

Cervical surgery rate in neck pain patients with and without acupuncture treatment: a retrospective cohort study

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Abstract

Objective: Surgical treatment of neck pain often entails high costs and adverse events. The present cohort study investigated whether utilisation of acupuncture in neck pain patients is associated with a reduced rate of cervical surgery.

Methods: The Korean National Health Insurance Service National Sample Cohort (NHIS-NSC) database was retrospectively analysed to identify the 2 year incidence of cervical surgery in Korean patients suffering neck pain from 2004 to 2010. The incidence was calculated and compared between patients receiving and not receiving acupuncture treatment using Cox proportional hazards models. Cumulative survival rates were compared using Kaplan-Meier survival analysis.

Results: The acupuncture and control groups included 50 171 and 128 556 neck pain patients, respectively. A total of 50 161 patients were selected in each group following propensity score matching with regard to sex, age, income and Charlson comorbidity index. The hazard ratio (HR) for surgery within 2 years was significantly lower in the acupuncture group compared with the control group (HR 0.397, 95% CI 0.299 to 0.527). In addition, subgroup analyses according to gender, age and income revealed consistent results for both men (HR 0.337, 95% CI 0.234 to 0.485) and women (HR 0.529, 95% CI 0.334 to 0.836); the results were consistently observed across all age and income strata. Sensitivity analysis with varying numbers of acupuncture treatments and treatment course duration also consistently indicated lower HRs for surgery within 2 years in the acupuncture group compared with the control group.

Conclusions: A significantly lower HR for cervical surgery was observed in neck pain patients following acupuncture treatment. Acupuncture treatment may therefore be an effective method for managing neck pain, and has the potential to mitigate unnecessary surgery. These findings need to be confirmed by prospective studies.

Keywords

acupuncture, epidemiology, musculoskeletal disorders, spinal neck pain

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Introduction

Neck pain is a major cause of discomfort and disability, and significantly reduces task performance.^{1–2} Neck pain can also lead to various social problems due to the burden it places on individuals and society at large. The annual prevalence of neck pain among adults is 30–50% worldwide,³ and the lifetime prevalence of neck pain in Korea has been estimated to be 20.8%.⁴ In addition, disability-adjusted life-years (DALYs) due to neck pain increased from 23.9 million in 1990 to 33.6 million in 2010,⁵ and neck pain accounts for one-fifth of all musculoskeletal-related DALYs, making it the second highest cause.⁶

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For neck pain accompanied by severe radiating pain or progressive motor and sensory loss, surgical treatment is considered.⁷ In Korea, the rate of spinal surgery has recently increased by 46%, from 2.38 cases per 1000 persons in 2007 to 3.36 cases per 1000 persons in 2013. The total medical cost of spinal surgery covered by Korean National Health Insurance has also recently increased by 40%, from 365.4 billion won in 2017 to 501 billion won in 2013.⁸ In a study based on the Nationwide Inpatient Sample (NIS), which gathered hospital discharge data of >8 million cases annually from 45 states across the USA, there was a similar albeit smaller rise in the rate of cervical surgery, increasing from 150 372 cases in 2002 to 186 679 cases in 2009. The average cost for anterior cervical fusion, which comprises 80% of all cervical surgery cases, increased by US\$3858 from 2002 through 2009; similarly, the cost for posterior cervical fusion, which comprises 11.2% of all cases, increased by US\$8845.⁹ Adverse events have been reported to occur at a rate of 14% following cervical surgery; resultant complications include dural tears, implant malpositioning, bone breakage, massive blood loss, neural injury and non-union.^{10 11}

