or arms/ wrists/shoulders would hurt. |
| The doctors told me to give up flute or just live with the pain of RSI. Went to acupuncture and it worked. The conversation was not supportive of musicians with RSI and no information was given about it. |
| Due to lack of injury prevention and posture techniques when I first started learning was the reason for the pain I have been suffering the past few years. But now with my current teacher, we are reversing this as we believe the pain is coming from incorrect technique (holding the flute) and some small postures when holding the flute also. So i have hardly any pain at all now. |

It is clear that flute PRMDs are a significant problem thus a range of solutions is required addressing organisational, workplace and individual responsibilities.

Discussion

Creating Safety Guidelines for Flute Players

Identifying risks and preventing injuries is central to occupational health and safety (OHS) principles. OHS is the responsibility of employers towards employees, but also to “others affected by their undertaking” (Ferrett, 2012, p.15) including contractors, trainees, temporary and casual workers, the general public, visitors, and students (pp.15-16). Business owners are responsible for creating safe work environments and conditions in many countries such as Australia (Australian Government, n.d.), the United Kingdom (HSE, n.d.) and also Malaysia (DOSM, 2013). Archer, Borthwick, & Tepe (2009, p.5) state that “in practice and under OHS law, it is usually restricted to occupations or workers that are paid either with wages or fees for-service”. Professional music teachers, freelance musicians and band conductors are generally paid either wages or fees for-service.

Music teachers and many freelance musicians operate small businesses, but there is generally little information available regarding how OHS legislation might apply

directly to them. In the United Kingdom, the government provides specific information about how health and safety legislation applies to both musicians, and operators of small to medium size enterprises on its Health and Safety website (HSE, n.d.). Musicians' injuries have otherwise gained little attention in the OHS literature, despite the high prevalence of playing-related physical problems. Grant & Brisbin (1992, p.92) suggest a possible reason for this: "The manifestations of an inappropriate set-up for young musicians may not appear until at least several years later. Additionally, only a small percentage of those being taught instruments in their youth will later move into paid employment as a musician, so few employers could be held accountable."

The OHS literature is intended for general application across a wide range of industries, and the information pertaining to musculoskeletal hazards and risk control focuses mainly on office equipment (such as computers), load handling and lifting technique (Alwi Saad, 2011; Ferrett, 2012; Pardey, 2007). Establishing a set of safety guidelines that is appropriate for musicians is vitally important in the prevention of PRMDs (Lonsdale, 2013a). The National Association of Schools of Music (NASM) in the USA has established standards and guidelines which all institutions and evaluators must follow. The NASM Handbook 2013-14 (p.65) states that:

Music program policies, protocols, and operations must reflect attention to maintenance of health and injury prevention and to the relationships among: the health and safety of musicians; suitable choices of equipment and technology for various specific purposes; appropriate and safe operation of equipment and technology; and the acoustic and other conditions associated with health and safety in practice, rehearsal, performance, and facilities.

Specific methods of providing information and addressing injury prevention, technology, and facilities are the prerogative and responsibility of the institution.

In addition to the Handbook, the NASM website provides draft documents for review by the NASM and the Performing Arts Medicine Association (PAMA), including a student information sheet on Neuromusculoskeletal Health (NASM & PAMA, 2013). The information sheet points out that "many neuromusculoskeletal disorders are preventable and/or treatable" (p.2) and emphasises the importance of adequately warming up, playing with good posture and correct technique, taking regular practice breaks, limiting the duration of daily practice, recognising the body's limits and avoiding fatigue, as well as sudden increases in practice time. Similar advice can also be found in other performing arts health and medical literature (e.g. Brandfonbrener, 2010; Dawson 2008; Horvath, 2009; Llobet, 2007; Watson, 2009).

The consistently high incidence of flute PRMDs needs to be addressed. Despite the appearance in recent years of useful generic performing arts health guidelines which can be applied at the organisational level, one could make the case that more detailed information specific to particular instruments and musicians may be helpful in the prevention and management of flute PRMDs. By examining ways in which ergonomic principles can be applied to teaching and rehearsal situations, the authors make recommendations herein for implementing injury prevention strategies in the flute teaching studio and rehearsal room.

