The effect of using Ergobrass ergonomic supports on postural muscles in trumpet, trombone and french horn players

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Abstract

Though ergonomic supports are widely used for many groups of instrument, they are rare for brass instruments, despite their considerable weight. Musculoskeletal injury and postural problems are common among this group and so both adult and young players are likely to benefit from supports that reduce the load placed on the body. Here, we assess the effects on postural muscle activity, of a recently developed range of supports (Ergobrass™) that use a rod to transfer the weight of the instrument to a harness, or to the chair or floor. Twenty conservatoire students (20.9 ± 0.5 years; m ± s.d.) of the trumpet, french horn or trombone used the supports while playing short brass studies, either sitting or standing. Surface electromyography (sEMG) recordings were made from key postural muscles and their activity levels were compared with and without the support. Statistically significant reductions (typically of 15-30%), were present in many of the muscles when using the supports, though in some players they were much larger. The number of muscles affected was least in the lightest of the instruments (the trumpet) with the effects mainly in the left deltoid and trapezius muscles. Reductions for the horn were bilateral, principally in biceps, pectoralis major and deltoid, while in the trombone they were confined to the left side

(pectoralis major, posterior deltoid and trapezius) as the right arm is in constant use to move the slide.

The supports are therefore effective and may be of particular benefit to injured or young players.

Introduction

Supporting the weight of a brass instrument can pose significant physical challenges [1] not only to young or injured players but also for uninjured musicians playing for prolonged periods, particularly under stressful conditions. Large scale surveys of musicians' health have so far focussed primarily on orchestral musicians. In one of the earliest of these, 32% of brass players disclosed that they had had a musculoskeletal problem sufficiently severe to have an impact on their performance at some stage in their career [2]. In a more recent study, almost twice that percentage reported chronic pain lasting more than three months, predominantly in the shoulder, neck or back [3]. While it cannot be stated unequivocally that this was always a direct consequence of playing, supporting the instrument is at the very least likely to have been an aggravating factor.

While a variety of ergonomic aids are used quite extensively by string and woodwind instrumentalists [4,5], until recently few have been available for brass instruments, despite being amongst the heaviest whose weight must be directly supported by the player. The only widely used supports are harnesses for marching bands (e.g. for tuba players) and hand straps or paddles to relieve the strain on the left little finger of french horn players. Woodwind supports designed to take the weight off the arms and shoulders are of two main designs; neck straps (e.g. for saxophone and sometimes for clarinet), or rods that contact the floor or seat (oboe, bassoon) [4-6]. Recently, supports for brass instruments have become commercially available from several companies (e.g. Hornsticks, Pipsticks etc.) but the most comprehensive set are produced by Ergobrass (see http://www.ergobrass.com). In this design, a support rod attached to the instrument distributes the weight to the floor, the chair seat, or a harness worn over the shoulders. The link to the instrument allows movement and can also be adjusted to balance it. This is particularly important for the french horn because of its width. The top of the rod carries a spring which aids fine adjustments of mouthpiece position during playing [7,8].

All supports and ergonomic aids used on musical instruments are designed empirically and rarely have their effects on posture and muscle activity been tested and validated objectively. One exception to this is the case of violin chin and shoulder rests, studies of which suggest that they may not always have the consequences expected for them. Using an optoelectronic motion capture system it has been demonstrated that optimal adjustment of the shoulder rest reduces head rotation and left shoulder internal rotation and elevation as expected [9] all of which are posturally negative and increase the risk of injury [4,10]. There was however no corresponding change in deltoid or trapezius muscle activity and the activity of sternocleidomastoid actually increased as posture improved. In another study [11] a comparison of three chin rests revealed that chin pressure exerted on one was much lower than on the other two. A hypothesis that having the rest nearer the midline of the instrument would reduce chin pressure was not supported by the experiment. Objective evaluation has also been carried out for an elastic neck strap designed for the clarinet. This produced a statistically significant reduction in forces exerted on the right thumb which normally provides the sole support for the weight of the instrument [12].

It is clearly desirable that ergonomic aids for musical instruments be tested objectively to determine whether they have the effects claimed for them. The object of the present study was to assess whether Ergobrass supports for trumpet, trombone and french horn are effective in reducing the activity of major postural muscles used to support them during playing.

Methods

The Ergobrass supports

In these supports, a holder attached to the instrument is clipped to a spring-loaded rod. When the player is seated, the other end of the rod either rests on the seat of the chair or is attached to a harness worn over the shoulders (Fig. 1a); when standing, either the harness is used or the rod is extended to reach the floor. For trumpet and trombone, the holder has one attachment point for the support rod, however the broad shape of the french horn makes achieving a balance more challenging. A perforated plate fixed to the instrument with cable ties offers several possible sites of attachment for the rod to optimise this (Fig. 1b).

