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Immediate Effects of Upper Trapezius Stretching in More and Less Tensed Positions on the Range of Neck Rotation in Patients With Unilateral Neck Pain

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Abstract

The purpose of this study was to compare the immediate effects of upper trapezius muscle stretching in more tensed position (MTP) and less tensed position (LTP) on the change of range of motion (ROM) for neck rotation, and the ROM for conjunct neck motions at end-range of neck rotation toward the painful side in patients with unilateral neck pain. Eighteen patients with unilateral neck pain were recruited for the study's MTP group, and 18 age-, weight- and gender-matched patients with unilateral neck pain were recruited for LTP group. The ROM changes in active neck primary and conjunct motions were measured using a cervical ROM inclinometer in the sitting position. Our results showed that both upper trapezius stretching method in MTP and LTP were significantly effective in increasing the ROM of neck rotation toward painful side in patients with unilateral neck pain. However, a significantly greater increase in the ROM for neck rotation and a further decrease in conjunct neck extension during neck rotation toward the painful side were shown in MTP group, compared to LTP group. The upper trapezius stretching in MTP is useful in increasing the ROM of neck rotation and decreasing the range of conjunct neck extension during neck rotation toward the painful side in patients with unilateral neck pain.

Key Words: Position; Range of motion; Stretching; Unilateral neck pain; Upper trapezius muscle.

Introduction

The reduced active range of motion (ROM) may be useful as an indicator of physical impairment when evaluating patients with mechanical chronic neck pain and/or whiplash-associated disorders (Cagnie et al, 2007; Chen et al, 1999; Chiu and Sing, 2002; Gargan et al, 1997; Jordan et al, 1997). The reduced active ROM of neck rotation, among other motions, is especially useful to discriminate significantly between asymptomatic persons and patients with persistent whiplash or mechanical neck pain (Dall'Alba et al, 2001; Lee et al, 2003). A previous study reported that 33% of mechanical neck pain was located in the central neck and 67% in the unilateral neck (Lee et al, 2005).

Unilateral restricted ROM for neck rotation toward the painful side has been found in patients with unilateral neck pain (UNP) (Fryer and Adams, 2011). According to a previous study, conjunct neck lateral bending and extension occur when performing neck rotation toward the painful side in patients with UNP (Fryer and Adams, 2011). Sahrmann (2011) stated that neck rotation, accompanied by an unwanted conjunct extension and lateral bending, may cause asymmetrical stress in the posterior neck.

Mobilization, acupuncture, and active stretching exercises are commonly used to decrease neck pain

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and increase neck mobility (Coppieters et al, 2003; Hoving et al, 2002; Hurwitz et al, 2005; Ma et al, 2010). To increase the reduced ROM for neck rotation, several studies have focused on joint stiffness (Hoving et al, 2002; Hurwitz et al, 2005). Joint manipulation or mobilization on the cervical spine is effective for increasing the ROM of neck rotation in patients with chronic neck pain (Hoving et al, 2002; Hurwitz et al, 2005). However, joint manipulation can have the negative effect of producing dissections involving of the vertebral arteries, and thus lead to the need for endovascular stenting and cranial surgery (Albuquerque et al, 2011).

Among the conservative methods, active muscle stretching is recommended due to the fact that it is safe, inexpensive, easy to perform, and can be applied as a regular self-administered exercise (Ylinen et al, 2007). In particular, the upper trapezius, which is a common site of trigger point in patients with chronic neck pain relative to other neck muscles, is likely to be shortened (Borg-stein and Simons, 2005; Iwama et al, 2001; Kamanli et al, 2005). The upper trapezius has an attachment from the cervical spine region directly to the scapula and clavicle (Sahrmann, 2011). Decreased passive tension of the upper trapezius can lead to a decreased load on the cervical spine connecting to the scapula and clavicle, and permit improved neck motions and less painful movement during neck motions (Sahrmann, 2011). Upper trapezius muscle stretching to reduce passive tension is recommended to relieve neck pain, reduce pressure pain threshold of upper trapezius, and increase neck mobility (Ylinen et al, 2007).