In addition to surgical treatment, conservative treatment methods—for example, exercise,¹² traction,¹³ physical therapy,¹⁴ manual therapy,¹⁵ and massage¹⁶—have been used for neck pain. Among the various modalities for conservative management of musculoskeletal pain, acupuncture is one of the most widely used.^{17–20} According to a recent systematic review and meta-analysis, acupuncture treatment was more effective in the short- and medium-term at treating neck and shoulder pain than controls and sham acupuncture.²¹ In a safety-focused systematic review that analysed >250 000 cases of acupuncture treatment, two cases of pneumothorax and two cases of broken needles were noted as the most serious adverse events, indicating that severe adverse events rarely occur after acupuncture.²² These studies demonstrate the safety and efficacy of acupuncture for neck pain. If acupuncture treatment lowers the incidence of surgical treatment in neck pain patients, it may also lower the rate of postoperative complications and adverse events as well as neck pain-associated medical costs, and acupuncture could be used as an effective method of treatment before consideration of surgery. To our knowledge, there are no prior studies examining the rate of surgery according to previous utilisation of acupuncture treatment or the number of acupuncture treatment sessions. The National Health Insurance Service National Sample Cohort (NHIS-NSC) is a large-scale cohort that includes approximately 1 million people and effectively represents the Korean population.²³ In this cohort study, the rates of surgery in neck pain patients receiving versus not receiving acupuncture were compared to investigate whether acupuncture treatment lowers the incidence of cervical surgery.

Methods

Data sources

The NHIS of South Korea covered the medical costs of 51.87 million Koreans as of June 2015. Medical services can be largely dichotomised into those that are eligible or non-eligible for National Health Insurance coverage in South Korea, and the billing statements for insurance-covered medical services are submitted for reimbursement to the NHIS by medical service providers. Based on these data, the NHIS-NSC database was established, and information on patient sex, area of residence, income level, insurance eligibility, medical services provided, medical service providers (institutions), and general health examinations are collected. The current study analysed data from the NHIS-NSC database compiled between 2002 and 2013. The NHIS-NSC database was established in 2002 and contains continuous data collected through follow-up of participants; newborns are introduced to the cohort to make up for losses to follow-up caused by death and emigration. This nationwide stratified random sample of the Korean population included 1 025 340 patients in 2002 and 1 014 730 in 2013; throughout the cohort analysis years, it represented approximately 2.2% of the entire Korean population. The NHIS-NSC dataset used in this study covers extensive information regarding patient characteristics and inpatient and outpatient medical examination data (e.g., diagnosis, prognosis and medication history). To protect participant privacy, resident registration numbers (RRN, Korean personal identification numbers) were replaced by randomly generated eight-digit numbers. Additionally, to prevent patient identification based on rare disease diagnosis combined with age and area of residence, the last section of the 114 International Classification of Diseases, 10th revision (ICD-10) codes related to rare diseases were replaced by asterisks.

Study design

As results may be influenced by previous treatment use or non-use for pre-existing neck pain, patients were defined in this study as those with newly diagnosed neck pain who underwent Korean traditional medicine treatment or conventional medical treatment. To identify patients with newly diagnosed neck pain, a 2 year wash-out period was applied (2002–2003) and the period for measuring the incidence of surgery was set to 2 years following treatment after discussion with experts. Neck pain patients who were registered from 2004 to 2010 were analysed accordingly.

After checking patient history for acupuncture treatment, those who did not undergo acupuncture treatment were assigned to the non-acupuncture (control) group. Based on discussion between clinical experts (JL, BCS) and researchers (DGH, YJL, IHH), and with reference to a Korean

medicine clinical practice guideline on acupuncture use for neck pain,²⁴ it was determined that patients who underwent ≥ 2 sessions of acupuncture treatment within 6 weeks would be assigned to the acupuncture group, to better reflect real-world clinical situations. Patients were excluded if they underwent acupuncture treatment for < 2 sessions within 6 weeks. Propensity score matching was performed for the acupuncture and non-acupuncture groups. Age, gender, income,^{25, 26} and Charlson comorbidity indices (CCIs) were used as matching covariates. The NHIS-NSC divided age distribution into 5 year intervals and income distribution into deciles. In our analysis, we condensed the age distribution into 10 year intervals and income distribution into three groups (lower, middle and upper). The CCI is a measure for assessing the mortality of diseases for a particular patient. Quan's ICD-10 CCI equation²⁷ was used to classify CCI into groups, ranging from 1 to 8. After matching, the hazard ratio (HR) of surgery was calculated for the acupuncture and control groups; comparisons were made between the HR for surgery up to 2 years after the first acupuncture treatment in the acupuncture group, and HR for surgery up to 2 years after the first examination in the control group. For the acupuncture group, the date of first treatment was used, as opposed to the date of first examination as it was assumed that patients would not have undergone surgery between the first examination and first acupuncture treatment, and immortal bias²⁸ could therefore be minimised—this bias may have provided an unfair advantage to the acupuncture group if the first examination date had been used.