Subjects

The subjects were 20 students (all playing their principal instrument) at the Royal Welsh College of Music and Drama (RWCMD); mean age of 20.9 $\pm$ 0.5 years (range 18-27) comprising 5 trumpeters (4 male, 1 female), 9 horn players (4 male, 5 female) and 6 trombonists (3 male, 3 female). All horn players used a B♭/F double horn. Surface electromyographic recordings were made from six postural muscles on each side of the body (biceps, the clavicular head of pectoralis major, anterior deltoid, posterior deltoid, trapezius and sternocleidomastoid, (see Fig 2) were obtained from 16 players, while in four players who participated in a pilot study (3 horn players and a trombonist) no recordings were made from deltoid or the sternocleidomastoid on the right side. The participants, none of whom had previous experience of the supports, were given eight weeks to adjust to using them before the electromyographic (EMG) recordings were made. All experiments were carried out with informed consent and according to the Helsinki declaration, and were approved under the local ethical procedures of the .

Musical tasks

For each instrument, the same high and low studies were played in random order, standing and sitting, with and without the Ergobrass support. These were 1) Horn: No 1 from Fantasy Pieces for Horn by Derek Bourgeois (high); arrangement of Bourée II from Cello Suite No 3 by Bach (low), 2) Trombone: Melodious Etude Number 1, Bordgoni/Rochut (high); Bel Canto study No 11 ,Bordogni/Rochut edited by Chester Roberts (low) and 3) Trumpet: Trumpet Tune by Jeremiah Clarke arranged S Wright (high); Etude No 2 from Book 3 of 'The Allen Vizzutti Trumpet Method (low). They provide a uniform set of realistic demands within the standard working register of each instrument but not exceeding that expected of an ABRSM Grade 8 player (not greater than high concert F for trumpet, high concert A for trombone or high concert B flat for horn). A balance of technical and sustained passages within each study ensured uniformity of physical and musical demands and this enabled student at any level of the undergraduate and postgraduate courses to participate, regardless of relative experience or ability within the expectations of Conservatoire level training. The tempo was set using a metronome to ensure that each performance had a similar duration (60-90 seconds). Recording sessions lasted an hour and the total playing time was approximately 8 minutes so fatigue was not an issue. The score was marked to show where breaths should be taken, though this was not always strictly adhered to by the players. Muscle activity was compared with and without the support.

Electromyography (EMG)

After skin preparation with alcohol wipes, pairs of self-adhesive bipolar silver/silver chloride surface electrodes (Kendall Medi-Trace 100, Tyco Healthcare Group, Mansfield, USA) were attached to the skin approximately 2cm apart, parallel to the estimated direction of the muscle fibres in the standard positions indicated by Criswell[13]. Of the muscles recorded, all but one play a significant role in supporting the weight of the instrument. The exception (sternocleidomastoids) mainly contributes to deep inhalation during brass playing, however they are also involved in forward head thrusting and were included to determine whether this was altered when the weight of the instrument was supported by the Ergobrass equipment. EMG signals were passed through CED 1902 amplifiers connected to a CED 1401 A/D converter (Cambridge Electronic Design, Cambridge, UK). A ground electrode was placed over the spinous process of the seventh cervical vertebra. The EMG signals were sampled at 1kHz and displayed and analysed using Spike6 software (Cambridge Electronic Design, Cambridge, UK). A high band pass filter (90Hz) and a 50Hz notch filter were used to eliminate movement artefacts and eliminate electrical interference. For further analysis and quantification, the raw EMG trace was processed using a root mean square (RMS) algorithm with a time constant of 100ms. The total muscle activity during the piece played was the trace amplitude integrated over the duration of the study. This was measured as the area under the trace. A maximum voluntary contraction measure was also made for each muscle, however as there was no objective way to determine how close this was close to what was achievable by the subject, this should value should be treated with caution. Sound was recorded with a Shure C606 microphone placed 1m from the player. The signal was passed through an SP-24B preamplifier (Maplin, Rotherham UK) and then to the CED 1401. The voltage output of the sound trace was monitored so that muscle activity could be correlated musical features and inhalation. In Table 2, the level of muscle activity during each playing task performed with an Ergobrass support is expressed as a percentage of the activity when performed without it. Levels of muscle activity with and without the support were compared separately for each instrumental group using a paired t-test.

Results

The number of subjects was relatively small due to the limited availability of Ergobrass supports and the time needed to adapt to using them. There was also some variation in how well each player adjusted to the supports. Nevertheless, the supports had a statistically significant effect on the level of activity of many muscles. The pattern of reduction varied according to instrument in a way that reflected both their absolute weights and how they are held and played.

