Difference in Clinical Effect between Deep and Superficial Acupuncture Needle Insertion for Neck-shoulder Pain: a Randomized Controlled Clinical Trial Pilot Study

Miwa NAKAJIMA1), Motohiro INOUE1), Megumi ITOI2), Hiroshi KITAKOJI1)

Abstract

Objective: The purpose of this study was to compare the effects of superficial and deep insertion of acupuncture needles in the treatment of patients with neck-shoulder pain and to search for more effective acupuncture methods.

Methods: The subjects were patients seen at the Meiji University of Integrative Medicine’s Department of Orthopedic Surgery Clinic. A randomized controlled clinical trial was conducted in which 20 patients with neck-shoulder pain were randomly allocated to either a superficial acupuncture group (n=10) or a deep acupuncture group (n=10). Treatment was applied to points where patients experienced the most pain. The maximum number of stimulation points for both groups was 10. In the superficial acupuncture group, the needle was only inserted to a depth of 5 millimeter. In the deep acupuncture group, the needle was inserted to a depth of 15 to 20 millimeter. Both groups were manually stimulated using a sparrow pecking method over 20 seconds, after which the needle was removed. Both groups were treated weekly for four weeks. The primary outcome measurement was intensity of pain evaluated using a Visual Analogue Scale (VAS). The secondary outcome measurement was the Neck Disability Index (NDI) for the purpose of evaluating the grade of disability in daily life due to neck-shoulder pain.

Results: There were no significant differences in age, male-female ratio, disease duration, or the initial scores of VAS and NDI between the two groups. VAS and NDI scores indicated significant differences between the groups (VAS: <0.0001, NDI: p<0.0001) in change over time, with the deep acupuncture group having more favorable results than the superficial acupuncture group. The degree of change from the baseline at the time of each evaluation was calculated, and results for the two groups were compared. The deep acupuncture group showed significantly better improvement in the sustained effects after completion of treatment (VAS: p<0.05). There were no significant differences directly after the first treatment (VAS: p=0.72) or in cumulative effect after repeated treatment (VAS: p=0.24).

Discussion and Conclusion: The results of this study suggested it would be more efficient to insert the needle to deep tissues when performing acupuncture treatment on subjective pain sites. The difference in the effects between the two acupuncture methods may be due to the difference in tissue stimulation received. The difference in effect is thought to be due to the differing influence of treatment on pain threshold, muscle blood flow, and muscle tones.

(Received: July, 30, 2014, Accepted: January, 23, 2015)

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Keywords: randomized controlled clinical trial, neck-shoulder pain, acupuncture, depth of insertion

I INTRODUCTION

To ascertain the efficacy of acupuncture treatment for neck-shoulder pain, not only case studies are reported or collected, but the effectiveness of acupuncture has also been tested in highly reliable clinical tests such as randomized controlled trials\(^1\),\(^2\). A wide range of verification by systematic review including meta-analysis is also being conducted\(^3\),\(^4\). Some papers report a significant improvement compared to non-intervention groups, and others indicate a greater benefit from acupuncture treatment than from medicinal treatment or physical therapy\(^1\),\(^2\). Although doctors are realizing its effectiveness in clinical sites, acupuncture is still in the investigation stage and it is too soon to declare acupuncture treatment effective. To firmly establish the effectiveness of acupuncture for treating neck-shoulder pain, a more effective treatment method needed to be established and clinical data demonstrating the significance of this technique needed to be presented. Hereupon, we focused on the depth of needle insertion. While it is one of the important elements for establishing an effective acupuncture treatment method, there is still no consensus\(^1\),\(^2\). In this study, the difference in clinical effectiveness due to the difference in depth of needle insertion to the same region was evaluated using a randomized controlled trial.

II MATERIALS AND METHODS

I. Subjects

This trial was conducted at the Department of Orthopedic Surgery Clinic, Meiji University of Integrative Medicine. From patients treated at the Department of Orthopedic Surgery Clinic, 20 patients suffering from chronic neck-shoulder pain originating from degenerative disease of the cervical vertebra were selected as the subjects. Patients had to have symptoms for at least 6 months.

