The Strength of the Lower Trapezius in Violinists With Unilateral Neck Pain

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Abstract

Violinists tend to position the neck asymmetrically to hold the violin between the chin and the left shoulder. Asymmetrical neck posture may induce unilateral neck pain. Previous studies have suggested that individuals with unilateral neck pain exhibit reduced muscle strength of the lower trapezius, but no study has investigated violinists with unilateral neck pain. To this end, we recruited 18 violinists with unilateral neck pain for the present study in which the side on which neck pain was experienced, pain duration, and intensity were recorded. Lower trapezius strength was measured bilaterally in each subject using a handheld dynamometer. Significant differences in lower trapezius strength were evident between the ipsilateral and contralateral sides of neck pain (p<.05). No significant association between neck pain intensity or duration, and the extent of a deficit in lower trapezius strength, was evident (both p>.05). The association between the sides of weakened lower trapezius strength and neck pain was significant (p<.05). In conclusion, violinists with unilateral neck pain exhibited significantly less lower trapezius strength on the ipsilateral compared to the contralateral side of the pain. Unilateral neck pain more frequently involved the left side of the neck, which is used to stabilize the violin during playing. Thus, our study suggests that a possible relationship exists between muscle weakness in the lower trapezius and neck pain.

Key Words: Lower trapezius muscle; Strength; Unilateral neck pain; Violin.

Introduction

Violinists assume static postures, and hold their instruments in the same position for several hours (Wilke et al, 2011). The static posture features lateral bending and/or rotation of the neck (Park et al, 2012). Repetitive or persistent lateral bending or rotation triggers an asymmetrical cervical posture, creating inappropriate mechanical stress on the side of the neck, inducing unilateral neck pain (Sahrmann, 2010; Wilke et al, 2011). A previous study found that lateral bending of the neck, rather than axial rotation (assumption of a more asymmetrical posture), may contribute to neck pain in some violinists (Park et al, 2012).

Excessive contraction of the upper trapezius muscle during playing also induces an asymmetrical posture (Park et al, 2012). In particular, the left upper trapezius is used to hold the violin between the chin and the left shoulder, causing sustained muscle contraction during playing (Falla and Farina, 2005; Shan and Visentin, 2003).

Overactivity of the upper trapezius muscle can induce middle and lower trapezius muscle weakness (Kelley, 1995; Hink and Tibone, 2000). Page et al (2010) also showed that the upper trapezius was prone to tightness, whereas the middle and lower trapezius were more weakened. Lower trapezius can contribute to scapular depression (Reis et al, 1979). During playing the violin, overactivity of unilateral upper trapezius, especially left side may induce excessive scapular elevation unless lower trapezius sta-
bilize the scapula by scapula depression. Muscle dis-
use contribute to muscle weakness in patients with
unilateral neck pain (Fernández de las Peñas et al,
2008). Hence, a previous study suggested that more
investigation should be needed to understand the
correlation between lower trapezius and unilateral
neck pain (Petersen and Wyatt, 2011).

Previous studies recorded lower trapezius weak-
ness in individuals with unilateral neck pain
(Choudhari et al, 2012; Petersen and Wyatt, 2011).
The latter authors showed that individuals with uni-
lateral neck pain had less lower trapezius strength
on the ipsilateral side of the pain than the con-
and middle trapezius strengths with lower trapezius
strength in individuals with unilateral neck pain, and
found no significant between-side difference in upper
trapezius strength, but found that lower trapezius
strength was lower than that of the middle trapezius
on the side of neck pain compared to the opposite
side (Choudhari et al, 2012).

Studies have also found that hand dominance may
affect the side of unilateral neck pain, but these re-
sults are controversial (Choudhari et al, 2012;
Petersen and Wyatt, 2011). One study found no sig-
nificant correlation between hand dominance and the
side of neck pain (Petersen and Wyatt, 2011). An-
other study suggested that the side of neck pain
was more commonly the dominant side (Choudhari et
al, 2012). However, regardless of dominant hand, vi-
olinists use the left hand to stabilize the instrument,
and the right hand to move the bow (Wilke et al,
2011).

Although deficits in lower trapezius muscle
strength have been found in individuals with unilat-
eral neck pain, no study has explored lower trapezius
muscle strength in violinists with unilateral neck
pain. The lower trapezius strength measurement
would be needed for violinists, who commonly as-
sume an asymmetrical neck posture for several hours
a day, day after day during playing. The primary
purpose of the present study was to compare the
lower trapezius strengths of the ipsilateral and con-
tralateral sides of the neck in violinists with unilat-
eral neck pain. The secondary purpose was to ex-
plor the relationship between the intensity of neck
pain or pain duration and lower trapezius strength.
In addition, we examined the relationship between
the side of neck pain and the side of the weaker
lower trapezius muscle.