The trumpet is the lightest of the instruments tested, generally weighing between 950-1200g [14] being mainly supported by the left arm, with the right elbow flexed to bring the fingers over the valve piston caps. The weight of the right arm must also be supported in a forward raised (flexed) position at the shoulder. Despite being the lightest of the three instruments studied, the playing position requires significant muscle activity, particularly on the left side (Table 1). Significant reductions in muscle activity with the Ergotrumpet support were most consistently seen in the anterior and posterior fibres of the left deltoid muscle, and in the left trapezius and was typically about 15% across the four playing tasks (Table 2). An example of raw data from one subject is shown in Fig. 3. Activity in the right anterior deltoid, right trapezius and right sternocleidomastoid were unaffected by the supports. Sternocleidomastoid activity was mainly associated with inhalation.

A double french horn typically weighs 2.3-2.7kg [15] and is supported by both arms. The right upper arm falls almost vertically though with slight abduction, and the right elbow is flexed to about 90^{o} so the hand can be placed in the bell. The left upper arm is more flexed at the shoulder and the forearm is flexed at the elbow to about 90^{o} for the hand to reach the keys and to hold the instrument so that the lead pipe is at correct angle for the embouchure.

Because the instrument is not held up like the trumpet, peak muscle activity is actually lower, and in the particular there is little activity in the posterior deltoid muscles (Table 1). With the exception of the sternocleidomastoid, the Ergohorn support reduced muscle activity on both the left and right sides by around by 15-20% (Table 2, Fig. 4). The reductions were statistically significant on both sides for biceps (except one task on the right), clavicular pectoralis major (except two tasks which were close to significance; p= 0.057 and p=0.056) and anterior deltoid (except one task on the right p = 0.055). For posterior deltoid there was a significant reduction on the right in only two of the tasks however the level of activity in these muscles is very low in the horn (Table 1). From the traces in Fig. 4 it can be seen that in some players there were very substantial reductions in the activity of some muscles (in this case 62% for the right trapezius and 30-45% for many others). Though sternocleidomastoid activity was associated with inhalation, this player also showed pulses linked to some individual notes during this high study, suggesting that the head was being thrust forward against the mouthpiece. This was noticeably lower when the support was used. This study was particularly demanding in terms of range and interval leaps. Several other horn players showed a similar pattern of activity in this muscle for the high study but not the low one.

An orchestral tenor trombone weighs in the region of 1.9kg [16] it is supported by the left arm which is flexed at both the shoulder and the elbow and its length means that the weight exerts strong turning forces on the left arm. The right arm is used to move the slide, requiring not only movement of the upper arm at the shoulder (at the glenohumeral joint) and elbow, but also protraction and retraction of the scapula. The average and maximum muscle activities recorded were therefore the largest of the three instruments examined (Table 1). Significant reductions in muscle activity when using the support were found mainly on the left side (Table. 2) as a similar degree of movement in the right arm must still take place (Fig. 5). The mean reduction in activity was in the range of 15-30% for anterior deltoid (except two tasks, p = 0.1 and 0.68), posterior deltoid (except one task, p = 0.054) and trapezius (Table 2). In the example shown in Fig. 5, much greater reductions in activity are seen in some muscles (e.g. 57% for the left trapezius and 42% for the left clavicular part of pectoralis major). Sternocleidomastoid activity was mainly associated with inhalation.

There were rarely any significant differences in effect of the supports between different tasks for the same instrument. The only exceptions were for the left biceps in the trumpet and horn where the reduction in activity due to the support for the low study when sitting was significantly lower ($p<0.05$) than the high study either sitting or standing. This may reflect the mouthpiece being pressed more forcibly against the embouchure.

Discussion

The trumpet, trombone and horn must be held in front of the body for playing and so the shoulder and elbow are flexed and the upper arm is medially rotated. On the basis of their actions, most of the muscles studied would be expected to play a significant role in supporting the instruments in this position as is borne out by Table 1. The main action of biceps is to flex the elbow, though it also contributes to flexion of the shoulder (raising the upper arm to the front) and supinating the forearm. The clavicular head of pectoralis major flexes the shoulder as well as adducting and medially rotating the upper arm. The anterior fibres of deltoid flex and medially rotate the upper arm, while the posterior fibres might be seen as less likely candidates for instrumental support as they extend and laterally rotate the arm and so may contribute to controlling the position of the head of the humerus in the glenoid fossa. Other muscles which do this were not recorded. The recordings from trapezius were made from its upper fibres which elevate the shoulder. A high, protracted and medially rotated left shoulder is a common postural problem in trombone players [16] that the support might alleviate. The sternocleidomastoid muscles are not involved in supporting the instrument; their activity is generally indicative of a deep inhalation as one of their actions is to pull the sternum (and hence the chest) upwards, however we hypothesised that they might become involved in pushing back against the mouthpiece if this is being pressed forcibly against the embouchure.

