



TUBA PLAYING

AND HEALTH

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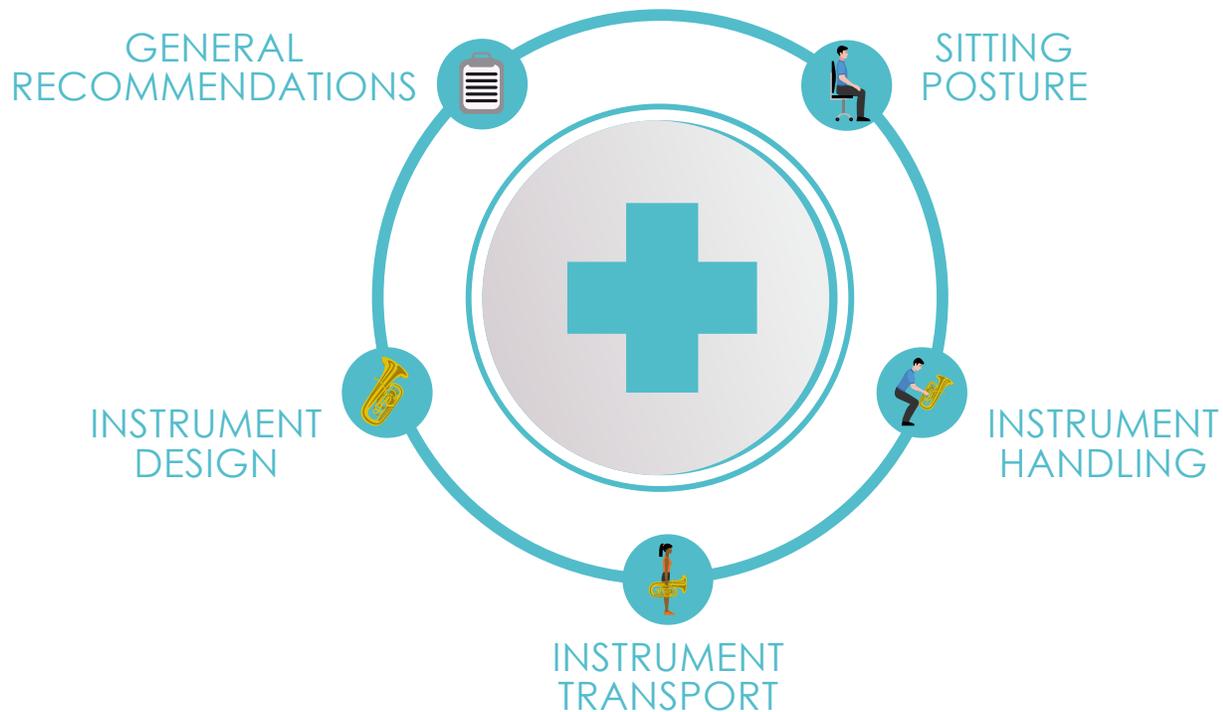
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INTRODUCTION

Playing a musical instrument involves complex motor skills. The daily training loads on the musculoskeletal systems of the body from playing the tuba at an elite level can be compared with those of elite athletes[1]. Complaints that result from playing an instrument are called performance-related musculoskeletal disorders (PRMDs)[2, 3]. Not many of those are known in tuba players. Yet, a high percentage (84%) of professional orchestral musicians experience performance-impairing pain [3]. In tuba playing, it is not only the challenge of holding and stabilizing the heavy instrument, it is also awkward postures, the duration of the many daily hours of practicing time and the repetitive physical loads that might increase the risk for those complaints. Although these aspects sound similar to sports related complaints/injuries, the perspectives of prevention, health promotion and therapy management are

PROMOTING HEALTHY TUBA ERGONOMICS



very different. While sports medicine and sports physiotherapy (physical therapy) management seems to be highly developed for athletes, the professional healthcare management, including education, advice and therapy for musicians, does not seem adequately provided[4].

PRMDs not only compromise the musician's skills and performance but also impact psychological factors, such as music performance anxiety and depression [3, 4]. The management of PRMDs in tuba playing as well as health promoting practical strategies may increase performance and wellbeing of musicians.