The subjects consisted of 16 patients with cervical osteoarthritis, two with cervical disc lesion, one with cervical posterior longitudinal ligament osteosis and one who had had a surgical operation on the cervical spondylosis myelopathy. Patients who had another disease related to the neck-shoulder region and upper extremity symptoms, patients who started another treatment within one month prior to the start of the trial, patients who changed their type of treatment and patients who had received acupuncture treatment before were excluded from the trial. Patients taking medication more than one month prior to the start of the trial were instructed not to change the type or dosage of medication during the trial period. No secondary intervention was introduced except for any medicinal treatment already being administered prior to the start of the trial. The purpose of the trial was explained to the patients and the trial was conducted with their written consent. At that time, patients were informed they would not be told which of the two depth dependent acupuncture treatment methods would be given or
was given. 20 patients were randomly allocated to either a superficial acupuncture group of 10 (2 male, 8 female) or a deep acupuncture group of 10 (3 male, 7 female) using a computer program (Sample Size 2.0, Blackwell Science Ltd.).

This study was performed with the approval of the Ethics Committee of the Meiji University of Integrative Medicine.

2. Intervention

Acupuncture treatments were performed for both of the superficial acupuncture group and the deep acupuncture group by an acupuncturist with 7 years of clinical experience specializing in motor disorder. All conditions except for the depth of needle insertion were the same for both groups. The depth of needle insertion was 5 millimeter or less for the superficial acupuncture group and 15 to 20 millimeter for the deep acupuncture group. The most painful points (maximum 10 points) of the neck and shoulder region were selected as needling sites\(^2\). Some participants had needle insertion on one side and others on both sides. A sparrow pecking method was used as acustimulation (2Hz) for 20 seconds. Then the needle was removed. A stainless steel needle (40 millimeter in length, 0.18 millimeter in diameter, made by SEIRIN Co., Ltd., Japan) was used. During acupuncture treatment feelings such as de qi sensation were not deliberately induced. The treatment was provided to both groups once a week for 4 weeks. The effects were evaluated after a four week treatment-free (no acupuncture treatment) from the last treatment. Thus, the study was carried out over seven weeks in total.

3. Evaluation

The Visual Analogue Scale (VAS) was used for subjective assessment of neck-shoulder pain. The results were recoded before and after each treatment and four weeks after completion of treatment. Using a Japanese translation of the Neck Disability Index (NDI)\(^5\), the degree of disability in daily life due to neck-shoulder pain was evaluated before the start of treatment, at completion of treatment and four weeks after completion of treatment. Furthermore, during the first treatment, patients were asked whether or not they felt pain the moment a needle was inserted and whether or not they felt the insertion. The evaluation was performed by an acupuncturist who did not know which patient was allocated to which group. Fig. 1 shows a flow chart of this trial.

4. Statistical analysis

All results are shown in the mean ± standard deviation.

An unpaired t-test was used for between groups comparison of the baseline data (age, disease duration, initial values of VAS and NDI) before the start of treatment. A paired t-test was used for within-group comparison of VAS measured values before and after the first treatment. Fisher’s exact test was used to check the male-female ratio, the presence of pain at the moment of needle insertion and the presence of a sense of insertion. The repeated measures ANOVA was used for the difference in pattern changes over time due to treatment. In addition, a t-test was conducted using the amount of change (a measured value before the first treatment
minus a measured value at each evaluation) in order to compare the effectiveness immediately after treatment, the effectiveness of continued treatment and the sustained effectiveness after completion of treatment between the two groups, and the Bonferroni correction was applied. All statistical analyses were performed using Statview version 4.5 (SAS Institute, Japan) and the significant level was determined to be 5%.

### III RESULTS

No patients dropped out during this trial. Neither symptom aggravation nor adverse events due to treatment was confirmed in both groups.

