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Comparison between the Subjective Evaluation and the Objective Evaluation of the Effect of Pain Control in the Masticatory Muscle Pain

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Purpose: This study was designed to evaluate the comparison between the subjective and the objective evaluation of pain control effect in masticatory muscle pain depending on time and dose change.

Methods: The patients were recruited to this study and diagnosed according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD). Experimental group were divided into three groups; saline injection group (n=10), morphine 1.5 mg injection group (n=10), and morphine 3.0 mg injection group (n=10). Evaluation list was the subjective pain evaluation (visual analogue scale, McGill pain questionnaire) and the objective pain evaluation (pressure pain threshold [PPT], pressure pain tolerance [PTO]). The subjective and the objective pain evaluation were performed at the times of just before injection, 10 minutes, 30 minutes, 1 hour, 24 hours, and 48 hours after injection. Then, data were statistically analyzed.

Results: The results were as follows: 1) There is no statistically significant difference between the results of the subjective and the objective pain evaluation with regard to the short-term (within 1 hour) analgesic effect of morphine sulfate. 2) However, after 1 hour of injection, while the subjective pain evaluation score still decreased, the objective pain evaluation didn't show significant changes in PPT and PTO (1 hour, $p<0.05$; 24 hours, $p<0.01$; 48 hours, $p<0.001$). 3) In comparison to changes in the dose, the McGill pain questionnaire was the most statistically effective method among the subjective pain evaluations (1.5 mg, $p<0.05$; 3 mg, $p<0.01$).

Conclusions: Therefore, it was revealed that the subjective pain evaluation was more effective to evaluate long-term pain control, and that the McGill pain questionnaire could be an effective way to evaluate pain control depending on dose changes. It requires further investigations with time and dose extension.

Key Words: Masticatory muscle pain; Morphine; Objective pain evaluation; Subjective pain evaluation

INTRODUCTION

Pain is a more or less localized sensation of discomfort, distress, or agony, resulting from the stimulation of specialized nerve endings by the medical dictionary definition.[1] It serves as a protective mechanism insofar as it induces the sufferer to remove or withdraw from the source. And pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage by the International Association for the Study of Pain (IASP) definition of pain.[2]

The subjective experience of pain arises by four distinct processes which consist of transduction, transmission, modulation and perception.[3] Transduction is the process

by which noxious stimuli lead to electrical activity in the appropriate sensory nerve endings. Transmission refers to the neural events that carry the nociceptive input into the Central Nervous System (CNS) for proper processing. Modulation refers to the ability of the CNS to control the pain-transmitting neurons. And if nociceptive input reaches the cortex, perception occurs; this immediately initiates a complex interaction among neurons in the higher center of the brain.

Four terms related with pain—nociception, pain, suffering, and pain behavior—are differently used.[3] Nociception refers to the noxious stimulus originating from the sensory receptor. Pain is an unpleasant sensation perceived in the cortex, usually as a result of incoming nociceptive input. The term suffering refers to still another phenomenon: how the human reacts to the perception of pain. Pain behavior refers to the individual's audible and visible actions that communicate his suffering to others.

The patient subjectively feels and objectively expresses pain. Difference between the subjective and the objective pain evaluations generally exists. It therefore makes clinicians difficult to exactly select and decide contents, duration and the final goal of treatment. Such difference also can be varied even depending on the duration of pain control, types of drug and dose change.

This study was designed to evaluate the comparison between the subjective and the objective evaluation of pain control in masticatory muscle pain with time and by dose change.

MATERIALS AND METHODS

1. Subjects

The subjects participated in this study were volunteers among outpatients of Department of Oral Medicine, Kyung Hee University Dental Hospital (Seoul, Korea) during the period from July to August in 2014. This study was conducted in Department of Oral Medicine, Kyung Hee University Dental Hospital after receiving approval from Institutional Review Board of Kyung Hee University Dental Hospital.

The participants were informed about the details of this experiment and signed the consent paper after reading it. All participants are limited that visual analogue scale (VAS) is over 50 and ages between 20 to 55 years who were diagnosed to axis I; group Ia, myofascial pain according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD).

The subjects who had systemic musculoskeletal pain, systemic arthritis, malignant tumor, hypertension, diabetes mellitus, and cardiovascular disease were excluded. Pregnant women and chronic analgesic or psychiatric drug users were also excluded.

2. Methods

One researcher randomly divided the subjects into three groups with 10 people each who had diagnosed according to the RDC/TMD. Another researcher injected 0.2 mL drug with 27 G subcutaneous needle and 1.0 mL disposable syringe (Sofjec; Hwajin Medical, Cheonan, Korea) into each subject for 10 seconds, and injection point was the most painful area on unilateral masticatory muscle in palpation.

The other researcher randomly ordered the sequence of injected drugs. As a result, double blind procedure about the injected drug was performed by both researchers and subjects.

Initially classified subject groups were morphine sulfate (15 mg/1 mL; BC World Pharm, Seoul, Korea) 3.0 mg injection group (n=10), morphine sulfate (15 mg/1 mL; BC World Pharm) 1.5 mg injection group (n=10), and saline (NaCl 9 mg/1 mL; JW Pharmaceutical, Seoul, Korea) injection group (n=10).

Each group was evaluated for both subjective and objective pain at just before the injection, 10 minutes, 30 minutes, 1 hour, 24 hours, and 48 hours after the injection.