Methods

Subjects
Eighteen violinists with neck pain were recruited
from the University of the Arts in Korea, and each
completed a questionnaire describing the side and
duration of neck pain. Subjects who reported unilat-
eral neck-shoulder pain at a level above 3 (off a total
score of 10) on a visual analog scale (VAS) after
violin practice, were included in the study. The sub-
jects were asked to rate the average level of
neck-shoulder pain after violin practice, over the past
3 months, on a 10 cm VAS: 0 indicated no pain and
10 indicated the worst pain imaginable. Dominant
hand was right in subjects. Prior to the study, the
principal investigator explained all procedures to the
subjects, all of whom signed informed consent forms.

Measurement of lower trapezius muscle
strength

A handheld dynamometer (HHD) (DFE2-200,
Chatillon, Florida, USA) was used to measure lower
trapezius strength. The HHD has been shown to ex-
hibit high inter- and intra-rater reliability, and to
yield valid data (Bohannon and Andrews, 1987;
Michener et al, 2005).

Procedures

Lower trapezius muscle strength was measured
using Kendall’s method (Kendall et al, 2005). Each
subject was placed in the prone position, and a rolled
towel was placed under the forehead to maintain the
neck in a neutral position, thus prohibiting excessive neck flexion during measurement. Each subject was then asked to raise an arm diagonally overhead, in line with the fibers of the lower trapezius muscle (Kendall et al, 2005). All subjects were able to assume this test position. To prevent compensation, the tester manually fixed the contralateral inferior scapula. Each subject was asked to maintain the arm in the test position as a tester applied resistance. The HHD sensor was positioned at the one-third position of the distal forearm, and downward force was applied by a tester until maximal muscular exertion was overcome. Two consecutive trials were performed on each upper extremity, with a 30 s rest between trials. The mean trial data from either side were used in the analysis (Petersen and Wyatt, 2011). The initial side of measurement was randomized, and the tester was blinded to the side of neck pain.

**Statistical analysis**

The age, weight, height, pain duration, and side of pain of the subjects were recorded. The paired t-test was employed to compare differences between lower trapezius strength on the ipsilateral and contralateral sides of the neck in subjects with unilateral neck pain. The percentage of strength deficit on the ipsilateral side was determined by subtracting the lower trapezius strength on the ipsilateral side from the contralateral side and then dividing the value by lower trapezius strength on the contralateral side. The correlation coefficient between VAS score and percentage strength deficit was calculated using Spearman’s rank correlation test. The correlation between pain duration and percentage strength deficit was calculated via the Pearson correlation analysis. The chi-squared test was used to explore the existence of any association between the side of the neck pain and the side of the weaker lower trapezius muscle. The significance level was set at p<0.05. All statistical analyses were performed using SPSS ver. 18.0 software (SPSS Inc., Chicago, IL, USA).

### Table 1. General characteristics (N=18)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean±SD*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>21.2±9</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>161.8±5.1</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>47.9±4.8</td>
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<tr>
<td>VAS (cm)</td>
<td>5.7±2.4</td>
</tr>
<tr>
<td>Duration of UNP (year)</td>
<td>8.2±3.3</td>
</tr>
<tr>
<td>Number of left side of UNP</td>
<td>15</td>
</tr>
<tr>
<td>Number of right side of UNP</td>
<td>3</td>
</tr>
</tbody>
</table>

*mean=standard deviation, *visual analog scale, *unilateral neck pain.

### Results

Age, height, weight, playing duration, pain duration, pain intensity and number of side of unilateral neck pain are summarized in Table 1. Lower trapezius strength on the ipsilateral side of neck pain (mean±standard deviation (mean±SD): 25.03±19.76 N) was significantly less than that on the contralateral side (mean±SD: 29.22±13.46 N) (p<0.05; mean difference: -4.2 N, 95% confidential interval: -8.0 N, -4 N) (Figure 1). Mean±SD for percent of strength deficit on the ipsilateral side was 20.42±18.21%. No significant association between VAS score and percentage strength deficit was apparent (r=0.02, p=0.93), and no significant association between pain duration and percentage strength deficit was noted (r=0.23, p=0.25). The association between the side of the neck pain and the side of the weaker lower trapezius was significant (χ²=5.29, df=1, p<0.05).