**Baseline patient characteristics (Table 1)**

The baseline data before the start of treatment was compared between the two groups. No significant difference was observed in age, male-female ratio, disease duration and the initial score of VAS or NDI in all data.

The presence of pain at the moment of needle insertion and the existence of a needling sensation at the first treatment (Table 1)

In the superficial acupuncture group, zero patients felt pain, and in the deep acupuncture group, one felt pain and nine did not feel pain at the moment of needle insertion, indicating there was no significant difference between the two groups. In the superficial acupuncture group, three patients experienced a needling sensation and seven did not, whereas all patients said they experienced a needling sensation in the deep acupuncture group, indicating a significant difference between the two groups.
Effect immediately after treatment (Fig. 2)

The scores before and after the first treatment were compared to assess the effect immediately after treatment. In within-group comparison of VAS pain scores, both groups showed significant improvements (for the superficial acupuncture group, 76.4 ± 21.7 millimeter before treatment, 44.3 ± 13.2 millimeter after treatment, and p<0.05, and for the deep acupuncture group, 79.2 ± 13.0 millimeter before treatment, 43.4 ± 26.0 millimeter after treatment, and p<0.05). No significant difference was recognized when comparing the change in VAS pain scores (VAS pain score before treatment minus VAS pain score after treatment) between the two groups (32.1 ± 18.9 millimeter for the superficial acupuncture group and 35.8 ± 25.6 millimeter for the deep acupuncture group, and p=0.72).

Pattern of change over time due to treatment (Fig. 3)

An interaction was observed between the two groups in VAS and NDI pattern changes over time due to treatment (VAS: p<0.0001, NDI: p<0.0001). Significantly positive results were observed in the deep acupuncture group.

### Table 1
Baseline data before the start of treatment, the presence of pain at the moment of needle insertion and the existence of a needling sensation at the first treatment

<table>
<thead>
<tr>
<th></th>
<th>Superficial acupuncture group</th>
<th>Deep acupuncture group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean±S.D.)</td>
<td>67.2 ± 12.8</td>
<td>68.7 ± 13.1</td>
<td>N.S.</td>
</tr>
<tr>
<td>Duration of neck-shoulder pain (months, mean±S.D.)</td>
<td>58.5 ± 54.1</td>
<td>45.5 ± 53.0</td>
<td>N.S.</td>
</tr>
<tr>
<td>Diagnosis (n)</td>
<td>Cervical osteoarthritis 8</td>
<td>Cervical osteoarthritis 8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cervical disc lesion 1</td>
<td>Cervical disc lesion 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSM after surgery 1</td>
<td>OPLL 1</td>
<td></td>
</tr>
<tr>
<td>VAS pain score (mm, mean±S.D.)</td>
<td>76.4 ± 21.7</td>
<td>79.2 ± 13.0</td>
<td>N.S.</td>
</tr>
<tr>
<td>NDI score (point, mean±S.D.)</td>
<td>19.0 ± 10.1</td>
<td>19.3 ± 10.1</td>
<td>N.S.</td>
</tr>
<tr>
<td>Other treatment (n)</td>
<td>Anti-inflammatory poultice 3</td>
<td>Anti-inflammatory poultice 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NSAIDs 1</td>
<td>Muscle relaxant 1</td>
<td></td>
</tr>
<tr>
<td>Pain at needle insertion (n)</td>
<td>Yes: 0, No: 10</td>
<td>Yes: 1, No: 9</td>
<td>N.S.</td>
</tr>
<tr>
<td>Needling sensation (n)</td>
<td>Yes: 3, No: 7</td>
<td>Yes: 10, No: 0</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

A significant difference was observed between the two groups only in the existence of a needling sensation (p<0.05).
Effect of repeated treatment (Fig. 4)

The VAS pain scores before treatment were compared with scores before the last treatment (values before the start of treatment minus values before the last treatment) to determine the effect of repeated treatments. The superficial acupuncture group scored 56.0 ± 29.0 millimeter, and the deep acupuncture group scored 69.2 ± 18.1 millimeter. Although the deep acupuncture group showed a higher score, no significant difference was recognized between the two groups (p=0.24). The NDI scores before the start of treatment were compared with scores at the last treatment (values before the start of treatment minus values at the last treatment). The superficial acupuncture group scored 10.3 ± 10.0 points, whereas the deep acupuncture group scored 16.1 ± 9.0 points. Although the deep acupuncture group showed a higher score, no significant difference was recognized between the two groups (p=0.19).