Criteria and definition

Diagnoses related to neck pain were classified as: cervical disc disorders (M50*), other spondylosis with radiculopathy (M4721, M4722, M4723), spinal stenosis (M4801, M4802, M4803), spondylolisthesis (M4311, M4312, M4313), spondylolysis (M4301, M4302, M4303), cervicgia (M542*), ossification of posterior longitudinal ligament (M4882), and sprain and strain of cervical spine (S134); according to diagnostic codes proposed in a report submitted by the Health Insurance & Assessment Service (HIRA)⁸. However, independent, mutually exclusive diagnostic systems were used for Korean traditional medicine and conventional medicine up to December 2009, creating problems regarding use of different codes for identical diseases. To overcome these problems, a modified Korean Classification of Disease, which added disease classifications of traditional Korean medicine to those of existing conventional medicine, has been used since January 2010. Thus, traditional Korean medical treatments performed up until December 2009 were searched using the following diagnoses related to neck pain: muscle injury of the neck (H350), sprain of the head and neck (J260*), and cervicgia (J07*). Neck stiffness (U30.3) was excluded, as it is used to diagnose multiple conditions for neck pain, cerebral diseases and headache. The HIRA

report was also referred to for the following surgical codes related to neck pain: spinal fusion (N0464, N0467, M2461, N2462, N2463, N2467, N2468, N2469), vertebral corpectomy (cervical spine) (N0451), discectomy-cervical spine (N1491, N1494), laminectomy, cervical spine (N1497), cervical spine laminoplasty (N2491, N2492), injection procedure for chemonucleolysis, aspiration procedure of nucleus pulposus of intervertebral disk, nucleoplasty (N1495, N1496, H0779), arthrodesis for spinal deformity (anterior technique) (N0444, N0445, N0446, N0447), osteotomy (N0303), percutaneous vertebroplasty (including discography) (N0471, N0472), percutaneous balloon kyphoplasty (including discography) (N0473, N0474), operation of spina bifida (N0480), costotransversectomy (N0500), and open reduction of fracture and dislocation of spine or pelvis (N0590)⁸. Acupuncture codes 40011* and 40012* were used. Clinically, 40011* and 40012* are always included in acupuncture treatment. Codes for electroacupuncture, laser acupuncture treatment, and *tu-ja* (penetrating) acupuncture treatment were used, in addition to 40011* and 40012*. Thus, by defining the acupuncture procedure codes as 40011* and 40012*, all patients were able to be included, and their history of acupuncture treatment was recorded accordingly.

Statistical analysis

Demographic characteristics and surgery rates were compared between the acupuncture and control groups using χ^2 test and Student's t-test. Logistic regression was used for propensity score matching. HRs and 95% confidence intervals (95% CI) between groups were calculated using a Cox proportional hazard model. The cumulative surgery rate for each group was calculated using Kaplan-Meier analysis. The level of significance was set at two-sided $P < 0.05$. SAS version 9.4 (SAS Institute, Cary, NC, USA) and Stata 14 were used for statistical analysis.