This manuscript is one outcome of a bigger project that was conducted at the Bern University of Applied Sciences, Department of Health Professions, in collaboration with the Bern University of the

Arts, with a multi-professional team with expertise in music, sport-science, biomechanics, engineering and physiotherapy. An ergonomic test ("Ergo-Test," provided by the Swiss National Accident Insurance Fund) was applied in order to investigate the physical hazards in sitting activities. Due to forced and awkward postures and the duration of sitting in tuba playing, the evaluation reveals a high to very high physical load. Additionally, an ergonomic inspection was performed with various types of tubas in the sitting posture. This article, written from a physiotherapy perspective, summarizes the most important aspects of this analysis. It also aims at providing information about potential risk factors for PRMDs among tuba players and illustrating feasible recommendations

that can promote health and wellbeing in tuba players.

Light on the Major Activities of a Tuba Player

In this section, we want to display the observational evaluation of

1. playing the instrument in a seated posture,
2. safe handling of the instrument (picking the tuba up and putting it down) and
3. transporting the tuba. With these perspectives, we finally also want to give
4. cues for instrument manufacturing and
5. general recommendations for the tuba player.

1) PLAYING THE INSTRUMENT (SEATED POSTURE)

Seated Posture

It has to be questioned whether "correct" sitting is at

all possible. The often-heard allegation that sitting in the "wrong" way will damage the spine is probably incorrect. It is a fact that sitting for long periods can cause problems, so rather the duration of posture should be addressed. A more appropriate goal would be to sit in a "healthy" upright way. This is a physiological (natural) way of sitting which allows the vertebral column to assume its natural double-S shape (Figure 1a) as much as possible. In order to adopt this position, a seated person must tilt his pelvis slightly forward. His chest straightens up and the neck sector of his vertebral column is stretched. His abdomen is freed of pressure, which assists breathing.

The upright posture can be compared to the interaction of cogwheels: when the lowest cogwheel (the pelvis) moves forward, the next one moves backward in the



Figure 1: Healthy upright sitting

1a From the side
Fig. 1b From the front
Fig. 1c Cogwheel

Figure 2

Fig. 2a: Head in upright and in continuation with the spine.

Fig. 2b: The head is bent to the side.



opposite direction (lifting the chest). This, in turn, moves the third wheel forward again (straightening the neck section of the spine and thus lifting the sitter's head and stretching his neck). (See fig. 1c.) It is important that from the back-view the sections of the spine are well aligned (fig. 1b), so that pelvic with lumbar spine, thoracic spine as well as cervical spine with the head, are above one another.

Neck and head placement are important, and the focus should be on a neutral spine posture. The tuba player has to resist the temptation to side bend the head (fig. 2).

The Chair

The type of chair that is used during practicing and in concerts seems to be a rather neglected topic, although the height of the chair and the form of the back is crucial

for the individual sitting posture. In case the height is too much, the tuba player is compelled to compensate for this by lifting the heel from the floor in order to raise the thigh (fig. 3a), upon which the instrument is supported. For a longer practice time this could lead to a higher demand on the calf-muscles. If the chairs do not present adjustment options, they offer no other alternative than the body's adaptation to the given circumstances.

High Demand On Finger and Hand Extensors

Depending on the type of instrument, the activity of the hand- and finger extensors can be demanding. Tuba players that play an instrument with front action might be at risk to develop tight muscles in the forearm. Breaks in rehearsals or at least after every 60 minutes with exercises that

promote muscle balance can be helpful.

The following recommendations can be made:

In a standing position, bring your arms together in front of your waist (fig. 5). Straighten the arms, rotate them inward and cross your arms. Then try to interlace your fingers. To stretch the right forearm, pull with your left hand in order to completely bend the right wrist and the fingers of the right hand facing your body. When you feel a stretch along the back of the forearm, then it is done correctly—hold it for 20–30 seconds. Repeat this stretch with your other hand. Do two or three stretches with both arms. Breathe slowly. SMR for the outer forearm: Place a small foam roller

between your outer forearm and the wall (fig. 6). Lean against the wall by putting more weight on the muscle. By bending your knees roll it slowly out from the elbow down in the direction of the wrist. Alternatively, you can stay on pain points for about 15 seconds. (If there is strain on the finger and hand flexors, the same exercise can be done on the inside of the elbow.)