3. Pain Evaluation

1) Subjective pain evaluation

The methods used to evaluate the subjective pain in this study were VAS and McGill pain questionnaire (MPQ) test.

For the VAS test, subjects were asked to mark their pain with marking pen (namepen; Monami, Yongin, Korea) on 100 mm straight line according to pain extent; start point of 100 mm straight line with no pain, end point with the strongest pain that they could imagine. The result was converted into numbers according to the percentage.

For the MPQ method, the MPQ in Korean version was

applied to evaluate the patient's pain. The patient's subjective pain was digitalized and the data of the questionnaire was calculated by average of total score, then the values were recorded and calculated for the VAS and the MPQ.

2) Objective pain evaluation

The methods used to evaluate the objective pain were pressure pain threshold (PPT) test and pressure pain tolerance (PTO) test.

The PPT test used in this study was to estimate the PPT around the most painful masticatory area before and after the injection with the pressure pain measuring instrument (Wagner Instruments, Greenwich, CT, USA), and then the estimation of pressure pain was converted into number.

The PTO was applied to the same area and used the same pressure pain measuring instrument to calculate the pain limit of same pressure, and its estimation was also converted into number.

We kept the patient's masticatory system as relaxed position as possible without tooth contact to use the pressure pain measuring instrument. The pressure was applied to muscle vertically with 11 mm diameter probe with 30 kPa/s velocity; the measured kgf value was divided by area of the probe and converted to kPa value. The subjects were asked to raise their left hand at the moment that they felt the first pain and intolerable pain, and then the values were recorded and calculated for the PPT and the PTO.

4. Statistical Analysis

The results from two subjective pain evaluation tests and two objective pain evaluation tests were analyzed by the repeated measures ANOVA (analysis of variance) test using descriptive statistics and Greenhouse-Geisser method for the short-term pain evaluation and one-way ANOVA test and Dunnett's multiple comparison test for the long-term objective pain evaluation. At first, we verified the effects; within subject effects, between subject effects and interaction effects. When there were effects, we tried post hoc through multiple comparisons using Tukey HSD (honestly significant differences) method.

All the statistics significance level were $p<0.05$ and study scores were analyzed with PASW Statistics version 18.0 (IBM Co., Armonk, NY, USA).

RESULTS

1. Short-term Pain Evaluation

The p-value summary of post hoc multiple comparisons by Tukey HSD in the short-term subjective pain evaluation and the objective pain evaluation was in Table 1. VAS ($p<0.001$) and MPQ ($p<0.001$) in the short-term subjective pain evaluation were significantly different and PPT ($p<0.001$) and PTO ($p<0.001$) in the short-term objective pain evaluation were significantly different.

Therefore, the difference between the subjective pain evaluation and the objective pain evaluation were no statistically significant in the short-term pain evaluation with time.

2. Long-Term Subjective Pain Evaluation

The mean data of VAS (%) for morphine 3.0 mg injection group in the long-term subjective pain evaluation were shown in Fig. 1A. Those for morphine 1.5 mg injection group in the long-term subjective pain evaluation were in Fig. 1B. The summary of mean data of VAS (%) in the long-term subjective pain evaluation was in Fig. 1C.

The mean data of MPQ (%) for morphine 3.0 mg injection group in the long-term subjective pain evaluation were shown in Fig. 2A. The mean data of MPQ (%) for morphine 1.5 mg injection group in the long-term subjective pain evaluation were in Fig. 2B. The summary of mean data of MPQ (%) in the long-term subjective pain evaluation was in Fig. 2C.

The p-value summary by one-way ANOVA test and Dunnett's multiple comparison test in the long term subjective pain evaluation was in Table 2.

Table 1. The p-value summary in the short-term SPE and OPE[a]

Subject effect	SPE		OPE	
	VAS	MPQ	PPT	PTO
Within	***	***	***	***
Between			*	

SPE, subjective pain evaluation; OPE, objective pain evaluation; VAS, visual analogue scale; MPQ, McGill pain questionnaire; PPT, pressure pain threshold; PTO, pressure pain tolerance.
[a]Post hoc multiple comparisons by Tukey honestly significant differences (HSD).
*p<0.05, ***p<0.001.