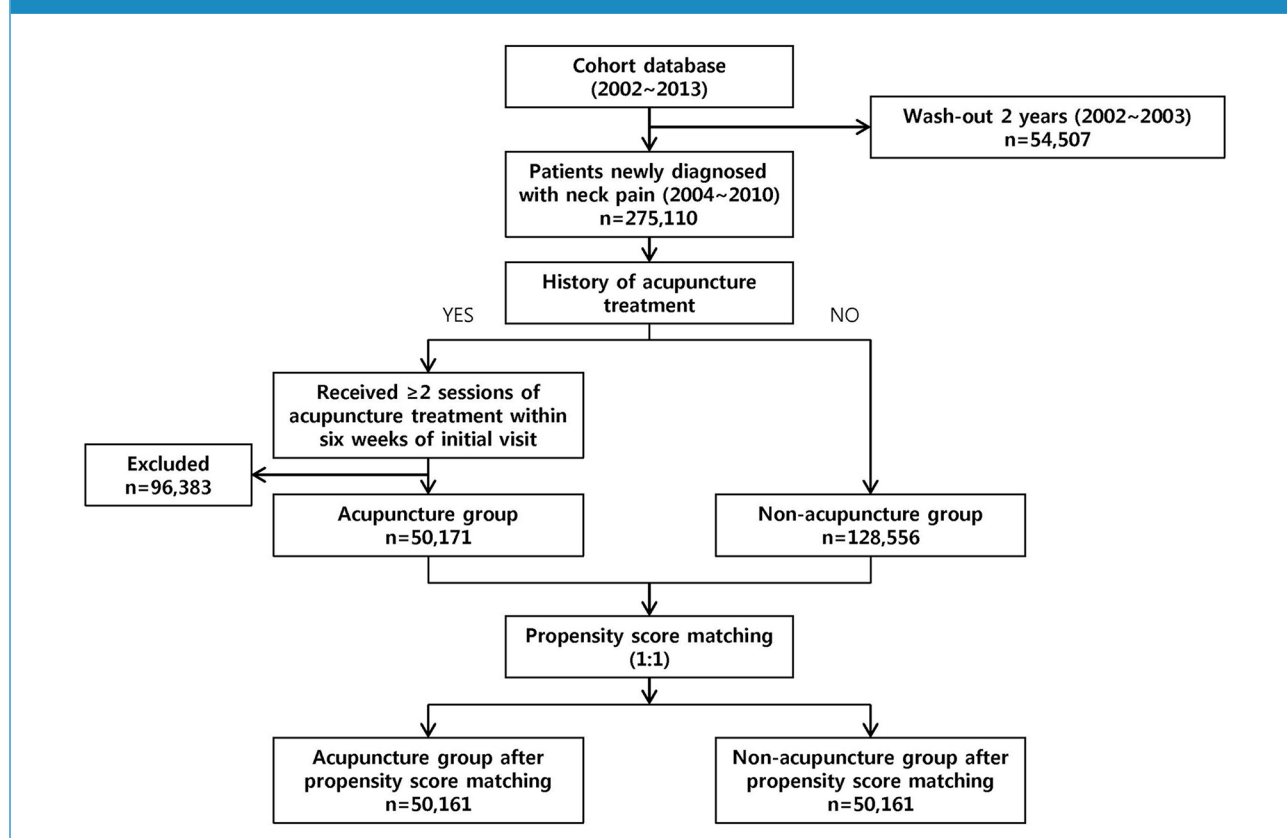
Ethical approval and consent to participate

The database analysed herein was generated from claims data, and thus was not subject to consent acquisition. All personal information was masked by the NHIS before public release. The current study was carried out in accordance with the Declaration of Helsinki. This study was reviewed by the Institutional Review Board of Jaseng Hospital of Korean Medicine (IRB approval no. JASENG 2017-12-009).

Results

Propensity score matching in a ratio of 1:1 was conducted in unmatched neck pain patients (Figure 1). Following matching, no significant differences were found between groups in terms of age, sex, income and CCI (Table 1).

Figure 1. Flowchart of study design.