Though the support significantly reduced activity in many of the muscles monitored, the sensitivity of the results was undoubtedly affected by the small sample sizes for each instrument. High activity levels in a muscle from a single individual could have a marked effect on whether the outcome from the instrumental group was significant. Though the subjects had several weeks to adapt to the Ergobrass supports, there was some variability in how well they coped with them. While some players showed dramatic reductions in postural muscle activity, in a few activity in some muscles actually increased as if they were fighting against the support. There could be a number of reasons for this. First, players must be willing to allow the support to take the weight of the instrument. There is also a change in how it feels to play and some restriction in the possible range of movement. Finding the optimal settings for the supports (e.g. selecting the correct support rod length) requires some trial and error and adjustment is often necessary as posture changes during a playing session due to fatigue. The support rod for the french horn attaches to the instrument via one of an array of holes in a perforated plate. Finding which one provides the best balance is crucial. Several designs of plate are available to enable them to attach to different makes of horn and allow a range of attachment points, something that is not an issue for the trumpet or trombone. Using the support may also result in a change in habitual posture, for example from a poor one to a better one, which can require a change in the pattern of muscle usage that may take some time to get used to.

Despite these issues, the reduction in muscle activity as a result of using the support system was marked, with mean reductions of 10-35% in the muscles that showed significant reductions (Table 2). In some individuals, even more dramatic changes were seen. One french horn player achieved reductions of over 70% in left trapezius activity in all four playing tasks. Not all muscles were equally affected but as indicated in the results section, this reflects how they were used in the support of each instrument and in the case of the trombone, the fact that the right arm must still move the slide whether the support is used or not. Muscles not directly involved in support, most notably the sternocleidomastoid, showed almost no change in activity. It is particularly instructive to compare the effects of the supports with the incidence of injury associated with different brass instruments. Most surveys of musicians do not provide this level of detail but one exception is a study by Chesky of medical problems in brass players [17]. As the gender balance of the sample for different instruments varied considerably, we will here consider only the average values. In trombonists, problems of the left arm (shoulder, forearm, elbow and wrist) which supports the weight, are around twice as commonly reported as those on the right side. For the french horn and trumpet problems involving these areas were virtually symmetrical. One exception is the greater prevalence of injury to the left as opposed to the right fingers of french horn players. Though which fingers were affected is not specified, it seems likely that much of this may reflect the load carried by the left little finger. Though other types of ergonomic aids such as a hand strap or ducks foot/flipper are widely used to deal with this particular issue, the Ergobrass support will also be of benefit. The relatively small difference in the prevalence in musculoskeletal injury between the trumpet and the much heavier french horn in Chesky's study is probably due to the different height at which these instruments are held which is reflected in the levels of muscle activity shown in Table 1. For all of the instruments compared by Chesky, the rate of musculoskeletal problems in a given region of the body was often 2-3 times greater in females than in males. Though this may partly reflect differences in a willingness to admit to and seek treatment for illness between the sexes [18] mean physical strength and body size may also be a factor.

Many of the players in the study reported effects on their subjective impression of sound quality, though these are intrinsically difficult to assess objectively using quantifiable parameters from the sound recordings and so we did not attempt it. This is a problem for many studies of the physiology of instrumental playing and of singing. It is most acute when comparing different strategies used by performers to achieve the same ends [19,20], though that was not an issue here. Some Ergobrass users also comment on the subjective feeling of reduced physical tension when breathing. One contributory factor for this might be a reduction in the tendency to engage the Valsalva manoeuvre (closing the glottis and raising lung pressure expiratory muscle action to stiffen the trunk when supporting a weight). This can interfere with note initiation [4]. Negative effects on intonation may be experienced when the support systems are first used, particular in trombonists who need to adjust to the rebalanced forces from the reduced tension in the left side. This affects right hand position and often creates heightened awareness of tension in the right arm which may have previously gone unnoticed. In all instruments, the angle of the mouthpiece needs to be carefully considered and ongoing adjustments of the systems may be required to preserve the integrity of the embouchure

Prevention is the key to a wider acceptance of support systems for brass instruments. Working professionals will most commonly be drawn to these because of fatigue and particularly, from injury. Future tests need to extend these studies to children and young players for whom such supports may have particular advantages, and also to embrace the older generation of professional users in order to assess and monitor the long-term effects across different groups of subjects. However the initial findings provided by the current study imply an immediate and relatively uniform reduction of activity among players in the supporting muscles, with positive informal subjective feedback of physical sensations and musical consequences from many participants.