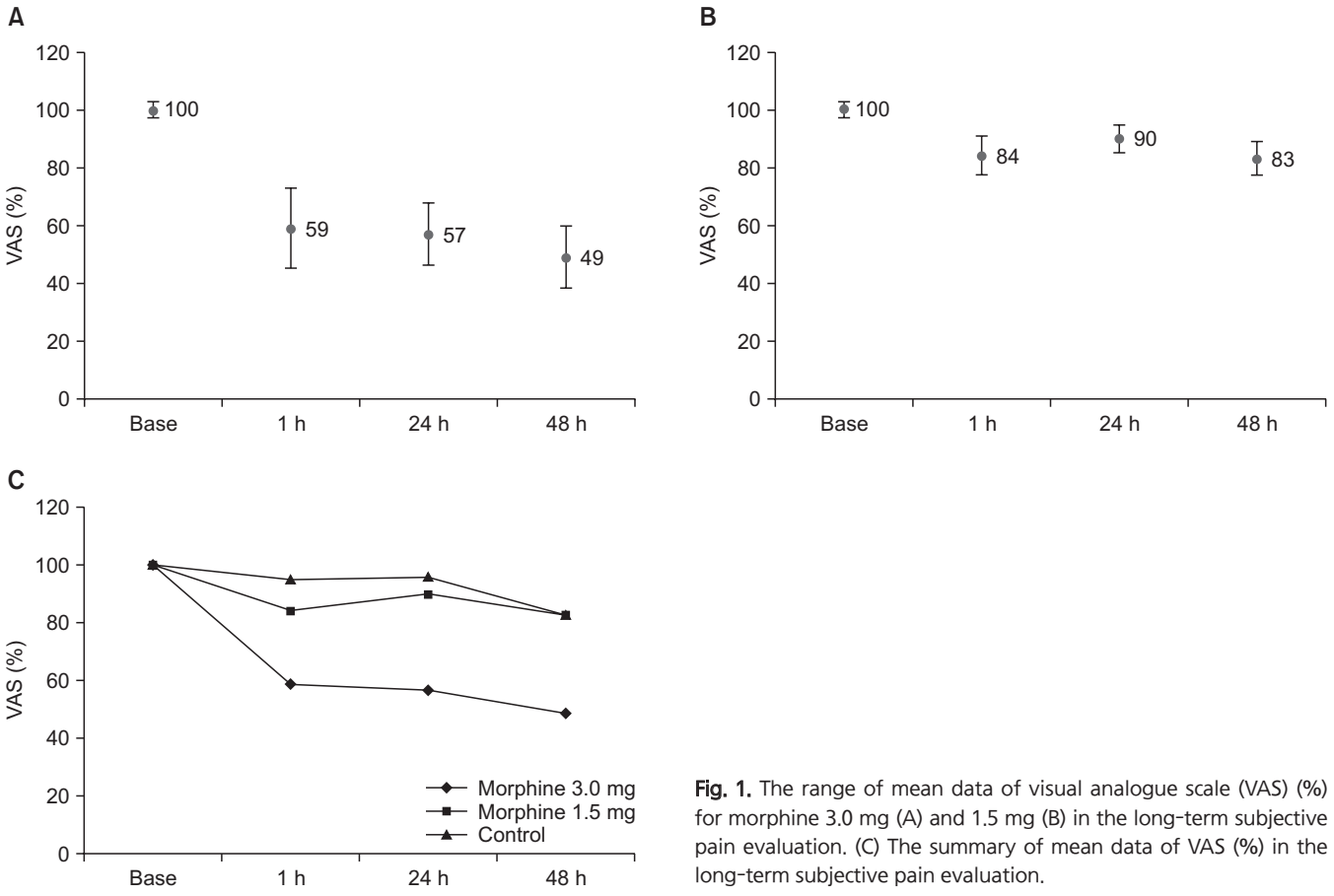

Fig. 1. The range of mean data of visual analogue scale (VAS) (%) for morphine 3.0 mg (A) and 1.5 mg (B) in the long-term subjective pain evaluation. (C) The summary of mean data of VAS (%) in the long-term subjective pain evaluation.

The morphine 3.0 mg injection group was more significantly different than the morphine 1.5 mg injection group in 1 hour ($p<0.05$), 24 hours ($p<0.01$), and 48 hours ($p<0.01$) in VAS. Twenty-four hours after the injection ($p<0.01$) and 48 hours after the injection ($p<0.01$) were more significantly different than 1 hour after the injection ($p<0.05$) in the morphine 3.0 mg injection group.

The morphine 3.0 mg injection group was more significantly different than the morphine 1.5 mg injection group in 24 hours ($p<0.01$) and 48 hours ($p<0.001$) in MPQ. Twenty-four hours after the injection ($p<0.01$) were more significantly different then 1 hour after the injection ($p<0.05$). Forty-eight hours after the injection ($p<0.001$) were more significantly different than 24 hours after the injection ($p<0.01$) in the morphine 3.0 mg injection group.

3. Long-Term Objective Pain Evaluation

The mean data of PPT (%) for morphine 3.0 mg injection group in the long-term objective pain evaluation were in Fig. 3A. The mean data of PPT (%) for morphine 1.5 mg injection group in the long-term objective pain evaluation were in Fig. 3B. The summary of mean data of PPT (%) in the long-term objective pain evaluation was in Fig. 3C.

The mean data of PTO (%) for morphine 3.0 mg injection group in the long term objective pain evaluation were in Fig. 4A. The mean data of PTO (%) for morphine 1.5 mg injection group in the long term objective pain evaluation were in Fig. 4B. The summary of mean data for conversion to PTO (%) in the long term objective pain evaluation was in Fig. 4C.

The p-value summary by one-way ANOVA test and Dunnett's multiple comparison test in the long-term objective pain evaluation were in Table 3.

The morphine 1.5 mg injection group was more significantly different than the morphine 3.0 mg injection group in 1 hour ($p<0.01$), 24 hours ($p<0.01$), and 48 hours ($p<0.01$) in PPT. The morphine 1.5 mg injection group was more significantly different than the morphine 3.0 mg injection group in 1 hour ($p<0.05$) in PTO.