The HR for cervical surgery was calculated in the two groups post-matching. With the control group as the reference, the HR for surgery in the acupuncture group was 0.397 (95% CI 0.299 to 0.527); the likelihood of patients receiving cervical surgery was significantly lower in the acupuncture group compared with the control group ($P<0.001$). To test the robustness of the findings, additional subgroup analyses were conducted according to age, sex and income level. In all strata, acupuncture treatment was found to significantly reduce the likelihood of cervical surgery (Table 2).

In the original design, only patients who underwent ≥ 2 sessions of acupuncture treatment within 6 weeks following initial diagnosis were assigned to the acupuncture group; those who received acupuncture treatment but failed to meet the criteria were excluded from analysis. These numbers (6 week period and two sessions) were determined by researchers through discussion to closely reflect real clinical situations. Sensitivity analyses were conducted using variable criteria standards for acupuncture treatment. First, keeping the number of treatment sessions fixed as at least two, the length of the treatment period was modified from 6 weeks to 1–5 weeks, respectively. Reduction of HR for cervical surgery was consistently observed in the acupuncture group across the different treatment periods

($P<0.001$) (Table 3). Second, the minimum number of acupuncture sessions was modified from two to three, four, or five, respectively, within a 6 week treatment window. Again, the decreased HR in the acupuncture group was consistently observed across the variable minimum number of acupuncture sessions ($P<0.001$) (Table 4).

Kaplan-Meier survival analysis revealed a significantly higher cumulative survival rate for the acupuncture group compared with the control group (Figure 2).

Discussion

We performed a retrospective nationwide propensity score-matched cohort study using Korean medical insurance claims data collected between 2002 and 2013. The present study was conducted to investigate whether acupuncture treatment lowers the incidence of cervical surgery in neck pain patients. The definition of acupuncture in the acupuncture group was set as ‘two sessions or more within 6 weeks’ with reference to a Korean clinical practice guideline on acupuncture use for neck pain, in which treatment durations were suggested as ≤ 3 weeks for acute neck pain, and 3 to 5 weeks for chronic neck pain.²⁴ The authors therefore considered that an acupuncture treatment window of ‘within 6 weeks’ would encompass the majority of acute

Table 1. Demographic characteristics of subjects pre- and post-matching

Characteristics	Pre-matching				P values*	Post-matching				P values*
	Acupuncture (n=50 171)		Control (n=128 556)			Acupuncture (n=50 161)		Control (n=50 161)		
	n	%	n	%		n	%	n	%	
Age					<0.001					0.999
20–29	7198	14.35	18 175	14.14		7195	14.34	7195	14.34	
30–39	12 887	25.69	27 157	21.12		12 887	25.69	12 887	25.69	
40–49	14 323	28.55	33 495	26.05		14 318	28.54	14 282	28.47	
50–59	5421	10.81	15 032	11.69		5420	10.81	5456	10.88	
60–69	6438	12.83	20 505	15.95		6437	12.83	6437	12.83	
70–79	3904	7.78	14 192	11.04		3904	7.78	3904	7.78	
Sex					<0.001					0.818
Male	21 233	42.32	56 518	43.96		21 230	42.32	21 194	42.25	
Female	28 938	57.68	72 038	56.04		28 931	57.68	28 967	57.75	
Income					<0.001					0.953
Lower	10 272	20.47	29 200	22.71		10 272	20.48	10 236	20.41	
Middle	19 184	38.24	50 039	38.92		19 178	38.23	19 214	38.30	
Upper	20 715	41.29	49 317	38.36		20 711	41.29	20 711	41.29	
CCI					<0.001					1.000
0	26 319	52.46	64 431	50.12		26 319	52.47	26 347	52.52	
1	14 857	29.61	38 892	30.25		14 857	29.62	14 865	29.63	
2	6100	12.16	16 652	12.95		6100	12.16	6100	12.16	
3	2018	4.02	5931	4.61		2018	4.02	1990	3.97	
4	631	1.26	1912	1.49		628	1.25	620	1.24	
5	190	0.38	539	0.42		188	0.37	188	0.37	
6	42	0.08	149	0.12		39	0.08	39	0.08	
7	10	0.02	39	0.03		9	0.02	9	0.02	
8	4	0.01	11	0.01		3	0.01	3	0.01	

*P value from χ^2 test.