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Figures.

Fig. 1. a) The Ergobone support, here used with a harness. b) The Ergobrass support for the french horn attaches via a plate with a set of holes that provide a range of fixing points to optimise the balance for different models of instrument.

Fig. 2. The muscles recorded from in the study. For the deltoid, the anterior (shown here) and poster parts of the muscle were recorded separately as they have different actions.

Fig. 3. Muscle activity for one trumpeter performing the high trumpet study while sitting. Activity without the support (grey) and with the support (black) are superimposed for comparison. The intensity envelope of the sound produced is also shown. Breath inhalations are marked by arrows on the sternocleidomastoid trace. The numbers on the right indicate the level of muscle activity with the Ergobrass support expressed as a percentage of the level of activity without the support while playing study (between the dashed lines). From this it is seen that the major reduction in activity is in the left trapezius. EMG trace amplitude is maximised for the trace window so the amplitude is in arbitrary units. The numbers on the left hand side indicate the maximum value of the y-axis as a percentage of maximum voluntary contraction (MVC). The very high levels of this for some traces probably represents poor effort in some muscles on the MVC tasks. Other abbreviations; scm,

sternocleidomastoid; clav pect, clavicular part of pectoralis major; ant. deltoid, anterior deltoid; post. deltoid, posterior deltoid.

Fig. 4. Muscle activity for a french horn player performing the high horn study while standing. Activity without the support is in grey and with the support in black. Reductions in activity due to the support are much greater than in the trumpet and are clear for muscles on both the left and right arm and shoulder. EMG trace amplitude is maximised for the trace window so the amplitude is in arbitrary units. Some peaks of activity in sternocleidomastoid are not related to inhalation but correspond to individual notes played. These are much less marked with the harness. Conventions, abbreviations and labelling are as in Fig. 3.

Fig. 5. Muscle activity for a trombone player while performing the low trombone study while standing. Activity without the support is in grey and with the support in black. The muscles of the right arm are used to move the slide and so they are relatively little affected by use of the support. The left arm supports the weight of the instrument and the support markedly reduces muscle activity on that side. EMG trace amplitude is maximised for the trace window so the amplitude is in arbitrary units. Conventions, abbreviations and labelling are as in Fig. 3.

Table 1.

Mean maximum and average levels of electromyographic (EMG) activity for each instrument in the most demanding condition (the high study played standing without the support) expressed as a percentage of maximum voluntary contraction (MVC)

Table 2.

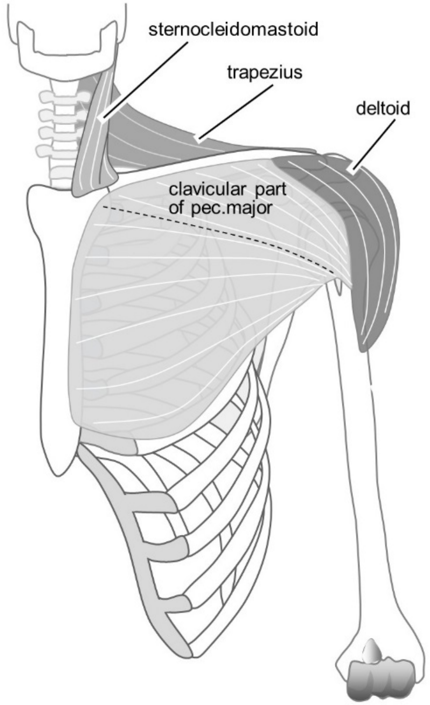
Summary of the statistical analysis of the effects of the Ergobrass supports. The numbers represent the level of muscle activity recorded using the support expressed as a percentage of the activity recorded without the support. Numbers in bold are statistically significant at least at $p<0.05$. Muscle abbreviations as Fig 3.

Fig 1b.

1

Fig 1a.