Sustained effect after completion of treatment (Fig. 5)

Both the VAS and NDI scores before the start of treatment were compared with their respective scores four weeks after completion of treatment (values before the start of treatment minus values four weeks after completion). The superficial acupuncture group scored 50.0 ± 25.0 millimeter, and the deep acupuncture group scored 64.0 ± 16.0 millimeter. Although the deep acupuncture group showed a higher score, no significant difference was recognized between the two groups (p=0.34). The NDI scores before the start of treatment were compared with scores four weeks after completion (values before the start of treatment minus values four weeks after completion). The superficial acupuncture group scored 11.0 ± 11.0 points, whereas the deep acupuncture group scored 16.0 ± 10.0 points. Although the deep acupuncture group showed a higher score, no significant difference was recognized between the two groups (p=0.25).
minus values four weeks after completion of treatment) to determine the sustained effect after completion of treatment. The VAS scores were $51.5 \pm 31.5$ millimeter for the superficial acupuncture group and $74.2 \pm 12.7$ millimeter for the deep acupuncture group, showing a significant improvement in the deep acupuncture group ($p<0.05$). The NDI scores were $11.2 \pm 10.4$ points for the superficial acupuncture group and $17.4 \pm 10.0$ points for the deep acupuncture group. Although the deep acupuncture group showed a higher score, no significant difference was recognized between the two groups ($p=0.19$).
IV DISCUSSION

In order to demonstrate the efficacy of acupuncture for treating neck-shoulder pain, results of clinical studies using more effective methods need to be presented. So, we examined the difference in the depth of needle insertion that is assumed to influence the degree of effectiveness. Subjective pain sites of the patients, which are often used in daily clinical practice, were chosen to be the sites for the treatment. By doing so, the effect of finger pressure resulting from pressure being applied by a practitioner when he/she is searching for tender areas can be avoided. Because no significant difference was observed between the two groups in all baseline data prior to the start of treatment, we assumed the baseline randomization was successful.

When assessing the effectiveness immediately after treatment, it is likely that the scores before and after the second or later treatments include the effect of repeated treatment; therefore, the scores before and after the first treatment were compared. The VAS score before the fourth treatment was compared with the VAS score prior to the start of treatment to assess the effect of repeated treatment because these scores do not include the effect immediately after treatment. Due to the characteristics of the evaluation type, NDI scores are

![Bar chart showing the degree of decrease in VAS and NDI pain scores](image)

**Fig. 4** Effect of repeated treatment

- A: Between-group comparison of the changes in VAS pain scores
- B: Between-group comparison of the changes in NDI scores

No significant difference was observed between the two groups in VAS or NDI.
not influenced by the effect immediately after treatment; therefore, the scores either before or after treatment were compared with the scores prior to the start of treatment. No significant difference was observed between the two groups in VAS scores reflecting the effect immediately after treatment, nor in VAS and NDI scores showing the effect of repeated treatment. However, a significant difference was recognized between the two groups in VAS scores reflecting the sustained effect after completion of treatment, which is an important factor in determining the effectiveness of treatment. Furthermore, an interaction was observed both in VAS and NDI pattern changes over time due to treatment.

Based on our comprehensive evaluation of these results, the deep acupuncture group is considered to be more effective. Therefore, we propose that inserting a needle to a deep site is more effective when acupuncture is performed for neck-shoulder pain. When considering the depth of needle insertion set for the two groups in this study, in the superficial acupuncture group, acupuncture stimulated the skin and subcutaneous tissues, whereas in the deep acupuncture group, in addition to these tissues it also stimulated deeper tissues such as fascia.