CCI, Charlson comorbidity index.

and chronic neck pain patients. The criterion of ‘two sessions or more’ was additionally set to exclude single session treatments. Propensity score matching was conducted to minimise the difference in propensity to acupuncture treatments; age, sex, income and CCI were included as covariates. Following matching, no significant differences were observed between groups with regard to age, gender, income or CCI.

Following matching, the HR of cervical surgery in the acupuncture group was calculated with reference to the control group, and the results showed that acupuncture treatment significantly reduced the risk of cervical surgery (HR 0.397, 95%CI 0.299 to 0.527). As these results may have been affected by factors such as sex, age and income, subgroup analysis was additionally conducted with these variables included as covariates. Sensitivity analysis was performed

Table 2. Whole and subgroup analyses of cervical surgery rates in acupuncture and control groups

	Acupuncture			Control			HR (95% CI)	P values*
	n	Cases	%	n	Cases	%		
Whole analysis								
Unmatched	50 171	67	0.13	128 556	417	0.32	0.448 (0.346 to 0.580)	<0.001
Matched	50 161	67	0.13	50 161	168	0.33	0.397 (0.299 to 0.527)	<0.001
Subgroup analysis								
Age								
20–29	7195	1	0.01	7195	8	0.11	0.125 (0.016 to 0.998)	0.050
30–39	12 887	7	0.05	12 887	17	0.13	0.411 (0.171 to 0.992)	0.048
40–49	14 318	27	0.19	14 282	62	0.43	0.433 (0.275 to 0.680)	<0.001
50–59	5420	11	0.2	5456	26	0.48	0.422 (0.209 to 0.855)	0.017
60–69	6437	16	0.25	6437	30	0.47	0.532 (0.290 to 0.977)	0.043
70–79	3904	5	0.13	3904	25	0.64	0.199 (0.076 to 0.520)	0.001
Sex								
Male	21 230	39	0.18	21 194	115	0.54	0.337 (0.234 to 0.485)	<0.001
Female	28 931	28	0.1	28 967	53	0.18	0.529 (0.334 to 0.836)	0.006
Income								
Lower	10 272	13	0.13	10 236	29	0.28	0.439 (0.228 to 0.845)	0.014
Middle	19 178	27	0.14	19 214	60	0.31	0.450 (0.286 to 0.708)	<0.001
Upper	20 711	27	0.13	20 711	79	0.38	0.341 (0.220 to 0.527)	<0.001

*P value from Cox regression analysis adjusted for age, sex, income and CCI.
CCI, Charlson comorbidity index.

for duration and number of acupuncture treatment sessions, as results may also have been influenced by these factors. The findings were consistent in the two additional analyses, confirming the robustness of the study results.

In cases where the patient received not only acupuncture treatment but also conventional medical treatment, this may possibly have affected the results. We therefore additionally investigated neck pain-related medical service usage in the acupuncture and control groups. Of the 50 161 patients in the acupuncture group, 17 113 patients concurrently received conventional medical treatment (34.12%). The number of visits to conventional medical facilities within the acupuncture group and control group were similar at an average of five sessions. Types of medical specialty and medical services were also comparable between groups; types of medical specialty most often interacted with were orthopaedic surgery, neurosurgery and internal medicine, and types of medical services used most commonly were consultation, physiotherapy,

injection, diagnostic imaging and medication in descending order, respectively (see Supplemental Table S1). We conducted additional analyses of the number of acupuncture sessions received by patients within the acupuncture group who underwent surgery relative to those who did not undergo surgery, to attempt to address the possibility of confounding by pain severity. The number of acupuncture sessions was comparable at 4.6 ± 4.20 in the surgery group and 4.8 ± 6.44 in the non-surgery group (Supplemental Table S2).