Fig 2



sternocleidomastoid
trapezius
deltoid
clavicular part
of pec.major

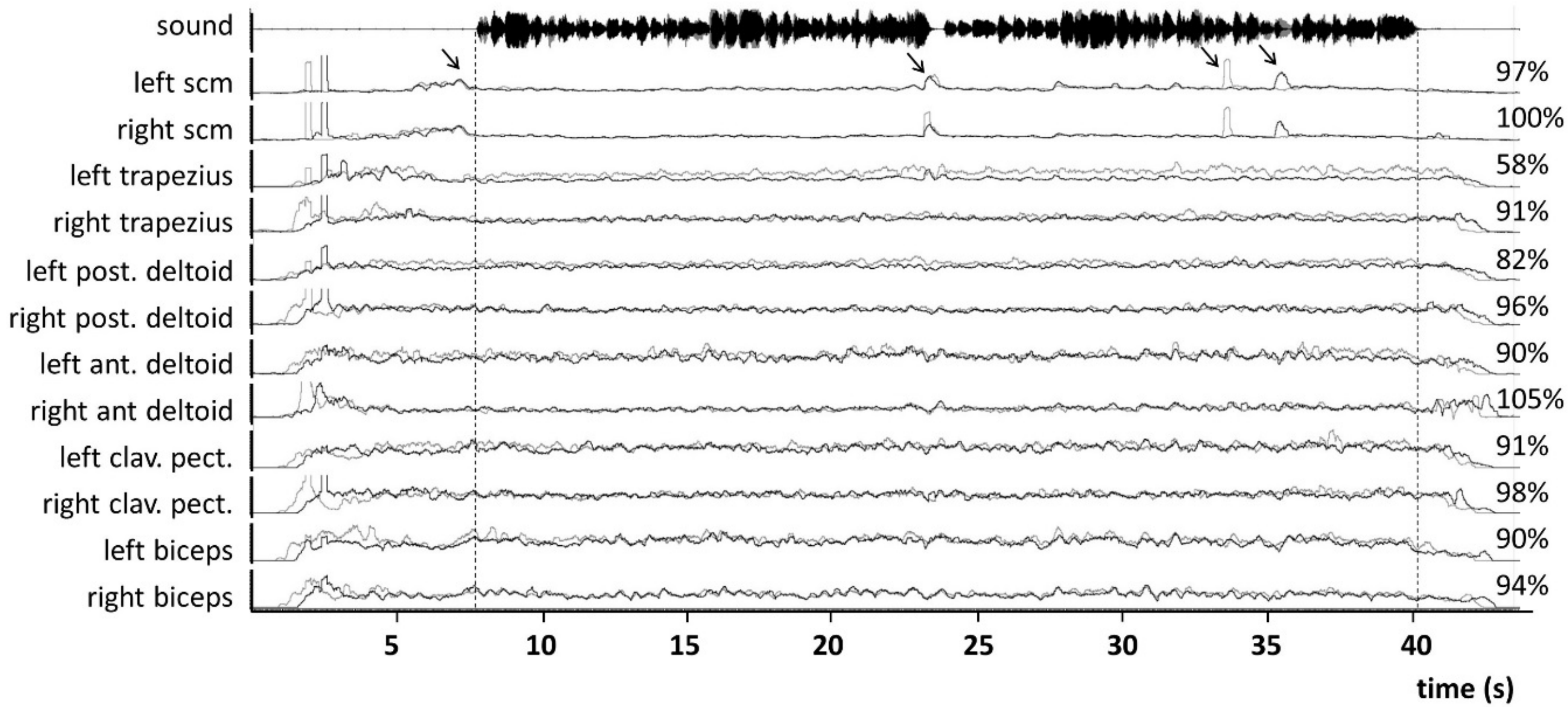


Fig. 3 Ergotrumpet

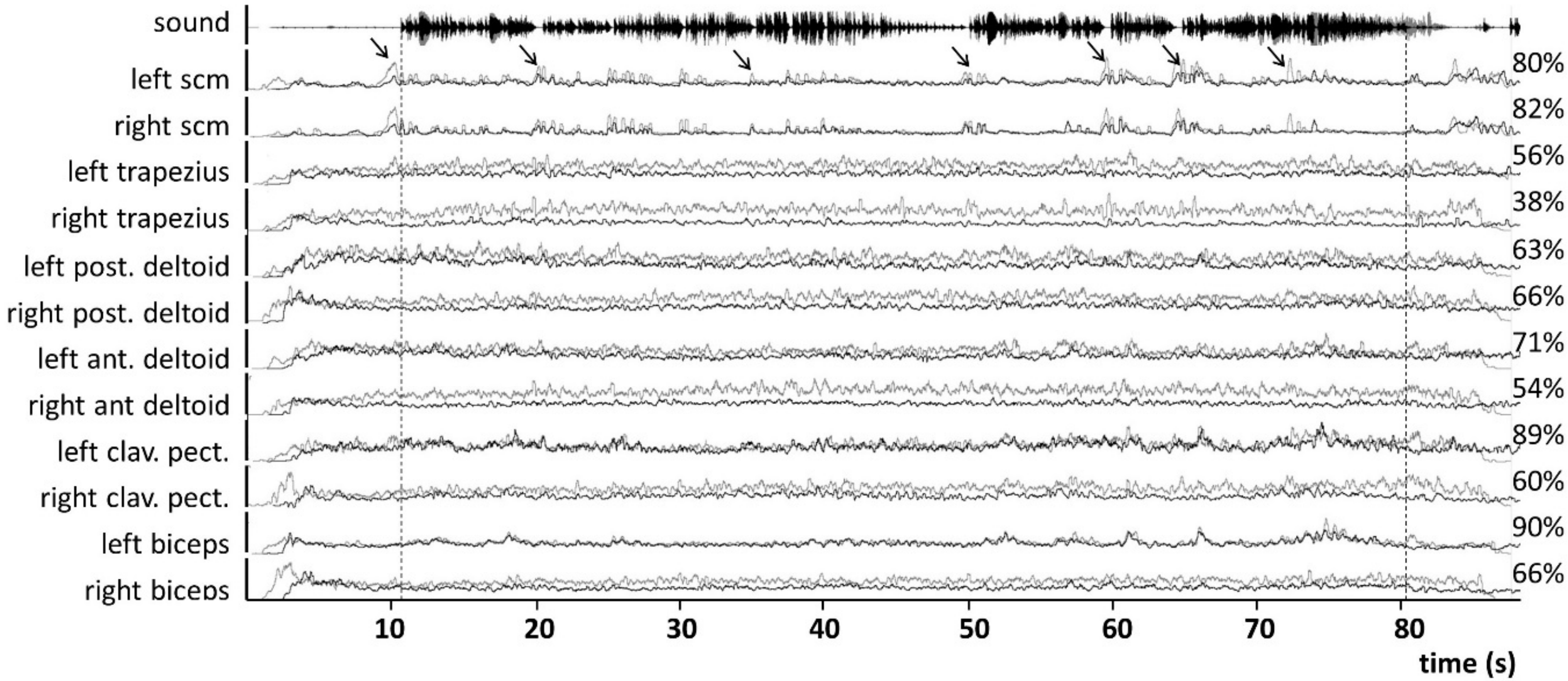


Fig. 4 Ergohorn

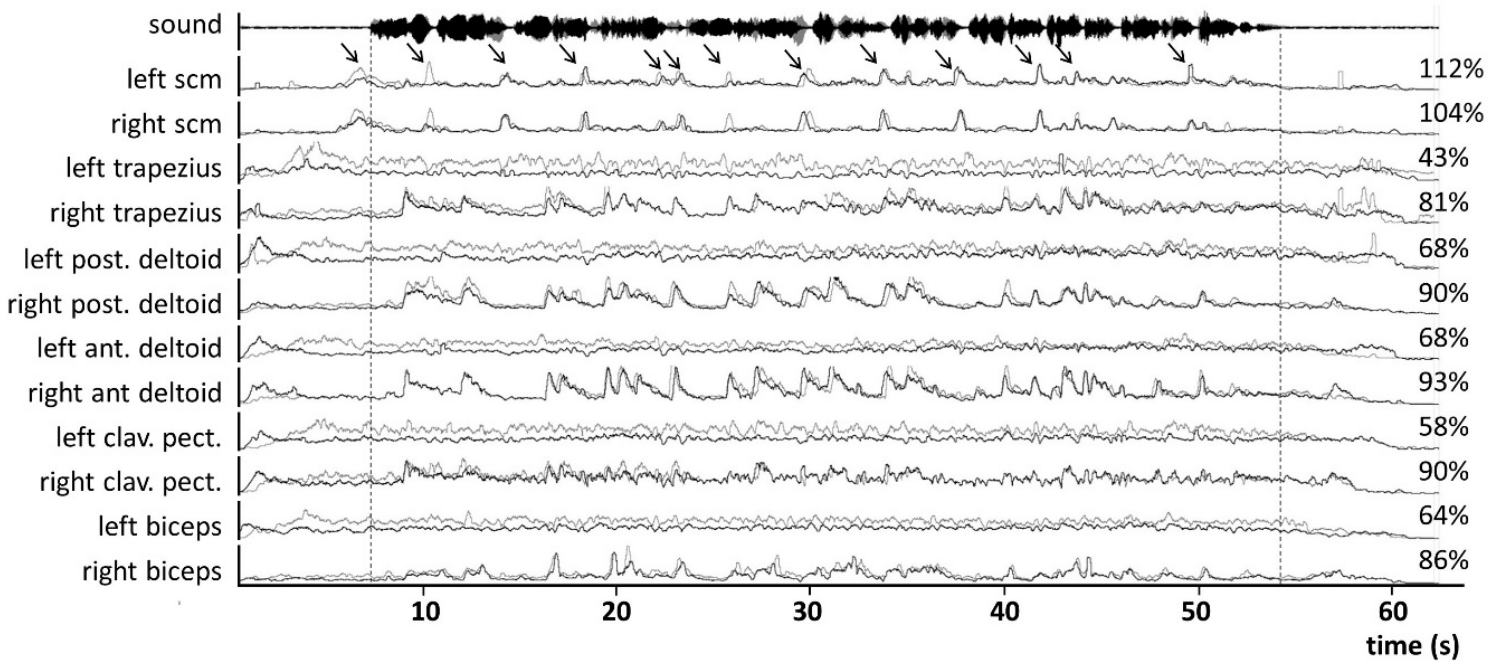


Fig 5. Ergobone

	Percentage maximum voluntary contraction					
	trumpet		**horn**		**trombone**	
	peak	average	peak	average	peak	average
Left SCM	32	11	25	7	29	7
Right SCM	27	10	29	10	40	11
Left trapezius	56	36	28	16	54	29
Rignt trapezius	33	18	25	15	35	14
Left post. deltoid	62	42	9	5	67	31
Right post. deltoid	40	28	4	3	97	37
Left ant. deltoid	58	36	35	20	64	37
Right ant. deltoid	46	31	16	10	70	29
Left clav. pectoralis	76	46	63	33	77	39
Right clav. pectoralis	38	24	25	13	73	32
Left biceps	48	28	44	17	86	37
Right biceps	29	17	35	19	54	16

TABLE 1.

trumpet	**biceps**	**n=5**	**clav pec**	**n=5**	**Ant Delt**	**n=5**	**Post Delt**	**n=5**	**Trap**	**n=5**	**SCM**	n=5