The use of self-myofascial release via a foam roller is becoming increasingly popular in athletes and physically active people but not yet much known among musicians. Although some of the study results are heterogeneous, self-myofascial release is effective at improving power, agility and strength [5] and appears to have a positive

Figure 3

Fig. 3a: Compensation for increased sitting height by lifting the heel from the floor in order to raise the thigh

Fig. 3b: If the chair is too high, one solution could be to put the appropriate foot on a firm block (like the ones that are used in Yoga classes).

Fig. 3c: An anti-slide mat can be very helpful. It sits on the thigh of the tuba player that carries the most weight of the instrument and prevents sliding of the instrument on the fabric of the clothing.



Figure 4



argue for this self-treatment technique (fig. 7)

High Demand on Hand and Elbow Flexors

Playing the tuba also involves high demands for the hand and finger flexor muscles as well as the biceps-muscle, especially in playing an instrument with pistons (fig. 8). Biceps stretch and opening of the chest: Interlace your hands at the base of your spine (Fig. 8c). Straighten your arms and raise your arms up as high as you can. Hold this position for up to 30 seconds. Repeat 1 to 3 times.

Unilateral and bilateral forearm flexor stretch (Fig. 8e): Lift your arm up to shoulder height, straighten the elbow and keep palm facing upwards. Next use the opposite hand to push the wrist back into an extended position. To stretch both arms at the same time, place both hands palms down on a stool (fig. 8f), or other supportive surface, with the fingers pointing in the direction of your thighs, and with both elbows straight, gently push your shoulders backward until you feel a stretch on the flexor surface

effect on range of motion and soreness/fatigue following exercise. As an aid for recovery following exercise, it has also been observed to decrease soreness following delayed onset muscle soreness, which may indirectly enhance performance [6–8]. Self-myofascial release via a foam roller therefore could be

a valuable tool for musicians, allowing them to self-treat at a time (i.e., breaks in rehearsals or concerts) and a frequency (i.e., several times a day) convenient for them by eliminating the need for a massage or physiotherapist.

Massage has traditionally been used to relieve pain,

promote blood flow, maintain or improve the mobility of connective tissue and promote relaxation of the muscles [9]. Besides some evidence of a benefit from self-massage [10] there are many practical reasons and independent research from health practitioners that