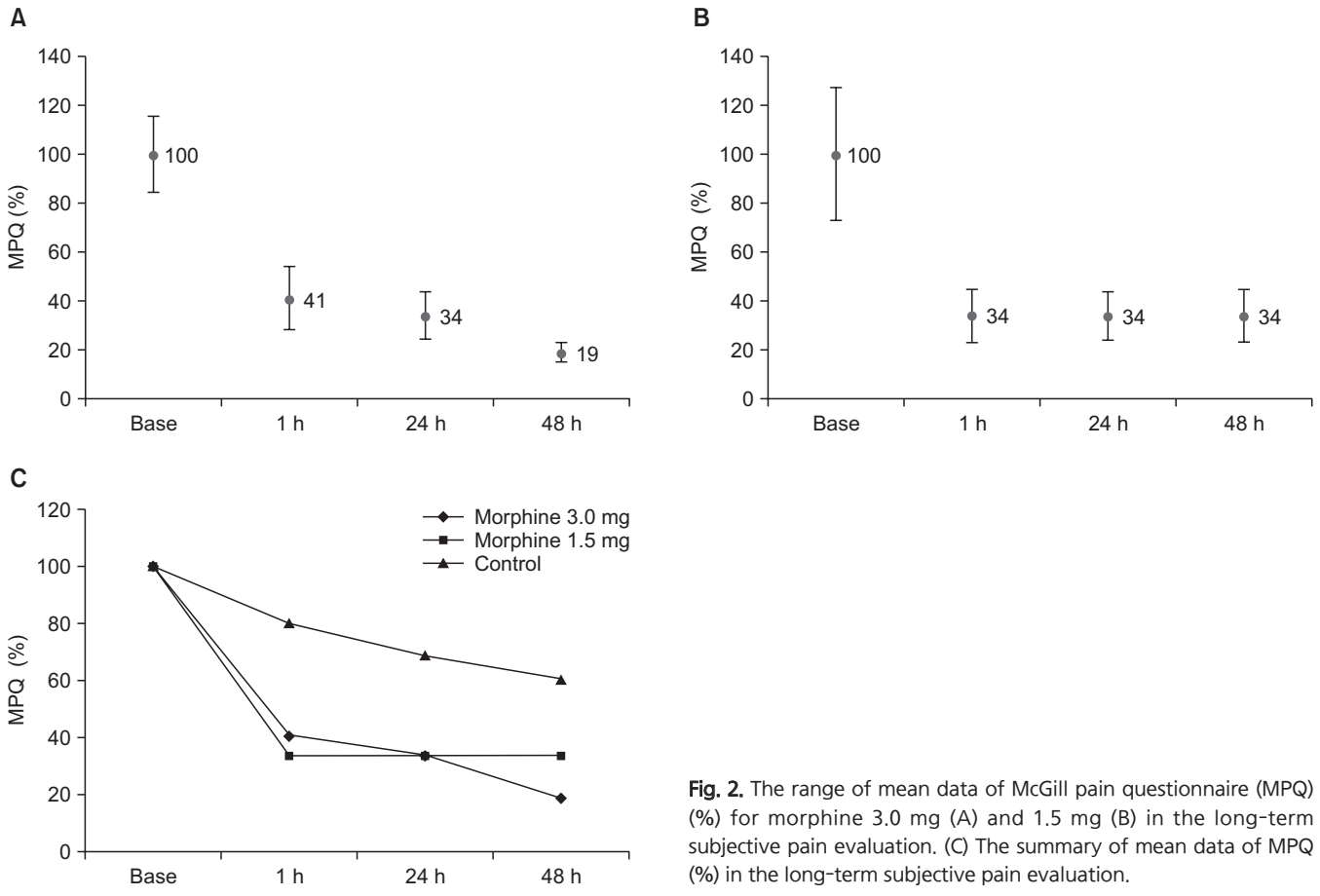

Fig. 2. The range of mean data of McGill pain questionnaire (MPQ) (%) for morphine 3.0 mg (A) and 1.5 mg (B) in the long-term subjective pain evaluation. (C) The summary of mean data of MPQ (%) in the long-term subjective pain evaluation.

Table 2. The p-value summary in the long-term subjective pain evaluation[a]

Evaluation	Dose	Base	1 h	24 h	48 h
VAS	3.0 mg		*	**	**
	1.5 mg				
	Saline				
MPQ	3.0 mg		*	**	***
	1.5 mg		*	*	*
	Saline				

VAS, visual analogue scale; MPQ, McGill pain questionnaire.
[a]One-way ANOVA test and Dunnett's multiple comparison test.
*p<0.05, **p<0.01, ***p<0.001.

DISCUSSION

Pains are perceived after activation of first afferent nerves by peripheral stimulations generating electrical impulses that transmitted to central nervous system through serial neuro-pathway. Pain-developing stimulations, such as tissue damages or inflammation, release pain neurotransmitters. These neurotransmitters activate receptors located on cell membrane, which cause excitatory action potential. Peripheral pain receptors play an important role in initiating pain pathway. Thus, wide and varied studies on peripheral tissue are underway so as to regulate pain by modulating peripheral pain receptors. A typical drug to control pain with its analgesic effect is opioid. Opioids are still the most powerful drugs for severe pain but their use is hampered by side effects such as respiratory depression, nausea, constipation, addiction and tolerance.[4] However, since peripherally-acting opioid agonists discovered, peripheral analgesic effect of opioid without central side effects has been anticipated.[5,6] Opioid receptors are synthesized at dorsal root ganglion and migrate along the neuronal axon to peripheral and central nerve terminals.[7-9] It has an analgesic effect on post-operative pain or chronic pain.[10] Especially, its peripheral analgesic effect is very strong under inflammatory state.[11] There are studies of applying opioid during oral surgery so that it can reduce post-operative pain.[12] Morphine sulfate (5 mg or 10 mg) was applied in temporomandibular