	R	L	R	L	R	L	R	L	R	L	R	L
sit low	**87.0***	**78.7***	**89.2†**	83.3	96.7	**83.4***	90.2	**80.6****	117	**79.9***	104.1	89.2
stand low	88.5	86.9	93.7	83.5	101.1	91.2	**83.5***	**85.9***	90.8	**83.1***	97.9	98.8
sit high	93	93.4	98.1	92	105.4	**89.7***	93.1	**85.0****	101.8	**85.7***	98.2	**89.9***
stand hi	**79.2†**	88.7	97	87.7	94.7	**80.9****	**92.9***	**89.0****	**90.1***	**83.9****	103.3	96.9
mean	86.9	86.9	92.9	87.4	99.5	86.3	89.9	85.1	99.9	83.1	100.9	93.7

horn	**biceps**	**n=9**	**clav pec**	**n=9**	**Ant Delt**	**n=6**	**Post Delt**	**n=6**	**Trap**	**n=9**	**SCM**	**n=6R, 9L**
	R	L	R	L	R	L	R	L	R	L	R	L
sit low	**80.2***	**76.6****	**82†**	**80.7***	**76.3***	**85.6***	79.5	**81.3†**	80.2	**80.6***	103.6	85.4
stand low	82.5	**81.1***	**84.8***	**80.8***	**88.7†**	**81.5***	**94.7***	83	**84.4†**	81.3	103.6	98.1