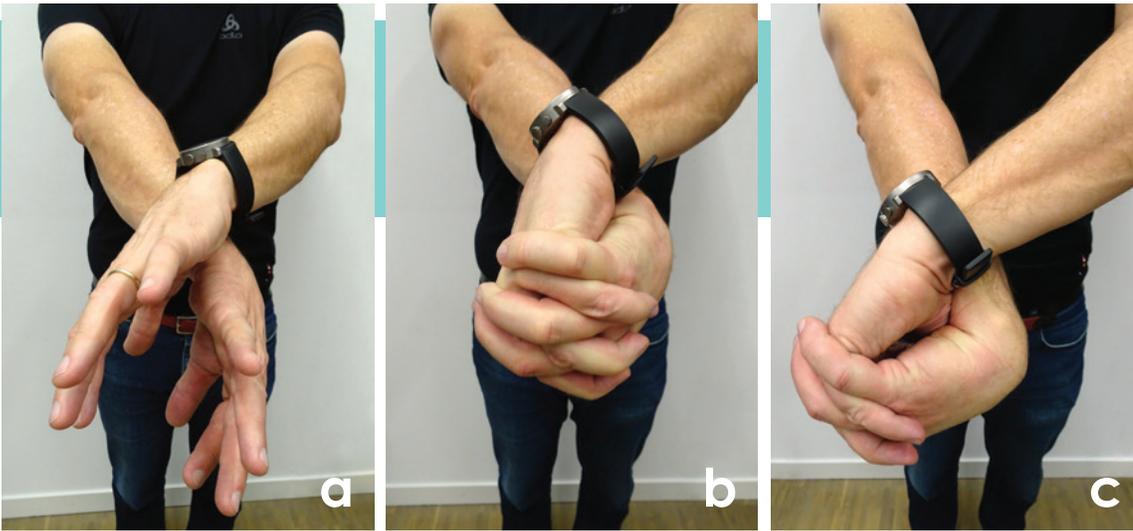


Figure 5
Muscle Stretching

Figure 6

Fig. 6a, 6b: Self-myofascial release (SMR) using a foam roller

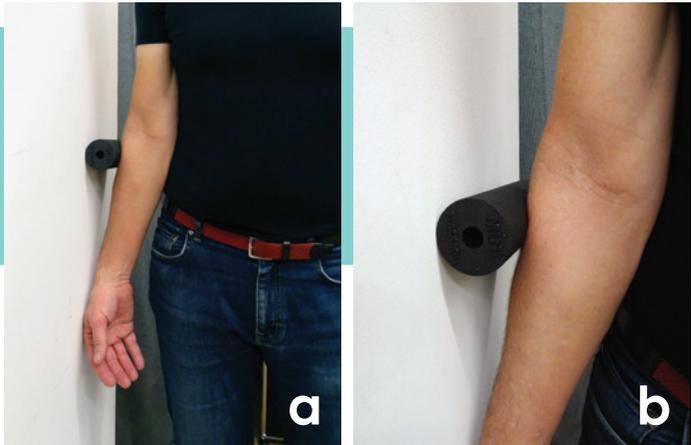


Figure 7

Fig. 7a: In case of a thumb-ring, much pressure is applied to stabilize the instrument that might result in muscle strain.



Fig. 7b: Self-massage for thumb muscles



Fig. 7c: Self-massage for tight forearm extensors

of both forearms. Hold this position for up to 30 seconds. Repeat 1 to 3 times.

General Compensatory and Equalizing Movements

As a large proportion of tuba players experience musculo-skeletal pain and discomfort, one crucial aspect of prevention and treatment is the organization of practice and break schedules. In office workers, supplemental rest breaks and workstation exercise breaks have demonstrated decreased work related musculoskeletal disorders[11]. Exercise breaks are small breaks during work, timed to diminish muscular discomfort. Therefore, exercise breaks along with supplementary rest breaks have been implemented as an organizational intervention as both of them are inexpensive

and advantageous in order to enhance the general health and wellbeing of office workers [12].

The regular daily training loads resulting from practice, rehearsals and performances place great demands on the neuromuscular and musculo-skeletal systems of the body. When studying the instrument, 3–4 hours are spent on average in practicing, while professionals reach up to 10 hours of practice per day. As a sudden increase in practice time is an important risk factor for PRMDs [13], a slow process of extending practice time should be targeted in order to allow soft tissues of the body to adapt.

The idea of compensatory and equalizing movements is to provide an alternate posture/

Figure 8



Figure 9

Fig. 9a: Deltoid stretch
Fig. 9b: Self-myofascial release for the deltoid muscle

Fig. 9c, 9d: Pectoral (chest) stretches
Fig. 9e-g Shoulder circles

Fig. 9h-i Reach for the stars
Fig. 9j-k Chest stretching



Figure 10



movement in order to give the challenged soft tissues a rest, to promote perfusion and metabolism of the tissues and enable motion/stretching in sections of the body that do not move for long periods of time.

Deltoid stretches: As the deltoid and pectoral muscles have to work consistently in order to stabilize the heavy instrument, stretches can increase the flexibility of muscles and reduce tightness and tension in the shoulders/chest

area. Exercises that open up the chest can also improve posture. In an upright posture, reach one arm across your body using your other arm (Fig. 9a). Slowly begin to pull your arm toward your chest, as far as possible, allowing the stretch to reach deep into the back of your shoulder. Hold this position for up to 30 seconds. Repeat 1 to 3 times.

Pectoral (chest) stretches (Fig. 9c-d): Turn your body and feet away from the wall. Put your hand back on the wall,

the elbow straight, and rotate your body away from the wall until a stretch in the chest can be felt. Repeat this exercise with the hand position lower and higher than shoulder. The stretch can be performed bilaterally with both arms actively stretched in different angles of shoulder abduction. Hold this position for up to 30 seconds or stretch dynamically. Repeat 1 to 3 times.

Shoulder circles: Straighten your spine while keeping some distance between yourself and

the backrest (fig. 9e-g). Draw up your shoulders. Then move them backward, then as far downward as possible, then forward and finally upward again. This circling movement can be repeated several times and duplicated in the opposite direction. Breathe in when you draw your shoulders up; breathe out when you let them fall. Note: Slowly increase the radius of the shoulder circles. Emphasize the backward and downward movements.

Figure 11



a plié or straight legs. (The latter places some strain on the lower back and may be more difficult for beginning or less-flexible people).