Although a previous study has shown the effects of muscle stretching on the increase in neck mobility (Ylinen et al, 2007), no study has investigated the effects of upper trapezius stretching on the restricted ROM for neck rotation toward the painful side in patients with UNP. To gain an increased ROM maximally using muscle stretching, the stretching position that places the greatest tension on the muscle is important (Sullivan et al, 1992). The conservative stretching position of the upper trapezius comprises only neck contralateral lateral bending (Ylinen et al, 2007). Yet the upper trapezius is able to perform contralateral neck rotation and extension as well as ipsilateral lateral bending (Sahrmann, 2011).

Therefore, the aim of this study was to compare the immediate effect of upper trapezius stretching in a more tensed position (MTP) and in a less tensed position (LTP) on the change of the ROM for neck rotation toward the painful side and conjunct neck motions in patients with UNP. The hypothesis was that upper trapezius stretching in MTP would be more effective than the conservative stretching method in LTP on improving the ROM for neck rotation toward the painful side and decreasing the conjunct neck motions in patients with UNP.

Methods

Subjects

Thirty-six male patients (41.6±3.2 years) with UNP were selected, and diagnosed with work-related chronic UNP at a workplace-based work-conditioning center in Korea. In this study, chronic UNP was defined in terms of the duration of UNP, which had to have exceeded six months (Ylinen et al, 2007). The average intensity of UNP was above 30 on a verbal pain scale ranging from 0 to 100 in millimeters (Table 1). The neck disability index was used to investigate the level of disability due to neck pain (Johnston et al, 2008). Patients had sustained their injuries at the workplace, and were treated with physical therapy at hospital using mainly modalities, before participating in this study. Patients were recruited at the start of this study based on their participation in a workplace-based conditioning program. Eighteen patients with UNP were recruited for MTP group. Another eighteen age-, gender-, and weight-matched patients with UNP, the control group, were recruited for upper trapezius stretching in LTP. The exclusion criteria included bilateral neck

Table 1. General characteristics (N=36)

	MTP[a] group (n_1=18)	LTP[b] group (n_2=18)
Age (yrs)	38.6±2.9	37.9±2.2
Height (㎝)	174.6±1.4	176.1±2.4
Body mass (㎏)	73.1±8.4	74.2±6.8
VAS[c] (㎜)	64.4±12.0	65.2±10.0
Duration of UNP[d] (yrs)	4.7±.8	4.6±1.4
Neck disability index (%)	20.5±4.9	20.3±5.2

[a]more tensed position for upper trapezius stretching, [b]less tensed position for upper trapezius stretching, [c]visual analogue scale, [d]unilateral neck pain.

pain, radiating pain, migraine or dizziness, and being unable to perform active stretching of the upper trapezius due to neck pain. Before this study, the principal investigator explained all of the experimental procedures to the patients in detail. All patients signed an informed consent form.

Instrument

The cervical ROM inclinometer (CROM, Performance Attainment Associates, Roseville, USA) measures the primary and conjunct neck ROM for flexion, extension, lateral bending, and rotation using separate inclinometers. These inclinometers are attached to a frame resembling three eyeglasses. The inclinometers for the sagittal (flexion and extension) and frontal planes (lateral bending) have a gravity-dependent needle, and the other for the transverse plane (rotation) has a magnetic needle (Figure 1). The patients wear a magnetic neck brace with the magnetic needle on the transverse plane. The inclinometers are marked in 2° increments. A previous study demonstrated the intra- and inter-rater reliability of the CROM inclinometer with an intra-class correlation coefficient range of .89 to .99 (Tousignant et al, 2002; Tousignant et al, 2006).

Figure 1. Cervical range of motion (CROM) inclinometer.