A recent systematic review and meta-analysis published in 2017 concluded that acupuncture treatment is more effective at relieving neck pain than conventional treatments such as physical therapy and medication, and that acupuncture does not cause serious adverse events.²⁹ Another meta-analysis published in 2017, which included 29 trials and 17 922 patients, reported that the effects of acupuncture treatment for neck pain last for >1 year.³⁰ Numerous other studies have reported on the effectiveness of acupuncture

Table 3. Sensitivity analysis of cervical surgery in acupuncture and control groups by treatment period

	Acupuncture			Control			HR (95% CI)	P values*
	n	Cases	%	n	Cases	%		
Treatment period (weeks)								
1	48814	56	0.11	48814	164	0.34	0.341 (0.251 to 0.461)	<0.001
2	49302	60	0.12	49302	167	0.34	0.358 (0.267 to 0.481)	<0.001
3	49609	62	0.12	49609	168	0.34	0.368 (0.275 to 0.493)	<0.001
4	49807	63	0.13	49807	172	0.35	0.368 (0.276 to 0.491)	<0.001
5	49998	66	0.13	49998	168	0.34	0.392 (0.295 to 0.521)	<0.001

*P values from Cox regression analysis adjusted for age, sex, income and CCI.
CCI, Charlson comorbidity index.

Table 4. Sensitivity analysis of cervical surgery in acupuncture and control groups by number of acupuncture sessions

	Acupuncture			Control			HR (95% CI)	P values*
	n	Cases	%	n	Cases	%		
Number of sessions								
Two or more	50 161	67	0.13	50 161	168	0.33	0.397 (0.299 to 0.527)	<0.001
Three or more	29 613	46	0.16	29 613	92	0.31	0.499 (0.350 to 0.711)	<0.001
Four or more	20 167	37	0.18	20 167	69	0.34	0.534 (0.358 to 0.796)	0.002
Five or more	14 427	28	0.19	14 427	53	0.33	0.534 (0.338 to 0.844)	0.007

*P values from Cox regression analysis adjusted for age, sex, income and CCI.
CCI, Charlson comorbidity index.

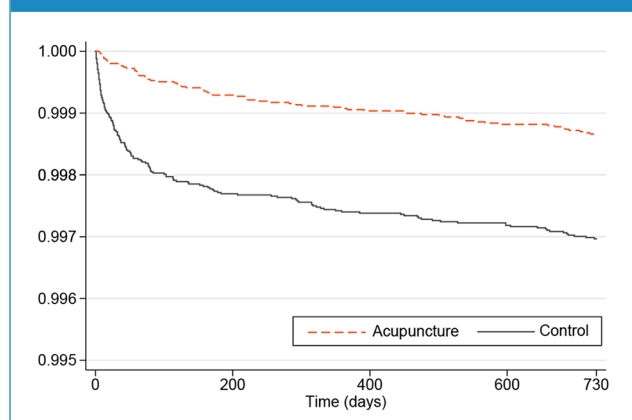
treatment at improving range of motion (ROM) and quality of life (QoL).^{31,32} Based on such evidence and empirical experience, acupuncture treatment is widely used for pain relief in Korea, and is receiving global recognition from various nations and regions including the USA and Europe. The results of this study, in which acupuncture treatment decreased the 2-year incidence of surgery in neck pain patients, support use of acupuncture treatment for neck pain.