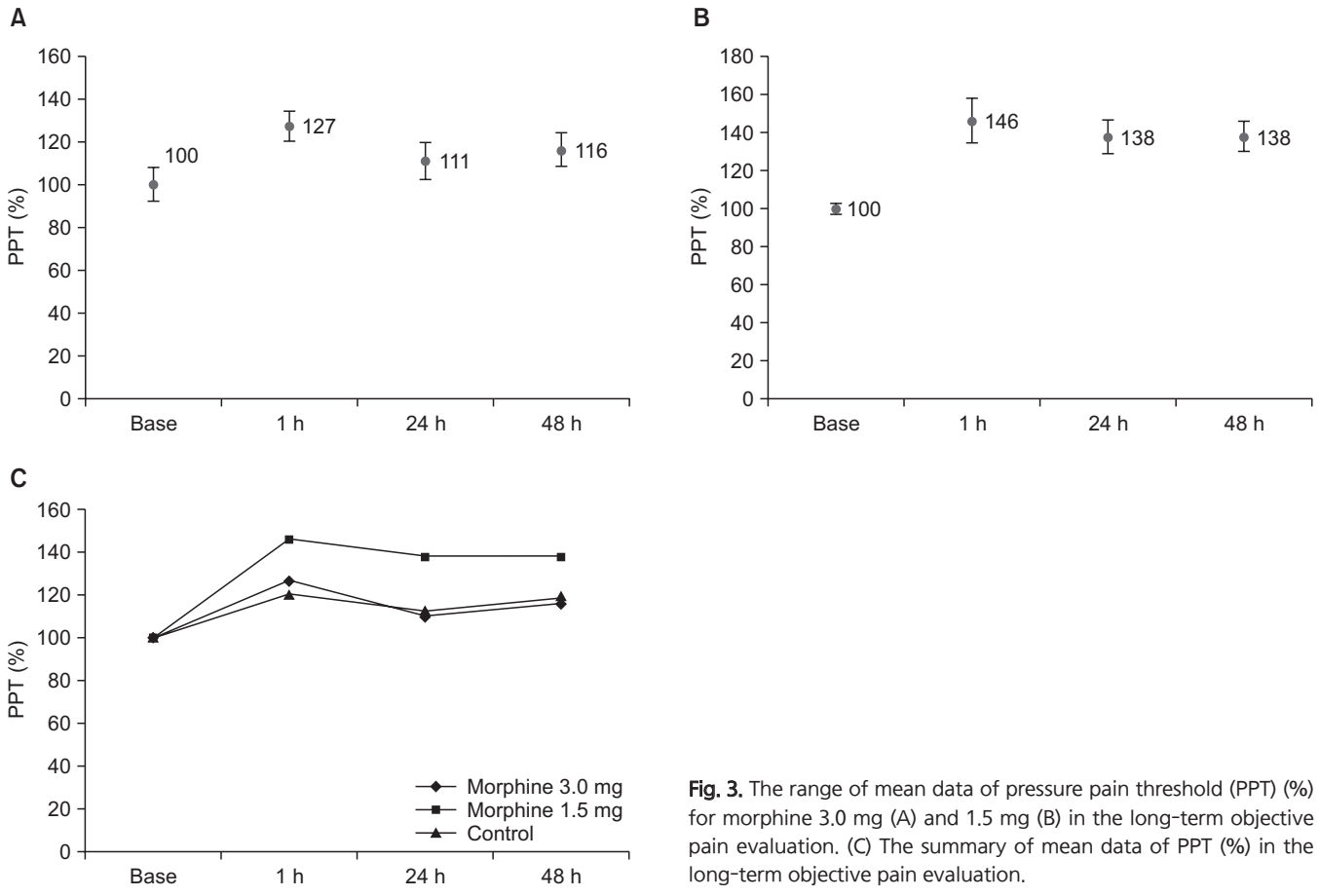

Fig. 3. The range of mean data of pressure pain threshold (PPT) (%) for morphine 3.0 mg (A) and 1.5 mg (B) in the long-term objective pain evaluation. (C) The summary of mean data of PPT (%) in the long-term objective pain evaluation.

joint (TMJ) to reduce pain.[13]

The study of Chun et al.,[14] which was about the influence of terminal AMPA receptor to the muscle nociception and c-fos activation, proposed that GluR1 and GluR2, the AMPA receptor subunits, were developed in the trigeminal ganglion neurons and masseter afferent nerve cell bodies. As a result, acute muscle pain is partially mediated by AMPA receptors located in the terminal, and when several terminal glutamate receptor subunits are blocked it might reduce the muscle pain and central nerve activation more effectively. In the study of Ro et al.,[15] the animal model of hypertonic saline (HS) infusion protocol causes peripheral release of glutamate, and that blockade of peripheral NMDA receptors significantly reduces HS-induced nociceptive behavior and central neuronal activation.

Chun and Ro[16] suggested that intramuscular capsaicin in rat masseter muscle significantly induced increase of trigeminal caudalis (Vc) neuron response and that the blockade of peripherally localized mGluR5 could effectively attenuate muscular hypersensitivity.

