Infrared thermography as diagnostic tool for physiotherapeutic taping support of musicians

Marija Podnar and Matthias A. Bertsch

University of Music and Performing Arts Vienna, Austria

Players of asymmetrical instruments, like the violin or flute, often suffer from health problems through the required unnatural body positions. The risk for overuse symptoms partly depends on the type of instrument but is also very individual. That is why all kinds of ergonomic support or therapeutic help have to be adjusted and customized. To detect individual critical areas, this pilot study presents non-invasive infrared thermography imaging of the bodies of eight different players. The assumption is that hot regions (i.e. more active and more vascularized areas) correspond with regions of higher risk for overuse and pain. The presented results show temperature change after 90 minutes of practicing the instruments. The measurements at 21 points could reveal many asymmetric and individual differences before and after playing. In addition, it was demonstrated that thermocam measurements with applied K-Tapes are also possible, since the material approximates the temperature of the skin below. The objective of a follow up study will be to determine whether the use of K-Taping—often used by sports therapists—could support pain relief for musicians with muscular problems or could be used as individual prevention opportunity.

Keywords: performing artists; health; infrared thermography; prevention; taping

Research shows that up to 85% of professional musicians suffer from pain, fatigue or musculoskeletal disorders (Spahn et al. 2010). This often results in the loss of strength, endurance, dexterity, and control. The figures of health complaints from music students look quite similar. About 25% of music students in instrumental classes at the University of Music in Vienna suffer from occasional or regular violent pain; another 25% of discomfort from playing related activities (Bertsch 2011). Some studies show that pain can occur even
in children and younger people while practicing and playing music (Ranelli et al. 2011). During performing or any other activity, muscle contractions and increased blood flow result in a higher temperature of the overlying skin. This effect can be visualized and quantified by infrared-thermography. Documentations of different playing techniques and variability between student and professional brass players were provided in earlier studies. Temperature changes have been measured at several points. Simple visual inspections have shown less effort and more symmetric patterns for advanced players (Bertsch and Maca 1997, 2001).

As other studies have shown, computer-assisted skin video-thermography (thermography) is also a highly sensitive tool in the diagnosis and monitoring of complex regional pain syndromes (Huygen et al. 2004). Changes in the blood-supply to the skin, resulting in an altered skin temperature and characteristics such as reduced mobility and on-going pain, have been demonstrated. In pilot-studies this method also applied the technology for pain-evaluation of musicians and proved that “thermography can be effective in diagnosing muscular pain, providing a relatively inexpensive and non-invasive imaging diagnostic tool” (Lourenço et al. 2011, p. 188).

In physiotherapeutic rehabilitation, taping is used both as a treatment and as prevention of sport-related injuries. K-Tapes could be placed on almost any muscle or joint in the body and should be applied with a special technique on the skin. Throughout lifting the tissue, better blood flow in the sore or damaged tissue would be possible, which could result with reduction in pain and sensitivity. The healing process could be stimulated, and the pain receptors might be relieved (Kumbrink 2012). A first meta-study on the basis of evidence-based medicine (EBM) came to an ambivalent result, because the method is new and only a few studies exist (Willbacher and Maringer 2011). K-Taping has been tested on its mode of action especially for shoulder and back pain in several clinical studies (Kalichman et al. 2010). Supplemented by medical diagnosis and the evaluation of individual complaints, further studies are supported (Thelen et al. 2008). If further studies can confirm positive effects, this technique could be documented as a new method to prevent and to cure health problems of performing artists.

The first aim of this study was to determine which muscles would activate the most during violin, viola and flute practice by thermography. The second aim was to see whether K-Tape application interferes with thermographic evaluation. This interdisciplinary research is possible through the experience of the first author as professional flautist, trained physiotherapist, and a certified K-Taping practitioner.
METHOD

Participants

All subjects in this pre-study were healthy college students enrolled at the University of Music and Performing Arts Vienna, Austria. Eight (six female and two male; one student with and without shoulder rest) students (instrumental players of viola [n=2], violin [n=4], and flute [n=2]) took part between September and November 2012. Screenings with infrared thermography were performed at the Medical University Clinic for Internal Medicine II. In a survey, fatigue symptoms were mentioned and most of subjects reported taking part in recreational sports. No player mentioned the importance of warm-up or cool-down, and none of them included a relaxation and invigoration program during their musical practicing sessions.

Materials

Recordings have been done with a FLIR® T335 Thermal Imaging Camera, showing exact skin temperature at the time. A FLIR R&D software 1.2. QuickPlot analysis system has been used for visual and quantitative temperature analysis. As far as possible, the distance from the camera and the position(s) of the players has been controlled.

Procedure

Participants were introduced to the camera and had around 20 minutes to acclimatize in the room. Since measurements focus on the skin temperatures, they had to undress the upper part of the body, except the bra of female players. Hair had to be tied up. The Flir® T335 Camera was mounted on a tripod and the thermographs were obtained for each participant in twelve clockwise positions. Pictures were taken with adducted arms, and also with arms 90 degrees up. Positions of the feet and the head were marked, so the distance was kept as similar as possible.

Data acquisition was done before playing (T0), after 30 minutes (T1), and after 90 minutes (T2) of practicing the instruments. There was no instruction to play specific pieces. Temperature values were obtained symmetrically from 21 points, and one larger area.

For quick visual analysis, the hot areas were marked in dark (see Figure 1). The effect of differently applied K-tapes on skin temperature was tested on one person by infrared thermography camera (see Figure 2).
RESULTS

The presented results demonstrate individual and instrument-specific activation patterns. It is easy to see asymmetric "hot areas" of muscle activation, especially how it progresses after a longer period of time combined with repetitive actions. Figures 3 and 4 show the different temperatures before (T0) and after playing (T2). For each point the values for left and right sides are next to each other, so asymmetric activation can be determined. Increased temperature from playing is superimposed with the acclimating effect of the room temperature and the undressed playing condition. For detection of asymmetries and relative values, this does not affect the analysis.

For string players, on the right side (bowing arm) the most activated muscles are M. Sternocleidomastoideus (upper and lower part), M. Pectoralis major, and M. Deltoideus (ventral, pars clavicularis, and pars acromialis). At the left side (holding side) the most activated muscles are Platysma, M. Sternocleidomastoideus (lower part with deep M. Scaleni), M. Pectoralis major (pars clavicularis), and M. Deltoideus (ventral und pars clavicularis).

For flautists, the most active muscles on the both sides are M. Deltoideus (ventral, pars clavicularis) and the M. Buccinator, which is essential for tone generation. Asymmetrically heated regions for the flautists were found espe-
Figure 3. Individual Temperature Differences after Performing (Δ°C).

Figure 4. Individual temperature differences after performing (Δ°C). (See full color versions at www.performancescience.org.)

Thermocam measurements with applied K-Tapes are possible, since the material approximates the temperature of the skin below (see Figure 2).

**DISCUSSION**

This study has shown that asymmetric activation patterns can be detected with thermocams, and that thermography can also be used when K-Tapes are applied. The results are essential for the second part of the study, in which the activity levels and areas are evaluated individually by thermocam and by means of electromyography (EMG) when players perform with and without K-Tapes. The target of the follow-up studies is to evaluate whether K-Taping can be used for the prevention and treatment of musicians’ complaints.
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Address for correspondence

Marija Podnar, Performance Science, University of Music and Performing Arts Vienna, Anton-von-Webern-Platz 1, Vienna A-1030, Austria; Email: marija.podnar.music@gmail.com

References