Applying Ergonomic Principles to Flute Playing

Ergonomics is a science based on the principle that tasks, environments and equipment can be designed to match a person's characteristics and improve their health, safety, and performance (Khalil et al, 1993, p.1; McCauley Bush, 2012, p.2; Pheasant & Haslegrave, 2006, p.13). Posture and positioning are central to ergonomics, which is an important component of occupational health and safety. Poor posture can lead to stress on muscles, ligaments and joints which can result in physical pain (Dul, 2008), however, it is possible to optimise positioning in order to minimise the risk of pain. Important principles of ergonomics, as summarised from Dul (pp.5-41), include: Keeping the joints in a neutral position and the work close to the body; preventing muscular exhaustion and limiting the duration of any continuous muscular effort; resting after heavy tasks; taking account of differences in body size; using adjustable seating and providing proper seating instructions; alternating postures and movements; taking more frequent breaks rather than a single long one; limiting the energy expenditure in a task; and avoiding bending forward, twisting the trunk, sudden movements and forces, excessive reaches and carrying out tasks above shoulder level.

Playing the flute involves ergonomic challenges in terms of the holding position required and include static loading, awkward postures, and asymmetrical positioning (Lonsdale, 2011b, 2013a). Some of Dul's (2008) ergonomic guidelines are impossible to apply to flute, such as: Joints must be in a neutral position, keep the work close to the body, and avoid carrying out tasks above shoulder level. The flute, however, is held against gravity, and unilaterally to the right side of the body. In order to keep the flute in the correct position to produce a good quality sound, the arms need to be elevated, with the hands held away from the midline of the body. If the arms are held below shoulder level, then the neck must also tilt to the right to keep the flute stable, and to maintain contact with the mouth and the instrument. Despite the challenges associated with the flute playing position, it is possible to apply ergonomic principles to playing the flute. The following six recommendations are designed to assist teachers and band conductors in implementing prevention of flute PRMDs in their teaching and rehearsal situations.

Recommendation 1 – Aim for Neutral Joint Positions and Avoid Unnecessary/Exaggerated Positions

While it is not possible to maintain a fully neutral position while playing a standard concert flute, it is possible to avoid unnecessary or exaggerated positions such as excessive head tilting, rolling the shoulders forwards, or pushing the hips to one side (Lonsdale, 2011b). Some other examples of excessive or exaggerated movements mentioned by the acclaimed flautist Michel Debost are: Jutting the chin forwards, or dropping the chin (Debost, 2002, p.142); excessive use of the jaw (p.145); raising the shoulders, wrists or elbows (pp.184-185); and unnecessary key slapping (p.5).

Recommendation 2 – Use Ergonomic Flutes and Devices

There are many different types of ergonomic flutes and flute devices available which can make flute playing more comfortable. Some of the most readily available options discussed in Lonsdale (2011b, 2013b) will be summarised.

Curved beginner flutes are 16 centimetres shorter than the standard concert flute (Visser, 2010), and therefore allow child flute players to hold the weight of the flute close to the body. However, the curved head joint presents another angle to negotiate, which may make balancing the instrument difficult (Visser, 2010). While flute teachers may recommend curved flutes for their young beginner students, some parents may not follow the advice, either because of the additional costs of buying a curved flute, or for other reasons, such as appearance (Lonsdale, 2011b, p.115).

Other ergonomic flutes for children include the Waveline flute which has a twist in the tube which shortens the length of the flute; and curved flutes with D-foot joints (shorter than the normal curved flute, due to the missing C and C sharp keys). The Yamaha Fife is another possible choice for small children, however due to not having a full chromatic range, it may not be suitable for band playing. The main advantage of playing shorter flutes is that the hands can be held closer to the body, making the playing position more comfortable (Lonsdale, 2009, 2011b; 2013b).

There are a number of relatively inexpensive flute modification devices which are readily available which may be used to make holding the flute more comfortably. Many flutes are now made with an offset G mechanism which reduces the distance that the left hand of the player needs to reach the G and G sharp keys, as compared to an inline G model. Other modifications include key extensions, and plastic thumb rests, such as the Thumbport device, which may assist some players in achieving a more stable holding position (Lee, 2014; Lonsdale, 2011a, 2011b; Norris, 1990). More recent innovations are Ho Fan Lee's Fingerport and Pinkieport which are devices that can be added to an inline G flute for increased stability. International flute makers are now also producing vertically held flutes which allow players to work in a more symmetrical position, however, these flutes are not yet widely available.