Procedures

Before performing active stretching of the upper trapezius, we measured the primary and conjunct ROM of each patient. To measure active neck ROM, all patients were asked to sit upright on a chair and look straight ahead. The tester explained and demonstrated neck motions to the patients. All patients performed a warm-up exercise, which involved repeating the six neck motions three times (Dall'Alba et al, 2001). To prevent compensatory trunk motions and perform accurate measurement of the active neck ROM, the upper thoracic region was restrained on the backrest with an orthopedic belt. The CROM inclinometer was placed on the head of each participant by the investigator. The patients were instructed to place their head in the neutral position. The neutral head position was defined and confirmed by 0° on the three inclinometers, without any motions on the sagittal, frontal, and transverse plane (Dall'Alba et al, 2001). Patients were asked to perform neck flexion, extension, lateral bending, and rotation to the end range of each motion as much as possible. The patients were asked to keep their heads at the end range of each motion without any UNP for 5 s so that the investigator could record the degrees of primary and conjunct motions. The

conjunct neck motion was measured as the angular values about the two conjunct axes associated with the maximum primary axis value. The conjunct ROM values in our study describe the conjunct motion at the end-of-range of primary neck motions (Dall'Alba et al, 2001). Three trials were performed for each motion. The mean value of the three trials was calculated to determine the ROM.

After measurement of the ROM, patients with UNP were randomized into two groups: MTP and LTP groups. Randomization was conducted by an investigator using computer-generated random numbers. The patients in each group were individually advised how to perform the stretching exercises in MTP and LTP by the principal investigator. Two stretching positions (MTP and LTP) were maintained for 30 s and repeated three times. A resting period lasting 30 s was given in between each session.

Upper trapezius stretching in MTP

The patients were asked to sit upright on a chair and look straight ahead. To reduce scapular elevation and upward rotation, the ipsilateral hand was placed below the buttock. Patients were then asked to perform deep neck flexion, ipsilateral neck rotation toward painful side, and contralateral lateral bending using the opposite hand in a diagonal direction. Patients were asked to maintain deep neck flexion when performing the ipsilateral neck rotation and contralateral lateral bending during stretching in MTP (Figure 2A).

Figure 2. Upper trapezius stretching (A: more tensed position (MTP), B: less tensed position (LTP)).

Upper trapezius stretching in LTP

The conservative method of upper trapezius stretching was performed in LTP. Patients were asked to sit upright on a chair and look straight ahead. Patients were then asked to perform contralateral lateral bending using the opposite hand on the frontal plane horizontally (Häkkinen et al, 2007) (Figure 2B).

After stretching in each group, we immediately measured the neck ROM for primary and conjunct neck motions in the same way described above.

Statistical Analysis

An independent t-test was used to compare the amount of changed ROM between MTP and LTP groups after stretching. A paired t-test was used to compare the amount of changed ROM within the MTP and LTP groups after stretching. The level of statistical significance was set at $p<.05$. Data was expressed as the mean and standard deviation. Statistical analyses were performed using SPSS 12.0 software (SPSS Inc., Chicago, IL, USA).

Results

The range of neck rotation toward the painful side was significantly increased in both MTP and LTP groups ($p<.05$) (Table 2). A greater increase in the ROM for neck rotation in MTP group compared to LTP group was shown ($p<.05$) (Table 3). In MTP group, the range of conjunct neck extension at end-range of neck rotation was significantly decreased after stretching in MTP ($p<.05$) (Table 2). However, there was no difference in the range of conjunct neck extension during neck rotation after the stretching in LTP (Table 2). The range of lateral bending was significantly increased in the LTP group ($p<.05$). On the other hand, the range of lateral bending was not significantly different in MTP

Table 2. Primary and conjunct neck motions in pre- and post-stretching period (Unit: °)

