In this study, we investigated the effect of lower cervical RFN on CGH in the patients who were treated by lower cervical RFN for lower cervical zygapophysial joint pain (CZJP).

MATERIALS AND METHODS

Patients

Eleven CGH patients who underwent lower cervical RFN for treatment of CZJP during the past 3 years (July 2007-June 2009) were enrolled in this retrospective study. All the patients had neck pain with referred pain to shoulder and arm, and unilateral occipital headache, persisting for more than 3 months despite NSAID and proper physiotherapy. On the cervical MRI study, there were no specific surgical conditions related to the symptoms. The original headache were precipitated by digital pressure at both the upper and lower cervical regions and the presumptive lower cervical facets. Candidates of RFN were selected when comparative local anesthetic blocks with 0.5 mL of 1% lidocaine and 0.5% bupivacaine for each medial branch showed a positive response; more than 90% pain relief and the duration of relief with bupivacaine should last at least 3 hours longer than that with lidocaine.

Lower cervical radiofrequency neurotomy

We recommended lower cervical RFN when the patient did...
not want to additional procedures for headache. RFN was performed under biplane fluoroscope with a radiofrequency gen-

erator (Radionics RFG-3B, Radionics, Inc., Burlington, MA, USA) and SMK-C10 cannula with a 4 mm exposed tip (Radionics, Inc., Burlington, MA, USA) at C4-7 facets ipsilateral to the symptom side. The cannula was inserted obliquely trying to be parallel to the medial branches at the lateral margin of the articular pillar, and positioned at the center of it on lateral fluoroscopic view. Low voltage (0.5 V) sensory and motor stimulations were performed at 50 Hz and 2 Hz, respectively. At this point, a radiofrequency lesion was made at 90°C for 60 seconds (Fig. 1).

**Evaluation of outcome**

The pre- and post-RFN levels of headache were evaluated by visual analogue scale (VAS) score. The VAS score was measured at one day before RFN (pre-VAS), 7 days, 1 month, 3 months, and 6 months after RFN (post-VAS). The degree of VAS improvement (VASi) (%) was calculated by comparing the difference between the pre- and post-VAS to the pre-VAS at the four time points after RFN. The VASi more than 50% at 6 months after RFN was considered a successful result, which is equal to the excellent or good result according to the Macnab criteria.

**Statistical analysis**

Data were analyzed by paired t-test and considered statistically significant when \( p < 0.05 \). The values were presented as mean±SD.

**RESULTS**

**Patients**

The total number of neck pain patients without any symptomatic disc disorders or stenosis during the same period was 1872. Among the patients, 116 patients were diagnosed to have CZJP and underwent cervical RFN, 6.2% of the total number of neck pain patients. Twenty-eight CZJP patients confirmed to have CGH by comparative local anesthetic blocks, 1.5% (28/1872) and 24.1% (28/116) of total neck pain patients and CZJP patients, respectively. Of these 28 patients, 11 patients (39.3%), whose initial diagnosis was lower CZJP, experienced disappearing headache by comparative local anesthetic block at C4-7 levels. The 11 patients underwent RFN at C4-7 and were successfully followed up more than 6 months.

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The mean age of the lower CZJP patients with CGH was 45.3±12.4 (26-69)

<table>
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<th>Patient No.</th>
<th>Sex</th>
<th>Age</th>
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<th>Post-VAS, 3-month</th>
<th>Post-VAS, 6-month</th>
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**Table 1.** List of patients including gender, age, and the changes of visual analogue scale (VAS) scores according to the time duration after radiofrequency neurotomy

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>VASi%, 7-day</th>
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<th>VASi%, 3-month</th>
<th>VASi%, 6-month</th>
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<td>42.9</td>
<td>14.3</td>
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**Table 2.** Degrees of visual analogue scale (VAS) improvement and their changes according to the time duration after radiofrequency neurotomy

* \( p<0.05 \), compared with the degree of VAS at 7 days after radiofrequency neurotomy (paired t-test). VASi% : degree (%) of VAS score improvement comparing to the pre-VAS.
years. There were 3 male and 8 female patients with a male to female ratio of 1 : 2.7. The mean symptom duration was 12.6±
12.3 (3 to 36) months. The mean pre-VAS was 8.1±1.1. All the
CZJP patients showed combined symptoms other than head-
ache such as dizziness in 9, nausea in 4, ophthalmic pain in 4,
blurred vision in 4, and tinnitus in 3 patients.

Outcome
Post-RFN VAS scores for headache at 7 days, 1 month, 3 months,
and 6 months were 4.8±1.8, 3.5±1.0, 3.6±1.9, and 4.0±2.5, re-
spectively, all of which were significantly decreased compared
to pre-VAS score, 8.1±1.1 (p<0.001) (Table 1). The degrees of
VASi at 7 days, 1 month, 3 months, and 6 months after RFN
were 39.5±22.5%, 54.9±16.2%, 53.7±25.2%, and 49.2±33.1%,
respectively. The degree of VASI was relatively lower at 7 days
(p<0.05), peak at 1 month, and then decreased slowly with time
(Table 2). The degree of VASI at 6 months after RFN was more
than 50% in 7 patients (63.6% of success rate).

There was no specific permanent complication. Most of the
patients experienced pain at the needle insertion sites for sev-
eral days after RFN. Sensory changes (hypoesthesia and/or pares-
thesia) at posterolateral neck and shoulder were noted in two
patients for several weeks (3 and 4 weeks) and then disappeared
discontinued completely.