The following mechanisms by which acupuncture treats neck pain have been suggested. First, acupuncture affects cerebrospinal fluid (CSF) concentrations of opioid neuropeptides, such as enkephalins, endorphins, dynorphins, endomorphins, and nociceptive signal mediators, as well as eliciting analgesic effects by increasing the level of adrenocorticotrophic hormone and endogenous corticosteroids.^{33–35} Moreover, the mesolimbic pathway, which is one of four pathways that utilise dopamine, is in an unbalanced state in patients with chronic pain; acupuncture treatment

corrects this imbalance, thereby promoting dopamine release and facilitating pain relief.³⁶ Acupuncture treatment promotes recovery at the site of pain by increasing local blood flow,³⁷ and reduces induration of soft tissues caused by myofibrillar enlargement.³⁸ Additionally, the neurogate theory helps explain the mechanism of acupuncture treatment from a neural standpoint³⁴; acupuncture treatment also stimulates the vagus nerve via the cholinergic anti-inflammatory pathway, thus activating parasympathetic nerves, inhibiting systemic inflammatory reactions, and reducing pain.³⁹

This study may be regarded as having the following strengths. It is the first study to identify an association between acupuncture treatment and the incidence of cervical spinal surgery in neck pain patients through analysis of a publicly available cohort database. Previous randomised controlled trials investigating the effectiveness of acupuncture treatment have mostly been

Figure 2. Kaplan-Meier survival estimates of cervical surgery incidence.



short-term, and were therefore not adequately equipped to study the effects of acupuncture treatment on long-term management decisions like elective surgery. The current study was able to analyse the occurrence of cervical surgery over a period of more than 10 years using a retrospective cohort study design, providing large statistical power and a small margin of error. Moreover, the NHIS-NSC database used in this study includes 1 million Koreans, and thus holds a high degree of representativeness. As the database consists of regional data, this study was able to collect information and perform subgroup analysis of a wide range of variables including age, gender, income and region. In this study, propensity score matching was performed for age, gender, income and CCI in order to minimise selection bias and the effect of variables other than treatment. Finally, subgroup and sensitivity analyses confirmed the robustness of the study findings.

However, this study also has a number of limitations. First, as the data from the NHIS-NSC were retrospectively analysed, potential confounding by other factors not included in the database could not be investigated. Second, the study lacks analysis of neck pain severity. The frequency, number and duration of acupuncture treatment sessions in neck pain patients may differ by pain intensity. This study attempted to address the issue of pain severity through comparison of the number of acupuncture sessions in patients who did and did not receive surgery in the acupuncture group. However, in order to clarify the association between the number of acupuncture treatment sessions and treatment course duration with the effect of acupuncture, further studies are called for. Third, patient groups were determined based on the number of treatment sessions, with no consideration for the number/location/depth of needle insertions and retention time; therefore, we could not assess the effects of these factors on the study results. Fourth, treatments other than acupuncture that may potentially influence neck pain (e.g., analgesics, physical therapy, massage, occupational

therapy) were not included as covariates in our analysis. Furthermore, acupuncture was often provided in the form of electroacupuncture clinically, which may have an effect on the prognosis of neck pain, but additional analyses according to electroacupuncture use was not performed. Future studies should take such factors into consideration.

Conclusions

Cervical surgery rates were significantly lower in neck pain patients who received acupuncture treatment compared with those who did not. The robustness of these results was further confirmed through subgroup and sensitivity analyses, which yielded consistent findings. Acupuncture treatment is likely to be an effective method for neck pain management, and may lower the incidence of cervical spinal surgery. Adverse events, complications and medical costs associated with surgery would be expected to be mitigated by acupuncture treatment, and could thereby reduce the social burden caused by neck pain. These findings need to be confirmed by prospective studies.

Contributors

D-gH, WK, YJL, M-rK, and I-HH conceptualised and designed the study. J-SS, JL, KK, B-CS, J-HC, and N-KK acquired and analysed the data. D-gH, WK, YJL, and I-HH interpreted the results. D-gH, WK, J-SS, JL, and I-HH drafted the original article. YJL, M-rK, KK, B-CS, J-HC, and N-KK critically revised the draft. All authors have read and approved the final version of the manuscript accepted for publication.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

The Institutional Review Board of Jaseng Hospital of Korean Medicine.

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Patient consent

Not required.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

The present study analysed the NHIS-NSC database, which is licensed by Korean NHIS. Data are available from Korean NHIS with an appropriate study design.

Supplemental material

Supplemental material for this article is available online.

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