Primary motion	MTP[a] group mean (standard deviation)						LTP[b] group mean (standard deviation)					
	Conjunct motions						Conjunct motions					
	Flexion /extension		Rotation		Lateral bending		Flexion /extension		Rotation		Lateral bending	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Flexion-extension												
Flexion	**50.8 (5.3)**	**50.0 (5.4)**	4.4 (2.1)	4 (1.9)	2.8 (1.0)	2.2 (.6)	**51.0 (7.2)**	**50.1 (7.2)**	3.6 (1.3)	3.4 (1.0)	2.8 (1.0)	2.4 (.8)
Extension	**46.0 (4.9)**	**47.0 (5.1)**	8.0 (2.3)	8.0 (2.3)	3.4 (1.0)	3.2 (1.0)	**44.6 (4.5)**	**45.4 (4.7)**	7.6 (2.0)	7.6 (2.0)	3.4 (1.0)	3.4 (1.0)
Rotation												
Rotation to painful side	-9.4* (1.0)	-2.8* (1.0)	**44.0* (2.3)**	**77.3* (1.0)**	.6 (1.0)	.4 (1.0)	-9.6 (.8)	-9.2 (1.0)	**43.6* (3.2)**	**54.6* (5.9)**	.8 (1.0)	.8 (1.0)
Rotation to nonpainful side	-2.6 (1.3)	-2.8 (1.4)	**-75.6 (8.9)**	**-75.0 (8.7)**	-2.6 (1.0)	-2.4 (.8)	-3.2 (1.0)	-3.2 (1.0)	**-76.8 (8.9)**	**-75.8 (9.0)**	-2.6 (.9)	-2.6 (.9)
Lateral bending												
Lateral bending to painful side	-2.4 (.8)	-2.4 (.8)	2.8 (1.0)	2.6 (1.3)	**28.4 (8.7)**	**27.8 (9.0)**	-2.2 (.6)	-2.2 (.6)	2.6 (1.0)	2.6 (1.0)	**29.2 (8.2)**	**29.2 (8.2)**
Lateral bending to nonpainful side	-3.2 (1.0)	-2.6 (.9)	-2.8 (1.0)	-2.6 (1.0)	**-37.6 (2.6)**	**-39.0 (5.8)**	-3.0 (1.1)	-2.4 (.8)	-3.0 (1.1)	-2.4 (.8)	**-38.2* (2.4)**	**-44.0* (3.3)**

*p<.05, [a]more tensed position, [b]less tensed position, "Pre" and "Post" means the value of ROM before and after upper trapezius stretching in MTP and LTP respectively, Mean values of primary neck motions are shown in bold type, For conjunct motion, mean raw values are displayed, Negative values indicate extension on the sagittal plane and lateral flexion and rotation to the non-painful side on the frontal and transverse plane.

Table 3. Comparison of ROM difference in both MTP and LTP groups

	Mean of difference of ROM[a] (°)		
	MTP[b] group	LTP[c] group	p
Neck rotation toward painful side	33.3±3.6	11.0±5.1	<.01*
Conjunct neck extension at end-range of neck rotation	-6.6±1.4	-.4±.8	<.01*
Neck lateral bending toward nonpainful side	2.6±2.3	5.6±5.8	.02*

[a]range of motion, [b]more tensed position for upper trapezius stretching, [c]less tensed position for upper trapezius stretching, ROM difference = ROM after stretching - ROM before stretching, *p<.05.

group (Table 2).

Discussion

When measuring the neck ROM, neck rotation was shown to be the most restricted direction, illustrating the difference between healthy subjects and patients with neck pain (Lee et al, 2003). Patients with UNP also have a restricted ROM for neck rotation unilaterally with conjunct neck extension and lateral bending toward the painful side (Fryer and Adams, 2011). To the best of our knowledge, this is the first study to show that upper trapezius muscle stretching is capable of increasing the restricted ROM of neck rotation toward the painful side and decreasing the conjunct neck extension during neck rotation in patients with UNP. Additionally, we demonstrated that upper trapezius stretching in MTP was more effective way to increase ROM for neck rotation and conjunct neck extension at end-range of primary neck rotation than stretching in LTP (Table 3).