![Graphs showing VAS and NDI scores](image.png)

**Fig. 5** Sustained effect after completion of treatment

A: Between-group comparison of the changes in VAS pain scores
B: Between-group comparison of the changes in NDI scores

A significant difference was observed between the two groups in VAS.

* $p<0.05$
and muscular layers. We believe the difference in tissue stimulation suppressed pain differently.

Comparative studies about the difference in effectiveness due to the different depth of needle insertion in acupuncture have been conducted including animal testing with nervous edema-induced model rats or clinical trials targeting patients with shoulder pain, lower back pain and knee pain. Most of the results reported that the deep needle insertion was more effective. Some animal testing results showed that afferent impulses from acupoints were transmitted through the nerve of the deep tissues and other results showed changes in muscular pain threshold or in muscle blood flow due to stimulation of the said muscles. Based on these results, we believe that, first, simply inserting a needle into a deep site is likely to produce improved results and that, second, for patients with chronic sharp pain like those in this study, it is plausible that the pain is indicative of a underlying physical problem which is rooted in the muscular or other deep tissues, as a result, needling into those sites, i.e., deep sites where possible root causes of the pain exist would be extremely effective.

Although many reports indicate that deep acupuncture is more effective, some reports show that superficial acupuncture is better for treating knee pain. This may be due to the fact that the knee lies close to the surface of the body, hence, the pathology is usually localized to a shallow site. As an example, a medial joint fissure gap causes tenderness due to medial knee osteoarthritis. However this needs to be further studied. While superficial acupuncture only stimulates the tissues located at the shallow regions, deep acupuncture stimulates the deep tissues in addition to the shallow tissues. To ascertain superficial acupuncture is effective, it is necessary to clarify why the effects of superficial acupuncture are negated by performing deep acupuncture.

In addition, as shown by the results of this trial, whether or not the patients experienced the needling sensation may be a possible factor for why deep acupuncture achieved better effects. In this study, however, we did not ask for details of the needling sensation. Therefore, it is not clear whether the sensation the patients experienced is simply a feeling of a needle being inserted, or could be an acupuncture specific feeling such as de qi that is assumed to have a possible effect on treatment effectiveness. More detailed study will be needed in future.

In any case, this study indicates that deep acupuncture tends to be more effective as seen in several preceding studies. This suggests that deep acupuncture may be more beneficial than shallow acupuncture for treating neck-shoulder pain.

However, we did not set a control group in this study; therefore, we cannot completely deny the likelihood of spontaneous remission. However, in this study we considered only cases in which the symptoms lasted for more than 6 months and showed no tendency of improvement, so we think it is highly likely the changes observed during this study period were caused by intervention. We think we need to set a control group (a group on which general conservative treatment is performed) in our future study.
V CONCLUSION

The difference in clinical effectiveness due to the difference in depth of needle insertion when performing acupuncture on the subjective pain sites of patients with neck-shoulder pain was examined in a randomized controlled clinical trial. Significantly better results were observed in the deep acupuncture group regarding pattern changes over time due to treatment and the sustained effects during a specified period after completion of treatment. Thus, based on the results of this study, inserting a needle into a deeper site may be more effective when performing acupuncture on the subjective pain sites of a patient.

Acknowledgments

The authors are grateful to Prof. N. Ishizaki, The Department of Clinical Acupuncture and Moxibusion, Meiji University of Integrative Medicine for his valuable suggestions.

Contributors

MN: Design study, research, data analysis and creation of the manuscript. MI: Correction of the manuscript and supervision of the study. MI: Analysis and interpretation of data. HK: Revision of the article critically for important intellectual content and overall control.

Competing Interest

None to declare.

Ethics approval

This study was performed with the approval of the Ethics Committee of the Meiji University of Integrative Medicine.

Provenance and peer review

Not commissioned; externally peer reviewed.

References