The study of Yoo et al.[17] was to evaluate the pain control by morphine injection to patient's masticatory muscle. For this study, patients with masticatory muscle pain were recruited and diagnosed according to the RDC/TMD. Experimental group were divided into three groups; saline injection group (n=10), lidocaine injection group (n=10), and morphine injection group (n=10). Evaluation list was the subjective pain evaluation (VAS, MPQ, and pain drawing) and the objective pain evaluation (PPT and PTO) and evaluation time were 0, 10, 30, 60 minutes after injection, and then data were statistically analyzed. In this study, the subjective pain evaluation and the objective pain evaluation were significantly different within group ($p<0.001$). The subjective pain drawing evaluation ($p<0.001$) were significantly different between groups. The objective PPT evaluation ($p=0.025$) were significantly different between groups. The morphine injection group ($p=0.001$) were more significantly different than the saline injection group in the pain

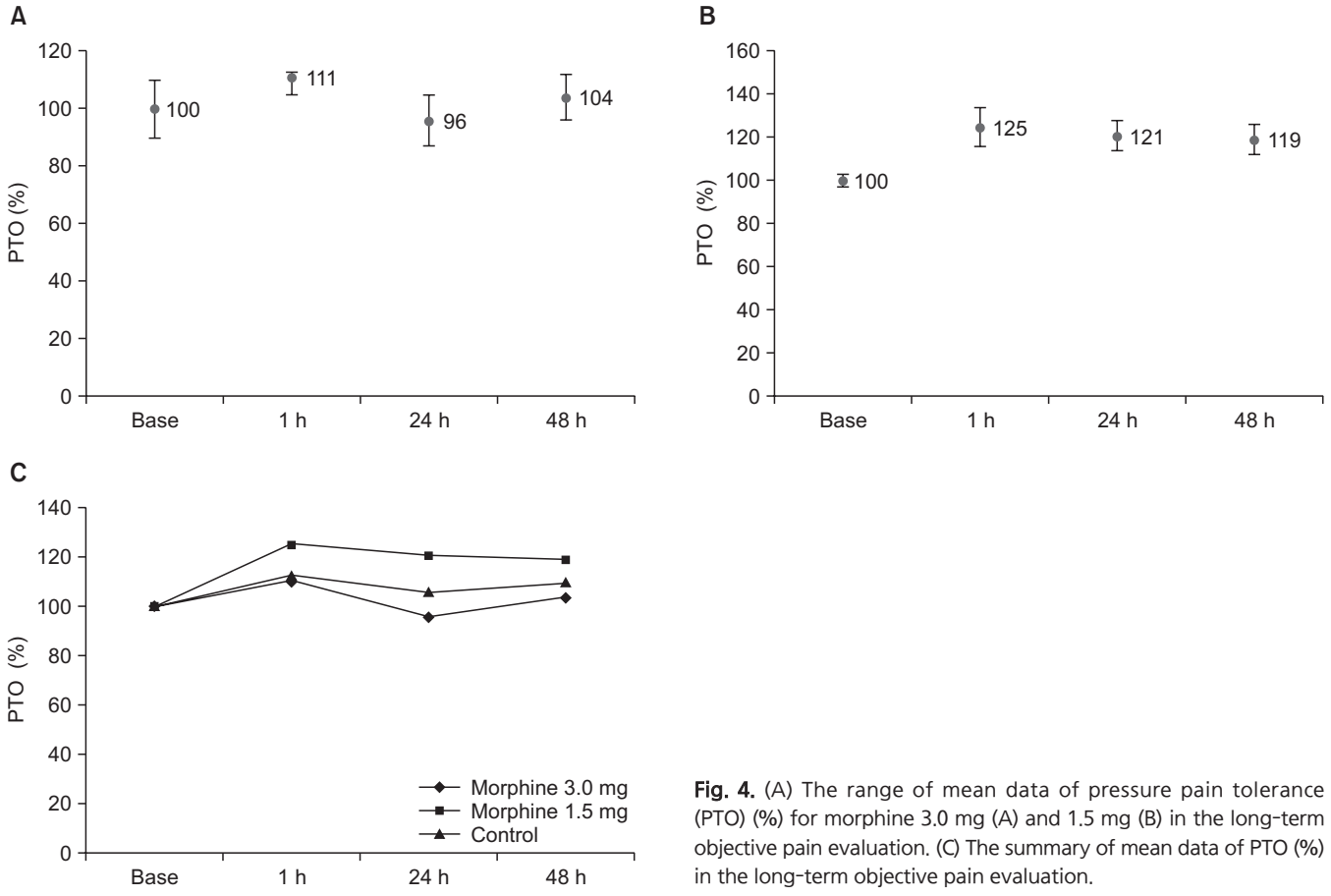

Fig. 4. (A) The range of mean data of pressure pain tolerance (PTO) (%) for morphine 3.0 mg (A) and 1.5 mg (B) in the long-term objective pain evaluation. (C) The summary of mean data of PTO (%) in the long-term objective pain evaluation.

Table 3. The p-value summary in the long-term objective pain evaluation[a]

Evaluation	Dose	Base	1 h	24 h	48 h
PPT	3.0 mg				
	1.5 mg		**	**	**
	Saline				
PTO	3.0 mg				
	1.5 mg		*		
	Saline				

PPT, pressure pain threshold; PTO, pressure pain tolerance.
[a]One-way ANOVA test and Dunnett's multiple comparison test.
*p<0.05, **p<0.01.

drawing evaluation. Therefore, it was considered that the morphine injection was effective to control masticatory muscle pain within 60 minutes.