Muscle stretching is an effective way to increase the ROM (Hoving et al, 2002; Hurwitz et al, 2005). When applying joint manipulation to the cervical spine during 4 weeks, the ROM of neck rotation increased by about 10° in patients with neck pain (Häkkinen et al, 2007). This improvement is comparable to other techniques that focus on the upper trapezius muscle, such as acupuncture and stretching (Häkkinen et al, 2007; Wang et al, 2007). Previous studies demonstrated that acupuncture and stretching on the upper trapezius muscles during 4 weeks can result in about 20° and 10° improvement in neck rotation in patients with chronic neck pain, respectively (Häkkinen et al, 2007). This means that techniques focusing on the muscle can increase the range of neck rotation safely without stressing the joint capsule by manipulation. In our study, the greater increased ROM for neck rotation (mean value : 33°) was shown when using upper trapezius stretching in MTP compared to other techniques, such as the conservative stretching method and acupuncture of the upper trapezius (Häkkinen et al, 2007; Wang et al, 2007). This result suggests that the active upper trapezius stretching technique in MTP can result in a better ROM gain in patients with UNP than the other techniques.

In our study, upper trapezius stretching in MTP was more effective than LTP group in increasing the range of neck rotation toward the painful side in patients with UNP. To perform the effective muscle stretching, the muscle would be placed in the position with the greatest tension (Takasaki et al, 2007). In our study, the position of the upper trapezius requires contralateral lateral bending with ipsilateral neck rotation, flexion, scapular downward rotation, and depression, which makes the upper trapezius muscle more tense than with the conservative stretching method. The neck position in the conservative stretching method requires only lateral bending toward the contralateral side (Ylinen et al, 2007). Lateral bending of the neck alone may not be enough to tense the upper trapezius during conservative stretching. Therefore, upper trapezius stretching in MTP may give rise to a greater increased ROM in neck rotation than LTP group.

Conjunct neck extension during neck rotation showed a greater decrease in MTP group than LTP group. The neck position in MTP group included deep neck flexion with neck rotation and lateral bending. Maintaining deep neck flexion during upper trapezius stretching in MTP may influence on decreasing the range of conjunct neck extension at end-range of neck rotation. Additionally, the actions of the upper trapezius can contribute to neck extension during rotation (Sahrmann, 2011).

There was significantly more increased range of lateral bending toward nonpainful side in LTP than MTP group after stretching. Because upper trapezius stretching in LTP focused on just lateral bending, LTP is able to increase the range of lateral bending toward nonpainful side.

This study has several limitations. First, our pa-

tients were male so the results cannot be generalized to women. Second, we could not measure the real-time primary and conjunct neck motions using a three-dimensional motion analysis system when performing neck motions. However, unlike the three-dimensional motion analysis system, CROM is easy to use in the clinical setting for patients with UNP in order to assess the ROM for primary and conjunct neck motion (Tousignant et al, 2002). Third, this study immediately confirmed the effects of upper trapezius stretching. Therefore further studies would be needed to demonstrate the long-term effects of upper trapezius stretching in MTP on the change in ROM for axial rotation and conjunct neck motions in patients with UNP.

Conclusion

Both upper trapezius stretching methods in MTP and LTP were effective for increasing the reduced ROM for neck rotation in patients with UNP. Upper trapezius stretching methods in MTP was more effective than stretching in LTP on increasing the ROM for neck rotation and decreasing the conjunct neck extension during neck rotation toward the painful side in patients with UNP. We recommend that clinicians adopt the upper trapezius stretching in MTP over other techniques, since it increases the range of neck rotation toward the painful side easily for patients with UNP in the clinical setting.

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