Recommendation 3 – Prioritise Stability, Control and Efficiency of Technique

In the early stages of sporting activity, the initial emphasis is on stability and control using “progressive adaptation” with a view to avoiding the need for later rehabilitation (Bompa & Carrera, 2005, pp.22-23). Similarly in music, it is important to ensure that irrespective of what level a player is at, stability, control and correct technique should be prioritised to avoid unnecessary tension (Dawson, p.25). Poor technique has been identified as a contributing factor to musculoskeletal problems in musicians (Abréu-Ramos, 2007; Fry, 1989). Similarly excessive repetition, force, or intensity during practice over a duration (Fry, 1987, 1989; Heming, 2004; Zaza, 1994) may eventually lead to playing-related pain. Players need to develop awareness of how to recognise and reduce excessive tension or force while playing the flute. Music should be learnt at an appropriate tempo so that the musical aspects are accurate, and the playing position is optimal.

Recommendation 4 – Tailor Flute Practice Times to the Individual Student

Flute playing is physically demanding due to the playing position, particularly for beginner players. Flute authors recommend various practice lengths for beginner players, anywhere from 20-30 minutes daily (Louke & George, 2010), building up to 30 minutes by the time a beginner has been playing six months (Blanchard, 2007), to 30-45 minutes daily (Moratz, 2010). Consistent with the ergonomics literature, Debost (2002) suggests a slow, careful, efficient and progressive approach so as to avoid later correction of bad habits caused by proceeding too quickly in the early stages of learning.

Practice time is closely related to the notion of ‘perfect practice makes perfect’. Literature in other disciplines demonstrates that practising incorrect techniques creates bad behaviours (Knight, 2007); skills retention and transfer is better when taught in a distributed manner (Moulton et al., 2006); and quality in the instructional context (training adaptation and purposeful focus) can be more important than the quantity of hours of practice (Brylinski, 2013). Whether a young flutist plays on an ergonomic flute or a standard concert flute affects overall comfort levels during playing, and overall ability varies between students. Nevertheless, the duration of practice time needs to be tailored to the individual flute player, and not based on a prescribed and standardised daily practice time common for every player; and should incorporate the notion of quality time rather than quantity of time.

Recommendation 5 – Ensure that Band and Ensemble Seating Arrangements Allow Flute Players to Hold the Flute Optimally

Musicians who are seated correctly should be able to play without a twisted trunk, which strains the back (Dul, 2008). However, the majority of flute teachers (200/210 or 95.2%) surveyed in Lonsdale (2011b) reported that they had attended school or community band/ensemble rehearsals and observed flute players sitting too closer together, which resulted in poor playing postures. Several respondents expressed concerns about this issue, commenting that conductors did little to address poor seating arrangements which result in flutists playing in positions which are not optimal for their physical wellbeing. This problem is not only found in student and community ensembles, but also in professional orchestras (Wye, 1987). In a study of classical orchestral musicians in the UK and Germany (Harper, 2012), cramped playing positions in orchestras were a concern. Harper (2012) asserts that improving ensemble seating should be an easy problem to address, stating that “It is unreasonable to expect workers in any profession to put up with inappropriate working conditions. This is particularly true regarding the provision of seating. There is little excuse for providing unacceptable seating for orchestral musicians.” (p.92)

A simple strategy to reduce unnecessary loading on flute players is to ensure that there is adequate room between ensembles seating allowing them to play in optimal playing positions. This strategy seems a reasonable expectation of music teachers, band directors and management personnel not just in professional playing situations but for all other ensemble players, whether students or community ensemble members.

Recommendation 6 – Encourage Rest and Breaks to Avoid Muscular Fatigue

The expressions “practice makes perfect”, “practice hard”, “practice, practice, practice” are well known and widely used by music teachers and others. Yet, in other disciplines such as sport, rest and recovery is a vital part of training (Wilmore & Costill, 2004, pp.107-108). It is particularly important that in periods of high intensity playing, students set aside time to recover, as pain symptoms often correlate with an increase in time multiplied by the intensity of practice, such as preparing for auditions, competitions and exams (Fry, 1987, p.38).

Encourage students to take breaks during their practice sessions, as well as full rest days after heavy playing loads. In addition to taking breaks, lessons and individual practice sessions can include many other musical learning activities apart from playing the flute. For example, students can listen to recordings, or study and mark up the accompaniment score. During lessons, teachers can also include musical games, theory or aural exercises, as well as discussions or quizzes on general knowledge which will alternate the playing position with a more neutral or natural body position.

Limitations

The recommendations in this paper are based on the ergonomics and performing arts medicine literature. The flute-specific applications and recommendations from the OHS and ergonomics literature have been refined by the authors through empirical observations in applied biomechanics.

Conclusion

This paper has drawn attention to the physical problems associated with playing the flute. It has highlighted the need for implementing prevention strategies in the flute teaching studio and ensemble room and provided specific recommendations for how to create more ergonomically sound work environments for flute students.

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