![Figure 1. Comparison of lower trapezius strength between ipsilateral side and contralateral side of unilateral neck pain](http://dx.doi.org/10.12674/ptk.2014.21.4.009)
Discussion

We found that violinists with unilateral neck pain had less lower trapezius strengths on the ipsilateral than the contralateral side of the neck pain. A significant association was evident between the side of weaker lower trapezius and that of neck pain. We found no significant association between the intensity of duration of neck pain, and percentage strength deficit. Petersen and Wyatt (2011) found that the lower trapezius strength was weaker in those with unilateral neck pain. Choudhari et al (2012) found no significant difference (compared to subjects without unilateral neck pain) in upper trapezius strength, but significant differences in middle trapezius and lower trapezius strengths, consistent with our finding that violinists with unilateral neck pain exhibited lower trapezius weakness on the side of pain, compared to the non-painful side.

The lower trapezius muscle is ideally utilized for stabilization, whereas the upper trapezius is more appropriately used for movement (Lindman et al, 1990). Previously, violinists with neck pain exhibited more muscle activity in the left upper trapezius during playing compared to those without neck pain (Park et al, 2012). In violinists with neck pain, the left upper trapezius is used to stabilize the instrument, rather than for movement, although use of the upper trapezius muscle for movement would be more appropriate (Lindman et al, 1990). Increased use of the upper trapezius and reduced use of the lower trapezius may induce a muscular imbalance leading to upper trapezius tightness and lower trapezius weakness (Cools et al, 2007; Reinald et al, 2009). In the present study, we found that if the violin was played for several years, limited use of the lower trapezius to stabilize the neck and scapula during playing could induce lower trapezius weakness about 20.4% strength deficit. However, further studies are needed to determine whether a cause and effect relationship exists between unilateral neck pain and lower trapezius strength in violinists.

83% of the subjects (n=15) in this study showed left-side affection of unilateral neck pain, weakened strength of lower trapezius. And there was significant association between the side of the neck pain and the side of the weaker lower trapezius. The side of the neck and scapula of the all subjects was same who used the left side to stabilize the violin, and the right side to move the bow in this study. During playing the violin, it is easier to protract and elevate the left for stabilizing than the right scapula (Ackermann et al, 2002). Although repetitive bilateral scapular stress can cause bilateral neck pain, prolonged uneven loading of the neck, especially left side, and scapula and neck, causes unilateral pain, especially on the left side (Fry, 1986). Thus, repetitive and sustained use of left-side musculature may explain higher prevalence of unilateral neck pain in left side. Another possible cause about weakened lower trapezius in left side may suggest that right side of scapular musculature use dynamically for moving the bow, resulting higher strength of right lower trapezius during playing compared to static left side regardless of side of unilateral neck pain.

No significant association was evident between VAS score and percentage of lower trapezius strength deficit on the side of neck pain, suggesting that violinists with higher levels of pain did not have greater deficits in strength than those with lower levels of neck pain. This lack of relationship between lower trapezius strength and neck pain intensity was consistent with data from a previous study (Pearson et al, 2009). We also found no significant association between pain duration and percentage of strength deficit, suggesting that violinists with unilateral neck pain of a longer duration did not have weaker lower trapezius muscles than those with shorter pain durations. This is in accordance with a previous finding that strength deficit and pain duration did not correlate (Petersen and Wyatt, 2011).

Although we found no significant correlation among lower trapezius strength, intensity of neck pain, or pain duration, our results cannot be general-
ized to all violinists with lower trapezius strength deficits, because the violinists whom we evaluated could raise their arms from the prone position, against gravity. This means that muscle function was better than fair. In addition, we compared muscle strengths between sides: side-to-side differences in lower trapezius strength may also be found in healthy violinists or in those with bilateral neck pain. Hence, future work should compare violinists without neck pain, and with either unilateral or bilateral pain. In addition, this study did not investigate the strength of another scapulothoracic muscles except of lower trapezius, although another scapulothoracic muscles can influence the unilateral neck pain (Page et al, 2010). Future study should be needed to compare another scapulothoracic muscle strength such as upper and middle trapezius muscles, serratus anterior muscle.

Conclusion

Violinists with unilateral neck pain exhibited significantly less lower trapezius strength on the ipsilateral side of the pain compared to the contralateral side. These results suggest an possible association between unilateral neck pain and imbalanced strength of lower trapezius in violinists.

References


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