The study of Ko et al.[18] was to evaluate the role of peripheral opioid receptors in masticatory muscle pain control. For this study, patients with masticatory muscle pain were recruited and diagnosed according to the RDC/TMD. Experimental group were divided into four groups; saline injection group (n=10), lidocaine injection group (n=10), morphine 1.5 mg injection group (n=10), and morphine 3 mg injection group (n=10). Evaluation was performed by the subjective pain evaluation (VAS, MPQ, and pain drawing) and the objective pain evaluation (PPT and PTO), and evaluation time was 0, 1, 24, 48 hours after injection. Data were statistically analyzed. The results were as follows: The subjective pain evaluation were significantly different in morphine 3 mg group at 48 hours after injection (VAS, $p<0.01$; MPQ, $p<0.001$; pain drawing, $p<0.05$). The objective pain evaluation were significantly different in morphine 1.5 mg group at 1 hour after injection (PPT, $p<0.01$; PTO, $p<0.05$). The morphine 3 mg group were more significantly different than lidocaine group and morphine 1.5 mg group in the MPQ evaluation (1 hour, $p<0.01$; 24 hours, $p<0.01$; 48 hours, $p<0.001$). Therefore, it was revealed that the morphine 3 mg injection was effective to control masticatory muscle pain within 48 hours and more effective than lidocaine injection.

The study of Bae et al.[19] was to evaluate the sex differences

in the pain control by morphine injection to masticatory muscle of pain patients. Patients with masticatory muscle pain were recruited and diagnosed according to the RDC/TMD. Experimental groups were divided into two of male (n=20) and female (n=20). Each consisted of four subgroups; saline injection group (n=5), lidocaine injection group (n=5), morphine 1.5 mg injection group (n=5), and morphine 3 mg injection group (n=5). Evaluation was done by the subjective pain evaluation (VAS, MPQ, and pain drawing) and the objective pain evaluation (PPT and PTO) and evaluation time was injection before, after 1 hour, 24 hours, 48 hours and then it was analyzed statistically. The results were as follows: Male and female were significantly different in morphine 3 mg subgroup with VAS evaluation (male, $p<0.05$; female, $p<0.05$). Male and female were more significantly different in morphine 3 mg group than morphine 1.5 mg subgroup with MPQ evaluation (male, $p<0.001$; female, $p<0.01$). Male group was significantly different in morphine 3 mg subgroup with pain drawing evaluation and PPT evaluation (pain drawing, $p<0.001$; PPT, $p<0.05$). Therefore, it was revealed that the morphine 3 mg injection for masticatory muscle pain was effective to control pain of male patients and more effective in male patients than female patients with the objective pain evaluation.

Emshoff et al.[20] performed the study which was to estimate a range of clinically important difference (CID) values of the VAS for pain intensity (VAS-PI) and to assess the effect of patient baseline characteristics on VAS change scores. Data from a prospective cohort study with 678 patients suffering subacute and chronic temporomandibular disorder pain were analyzed. Patients were divided into 9 cohorts on the basis of the baseline VAS score and the duration of pain. The CID was estimated over a 12-week-period, and two different methods were used: the mean change scores and the optimal cutoff point in receiver operator characteristic curves. The patient's global impression of change was used as an external criterion. The general linear model univariate analysis was applied to assess the effect of baseline pain level and duration of pain on the raw VAS change scores, while adjusting for age and sex. The CID mean change ranged from 20.9 to 57.5 mm (64.1%-6.3%), and the CID optimal cutoff point from 11.5 to 28.5 mm (29.9%-7.7%). For the VAS change scores, the main effect of the variable baseline pain level was significant ($F=107.09$, $p<0.001$). However, there was no significant baseline pain level by duration of pain interaction effect ($F=1.13$, $p=0.340$). On the basis of the results, we advocate the choice of a single CID value according to the context of the patient's baseline level of pain.

There are study of VAS effect; methodological problems in the measurement of pain: a comparison between the verbal rating scale and the VAS by Ohnhaus and Adler,[21] the VAS: Its use in pain measurement by Langley and Sheppeard,[22] the VAS-PI: what is moderate pain in millimeters? by Collins et al.,[23] and the pain VAS: Is it linear or nonlinear? by Myles et al.[24]

In the study of MPQ by Melzack,[25] a short-form of the MPQ (SF-MPQ) has been developed. The main component of the SF-MPQ consists of 15 descriptors (11 sensory; 4 affective) which are rated on an intensity scale as 0=none, 1=mild, 2=moderate, or 3=severe. Three pain scores are derived from the sum of the intensity rank values of the words chosen for sensory, affective and total descriptors. The SF-MPQ also includes the present pain intensity (PPI) index of the standard MPQ and a VAS. The SF-MPQ scores obtained from patients in post-surgical and obstetrical wards and physiotherapy and dental departments were compared to the scores obtained with the standard MPQ. The correlations were consistently high and significant. The SF-MPQ was also shown to be sufficiently sensitive to demonstrate differences due to treatment at statistical levels comparable to those obtained with the standard form. The SF-MPQ shows promise as a useful tool in situations in which the standard MPQ takes too long to administer, yet qualitative information is desired and the PPI and VAS are inadequate.