Self-myofascial release (SMR) for the back muscles (fig. 9n–o). Softly lean against a wall, with a small foam roller or foam ball in between the wall and your back. Put slight pressure (as convenient) on your muscles and by bending your knees slowly

a slight lift and guide it to your thighs (fig. 10 a–d).

Putting the tuba down to the front: Use the thighs as a sliding surface to slowly bring it down to the front between your feet (fig. 10 e–h).

Putting the tuba down to the side: Place the shorter side of the instrument on your thigh, roll the instrument over the thigh and keep contact until you slowly place it on the floor (fig. 10 i–l).

Figure 12

Handling of the tuba hard case



As an alternative, you can stand to do this exercise.

Reach for the stars: You can do this exercise sitting upright on your chair or preferably standing. Stretch your hands toward the ceiling (fig. 9h–i). Imagine reaching for the stars, and try to get taller and taller. Feel how your back stretches. Give more attention to stretching the right side, then the left side. As in all exercises, make sure your breathing is continuous and relaxed.

Chest stretching: Bend your head and the upper part of your back forward, draw your shoulders forward, and turn your thumbs inward (fig. 9j). At the same time, breathe out. Straighten up, push your breastbone forward and upward, push your shoulders back, and turn your thumbs

outward (fig. 9k). At the same time, breathe in.

Spine roll down and straighten up: Begin in a well-aligned stance with your weight evenly distributed over the feet. Start the movement with the head, which will drop forward with your chin toward the chest, start flexing the spine, one vertebrae at a time (fig. 9l–m). Sequentially release the shoulders forward, followed by the upper and middle back.

As the head lowers toward the ground, the back of the legs and lumbar spine (lower back) will be stretched.

This movement can be reversed to bring you back to an upright stance with lifting the arms to the ceiling as if you would like to reach for the stars again. Either

roll your back muscles or the tight spots on the foam material. Either maintain the pressure for 20–30 seconds or dynamically roll your muscles very slowly.

2) SAFE AND HEALTHY HANDLING OF THE INSTRUMENT

In terms of health promotion, this section deals with the various ways in which the musician can be fitted to his daily work, thereby covering the aspect of human behavior (“Fit the man to the work”). As tubas weigh up to 14 kg, the way in which its handling is performed seems to be crucial in the prevention of PRMDs.

Picking the tuba up from the front: Grab the instrument, put one foot carefully underneath it, give the tuba with this foot

Standing up with the tuba: Bend your hips and knees to squat down to your instrument like a weight lifter, grasp the tuba and keep it close to your body while you straighten your legs to lift (fig. 10 m–o).

Carrying the tuba: Embrace the tuba where possible and hold the tuba against your upper body. In this way you can safely move around (fig. 10o).

3) TRANSPORTING THE TUBA

Travelling with the tuba and transporting it is a challenge. Special luggage is needed to prevent damage to the instrument. The weight of the instrument plus the oversized luggage needs to be handled with care. Transporting instruments and other musical equipment is regarded as a

high-risk activity with regard to musculoskeletal disorders [13]. The weight of the case adds to the weight of the tuba.

For transportation, rolling cases are highly recommended. The case should be lifted by a carrying handle. An important aspect for the stability of the transportation is the distance between the wheels. If the wheels are constructed too narrowly the case can tilt.

Preferably, a wide distance between the wheels promotes easy and safe rolling (fig. 12).

In case of short distance transportation, a lighter alternative to the case, the gig bag, can be used (fig. 13). This bag does not provide rollers and therefore should be carried symmetrically as a backpack.

4) CUES FOR INSTRUMENT DESIGN

The word 'ergonomics' is derived from the Greek words 'ergon' (work) and 'nomos' (law). According to the International Ergonomics Association (IEA), ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance [14].

The interface between musicians and their instruments is the focus of ergonomic perspective. In the original meaning, ergonomics analyzes how the instrument can be fitted to its user („Fit the work to the man“) in order to promote safety, performance and wellbeing.