DISCUSSION
CGH can be defined as a headache originating from a neck
condition2,3,22,42. The use of the term CGH was controversial due
to lack of consensus among physicians in the past17,25,32. Even
there had been confusion regarding the use of terms such as
greater occipital neuralgia2,22, third occipital neuralgia3,38, rep-
resenting the same clinical condition as CGH. CGH was first
introduced in 198342 and is currently being investigated mainly
by the Cervicogenic Headache International Study Group (CHISG)
and the International Headache Society (IHS). As a result,
CGH can be diagnosed according to the diagnostic crite-
ria of the CHISG41 or IHS27. According to the diagnostic crite-
ria of the CHISG41, CGH can be diagnosed with precipitation
of headache by external pressure over the upper cervical or oc-
cipital region, positive response for comparative local anesthetic
blocks, and unilaterality of headache without spreading across
the midline. But, in this study, the headache related with lower
cervical disorders in the CZJP patients was confirmed by com-
parative local anesthetic blocks at C4-7 levels.

The prevalence of CGH in the general population ranges from
0.4% to 2.5%37,40, and CGH was reported in approximately
1.5% to 20% of headache patients4,16,37. Approximately 3% to
54% of whiplash patients were reported to have CGH1,4,17,40.
The considerable discrepancy in the reported prevalence rates
was mainly attributed to the different diagnostic criteria for CGH.
However, the diagnosis of CGH became more obvious with the
diagnostic criteria of the CHISG41 and IHS27. We followed the
CHISG criteria which include symptom precipitation from
neck, anesthetic blockade effect, and unilaterality without side
shift41. Bilateral headache can be acceptable as “unilaterality on
two sides” which should be confirmed with bilateral anesthetic
blockade41, but there was no bilateral case in our study. To con-
firm the positive anesthetic blockade effect, 0.5 mL of 1% lidoc-
aine and 0.5% bupivacaine were injected consecutively with 1
week interval at each medial branch of C4-7, and pain relief
(>90%) with bupivacaine should last at least 3 hours longer
than that with lidocaine41. Even though we followed the same
diagnostic procedures, it was relatively complicated and the pa-
ients suffered much inconvenience during the procedures. It
seems that there should be a less complicated and less painful
diagnostic method for CGH in the future.

Accompanying symptoms such as wide spread headache,
blurred vision, dizziness, or tinnitus are common symptoms in
other disorders causing headache. Therefore, CGH should be
differentiated from migraine, tension headache, sinusitis, tem-
poromandibular joint syndrome, visual problems, auditory dis-
turbance, and cluster headache13,25,44. According to a study re-
porting that pressure pain threshold at the facets in the CGH
was lower than migraine and tension headache, the pathophysi-
ology of CGH thought to be different from other types of head-
aches13. There were three cases of glaucoma and two cases of
herpes zoster among patients with occipital headache and neck
pain (data not presented), and were excluded from this study.

Pathogenesis of CGH remains controversial, suggesting that
almost all the structures around the neck may cause CGH. Fac-
et joints30, cervical muscles24,36, intervertebral discs29, nerve
roots23, vertebral arteries24, and uncovertebral joints20 were
reportedly related to CGH. The greater and lesser occipital nerves
and the third occipital nerve, branches of C2-3 roots, were re-
ported to be responsible for CGH as well30. CGH related struc-
tures have their sensory connection with upper cervical nerve
roots, which converge into the spinal tract of the trigeminal nu-
cleus41 and can explain the spreading of pain to frontal and or-
bital areas from cervical disorders. However, according to a
study blocking mid-cervical nerves for CGH13, the mid-cervi-
cal nerves were also related to CGH. This supports our data
showing considerable effect of lower cervical RFN on CGH.

Although medication and physiotherapy have been used as
the initial management for CGH, transcutaneous electrical nerve
stimulation10, nerve block16,20, botulinum toxin injec-
tion15, and RFN8,12,43 have also been recommended for treatment
of medically intractable CGH. The RFN was reported to be ef-
factive in approximately 80% of the CGH patients. In this study,
the majority (93.8%) of neck patients was treated with conser-
ватive methods, and only a small portion of the patients (6.2%)
required RFN. Lower cervical, C4-7, RFN was performed for
lower CZJP with CGH (11 patients), and was considered effec-
tive for headache in 63.6% of the patients. Even though direct
comparison is difficult, the rate of effectiveness of this study was
considerably lower than that of other reports performed upper
cervical RFN[12,43]. The relative ineffectiveness of lower cervical RFN not only emphasizes the contribution of upper cervical spinal nerves but also a considerable responsibility of lower cervical nerves to the CGH.

The VAS score slowly improved during the first week after RFN and then showed prominent improvement at one month. This clinical pattern after RFN, slow initial improvement, appears to be related to local pain at the electrode insertion sites. There are limitations of this study. The original diagnosis of the patients enrolled in this study was not the CGH related with lower cervical disorder. They were known to have lower CZJP as a first impression, and then their headaches were noticed during the diagnostic process, which must be the problem related with retrospective study. We could not rule out the effect of other types of headache like migraine and tension headache or differentiate the effect of upper cervical region in the failed group. The number of patients was small, which seems to come from relatively complicated diagnostic method.

CONCLUSION

The results from the present study suggest that lower cervical disorders play a considerable role in the pathogenesis of CGH. Although upper cervical levels are the primary targets for treatment, lower cervical levels should not be overlooked in the treatment of CGH for better clinical results.

References

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