sit high	**78.0****	**85.2***	**75.0***	**81.3****	**80.1***	**84.4****	**79.4***	82.8	**76.0***	98.2	100.8	95.6
stand hi	**86.2***	**88.1***	**77.9†**	**83.3****	**72.8***	**85.8***	89.1	89.1	82.9	84.4	95.4	95.4
mean	81.7	82.7	79.9	81.5	79.4	84.3	85.7	84.0	80.9	86.1	100.9	93.6

trombone	**biceps**	**n=6**	**clav pec**	**n=6**	**Ant Delt**	**n=5**	**Post Delt**	**n=5**	**Trap**	**n=6**	**SCM**	**n=5R, 6L**
	R	L	R	L	R	L	R	L	R	L	R	L
sit low	94.1	88	101.4	**81.2***	109.4	**82.7****	100.8	**80.8***	90.9	**72.9***	100	103.2
stand low	**95.0***	95.5	97.4	**80.2***	105.2	86.6	101.4	**81.4***	89.4	**74.1****	95.0	101.5
sit high	95.5	86.6	106.4	**80.3***	115.9	84.8	97.1	**83.12†**	79.1	**64.8***	110.4	104.8
stand hi	94.5	91.6	105.2	**78.0***	100.1	**84.8***	93.4	**80.4***	92.7	**72.2***	103.7	101.5
mean	94.8	90.4	102.6	79.9	107.7	84.7	98.2	81.4	88.0	71.0	102.3	102.7

* $p \leq 0.05$ significant
**$p \leq 0.01$ significant
† p = 0.06-0.05

TABLE . 2