Firstly, the thumb ring position should be adapted. The

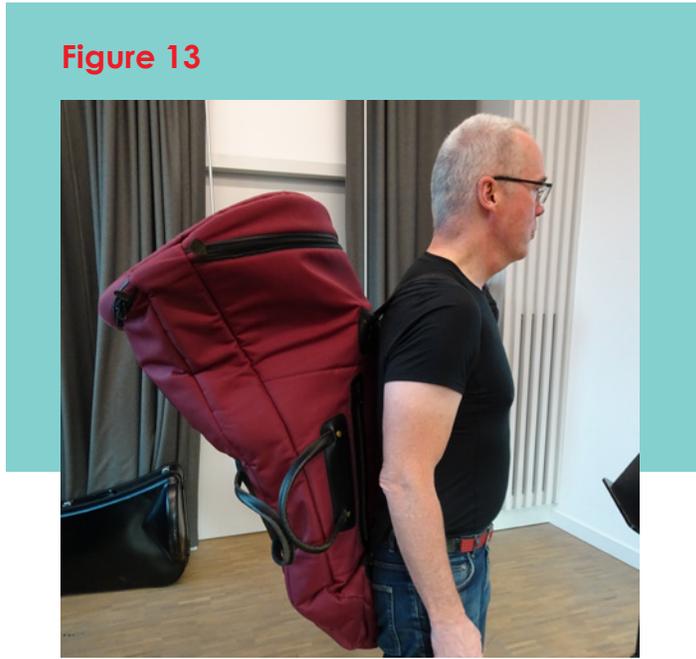


Figure 13

thumb ring, status quo, see fig. 14a. The thumb ring in a wishful position, showing the elbow with less flexion, more relaxed forearm extensors and probably less demand on the trapezius muscle, fig. 14b.

Secondly, another relief of the forearm muscles might be reached by repositioning the valves to allow a more neutral position of the hand, minimizing the awkward hand position (ulnar deviation (Fig. 11a)).

Thirdly, the height of the mouthpiece should be individualized so that the sitting posture is not disrupted.

5) GENERAL RECOMMENDATIONS FOR HEALTH PROMOTION

In case of complaints, the assessment and management of PRMDs should be individualized, as every person has a unique physique, history and resilience. Nevertheless, there are general recommendations, which are mentioned below that can improve the overall vitality of the individual

musician and can assist in preventing PRMDs:

- Enhance physical activity

As playing tuba is predominantly performed in a static sitting position, there might be a tendency for physical inactivity, which is detrimental to overall health and counts as the fourth leading cause of death worldwide [15]. The Physical Activity Guidelines recommend that adults obtain at least 150 minutes/week of moderate-intensity physical activity or 75 minutes/week of vigorous-intensity physical activity [16].

Moderate-intensity activities are those that get you moving fast enough or strenuously enough to burn off three to six times as much energy per minute as you would when you are sitting quietly, like walking very briskly (4 mph), cleaning (washing windows, vacuuming, mopping) or bicycling with a light effort (10–12 mph). Vigorous-intensity activities make you breathe much faster and make you sweat, such as hiking, jogging at 6 mph, carrying heavy loads or bicycling

fast (14–16+ mph) and contribute to aerobic fitness.

- Improve overall conditioning, especially add specific resistance training for strength, stretching or flexibility, coordination.

There is evidence that professional orchestral musicians benefit from exercise programs [17], with significant reductions in PRMD levels and self-reported improvements in playing-related posture, strength, fatigue, anxiety and ability to cope with work-related stress.

Exercise programs that focused on strengthening the supportive musculature of commonly injured areas in musicians were effective in reducing PRMDs and improved numerous other playing-related factors [18].

- Training body awareness (e.g. with Alexander technique, Feldenkrais, Yoga) might increase relaxation and body awareness during playing.
- Interrupt the practice/rehearsal frequently, especially every 30–60 minutes, and stretch, change positions, perform self-myofascial releases, as described in section 1.
- Deepen your breath regularly during practice or performance, when possible.
- Sleep is important, as it helps tissue healing and regeneration during a good night's sleep [19].

CONCLUSION

Due to the heavy instrument and its lever actions, prolonged sitting times and awkward postures due to the construction/position of valves and slides, tuba players endure substantial loads on their musculoskeletal system. Musicians seem to

Figure 14

Imagining the ideal valve and thumb ring position

be underserved in the health care system and health promotion and sometimes play through the pain until they can no longer manage the discomfort. Therefore, more focus should be put on the observation and management of performance-related pain in musicians. With this article we aimed at providing an analysis of and recommendations for some challenging aspects of tuba playing. We hope that this can facilitate musicians to better manage their loads and help to enhance their health and wellbeing.

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