There are study of MPQ effect, reliability, validity, and sensitivity measures of expanded and revised version of the short-form MPQ (SF-MPQ-2) in Iranian patients with neuropathic and non-neuropathic pain by Adelmanesh et al.,[26] trigeminal neuralgia and atypical facial pain: use of the MPQ for discrimination and diagnosis by Melzack et al.,[27] the MPQ from description to measurement by Melzack,[28] TMJ disorders and myogenic facial pain: a discriminative analysis using the MPQ by Mongini and Italiano.[29]

In the study of PPT by Melia et al.,[30] pain thresholds are widely used in behavioral research, but unlike other pain

modalities, a standardized assessment of pressure pain remains a challenge. In this research, they described the application of an automatic pressure algometer with a linear increase in force. Ergonomically designed fixation devices were developed to increase the accuracy and to shorten the time of each measurement. Ten healthy volunteers were included in a pilot study to test the algometry method. PPT were investigated over 2 experimental days in three nonconsecutive runs at 29 measurement sites. During the experiment, subjects reported their subjective sleepiness, level of state-anxiety, psychological status and the perceived PI of each measurement. PI ratings indicate that instructions were followed. State-anxiety and subjective sleepiness levels were low throughout the experiment. The method has proven to be suitable for standardized PPT measurements across the body in an ergonomic, safe, and user-friendly fashion.

There are study of PPT effect, palpation and PPT: reliability and validity in patients with TMD by Gomes et al.,[31] PPT in the detection of masticatory myofascial pain: an algometer-based study by Santos Silva et al.,[32] PPT, clinical assessment and differential diagnosis: reliability and validity in patients with myogenic pain by Ohrbach and Gale,[33] and the Influence of myofascial temporomandibular disorder pain on the PPT of women during a migraine attack by Pinto Fiamengui et al.[34]

In the study of PTO by Chesterton et al.,[35] the effects of varying frequency, intensity and stimulation site, of transcutaneous electrical nerve stimulation (TENS) in an experimental model of pain. In a double-blind design 240 volunteers were randomized to one of six experimental TENS groups, a sham TENS or control (n=30 per group; gender balanced). Two TENS frequencies (110 or 4 Hz) and two intensities (strong but comfortable or highest tolerable) at a fixed pulse duration (200 ms) were applied at three sites relative to the measurement site (segmentally, extrasegmentally or a combination of these) for 30 minutes. PPT were measured using a pressure algometer, in the first dorsal interosseous muscle, every 10 minutes, during stimulation and for a further 30 minutes. The high frequency, high intensity segmental, and combined stimulation groups showed rapid onset and significant hypoalgesic effects. This effect was sustained for 20 minutes post-stimulation in the high frequency segmental group. All other TENS intervention groups showed hypoalgesic responses similar to the sham TENS group, and none of these groups reached a clinically significant hypoalgesic level. This study concluded that the role of TENS frequency, intensity and site was pivotal to achieving optimal hypoalgesic effects during and after stimulation. Clinical applications of these parameter combinations require further investigations.

There are study of PTO effect, cephalic muscle tenderness and PPT in a general population by Jensen et al.,[36] predicting postoperative pain by preoperative pressure pain assessment by Hsu et al.,[37] pressure-pain threshold in human temporal region. Evaluation of a new pressure algometer by Jensen et al.,[38] and reliability and usefulness of the PPT measurement in patients with myofascial pain by Park et al.[39]

In the results of this study, VAS ($p<0.001$) and MPQ ($p<0.001$) in the short-term subjective pain evaluation were significantly different and PPT ($p<0.001$) and PTO ($p<0.001$) in the short-term objective pain evaluation were significantly different. Therefore, there is no statistically significant difference between the results of the subjective and the objective pain evaluation with regard to the short-term (within 1 hour) analgesic effect of morphine sulfate.

By the way, the morphine 3.0 mg injection group were more significantly different than the morphine 1.5 mg injection group in 1 hour ($p<0.05$), 24 hours ($p<0.01$), and 48 hours ($p<0.01$) evaluated by VAS. Twenty-four hours after the injection ($p<0.01$) and 48 hours after the injection ($p<0.01$) were more significantly different than the 1 hour after the injection ($p<0.05$) in the morphine 3.0 mg injection group.

The morphine 3.0 mg injection group were more significantly different than the morphine 1.5 mg injection group in 24 hours ($p<0.01$) and 48 hours ($p<0.001$) evaluated by MPQ. Twenty-four hours after the injection ($p<0.01$) were more significantly different than the 1 hour after the injection ($p<0.05$). Forty-eight hours after the injection ($p<0.001$) were more significantly different than the 24 hour after the injection ($p<0.01$) in the morphine 3.0 mg injection group.

The morphine 1.5 mg injection group were more significantly different than the morphine 3.0 mg injection group in 1 hour ($p<0.01$), 24 hours ($p<0.01$), and 48 hours ($p<0.01$)

evaluated by PPT. The morphine 1.5 mg injection group were more significantly different than the morphine 3.0 mg injection group in 1 hour ($p<0.05$) evaluated by PTO.

Therefore, it was revealed that the subjective pain evaluation was more the effective to monitor long-term pain control with time, and the MPQ was effective way for evaluating pain control by dose change. It needs further investigations with time and dose extension.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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