The Effect of Indomethacin Phonophoresis on the Relief of Temporomandibular Joint Pain

Soon-Moon Shin, D.D.S., **Jae-Kap Choi**, D.D.S., M.S.D., Ph.D.

Department of Oral Medicine, School of Dentistry, Kyungpook National University

CONTENTS

I. INTRODUCTION

In managing symptoms associated with many temporomandibular joint disorders, pharmacologic therapy can be an effective method. Although medication does not usually offer a solution or cure to temporomandibular joint problems, it does offer the most complete approach to many problems in conjunction with appropriate physical therapy and definitive treatment. Steroids, nonsteroidal anti-inflammatory drugs and narcotics are usually used in the management of temporomandibular joint problems to reduce inflammatory responce and to alleviate painful symptoms.

The most common route for administration of these drugs to temporomandibular joint is oral intake or sometimes by intra-articular injection. However, these administration methods have some disadvantages of systemic side effect and infection of injection site. Thus topical application methods such as phonophoresis and iontophoresis were introduced in the management of temporomandibular joint problems.

Phonophoresis is defined as the migration of drug molecules, contained in a coupling or contact agent, through the skin under the influence of ultrasound. Phonophoresis on temporomandibular joint has several advantages over the intra-articular injection. First, because phonophoresis is noninvasive method of drug administration, patients complain of little or no discomfort.[1] Second, phonophoresis offers a safe alternative method for delivering a pharmacologic agent without the risk of infection inherent in a percutaneous injection. Third, it seems to be relatively devoid of systemic side effects. Fourth, it is an easy method of application.

Novak[2] reported the ability of ultrasound to increase the amount of lidocaine that was transmitted through the skin and into the quadriceps femoris muscles of rabbits. Griffin and Touchstone[3,4] reported in vitro research on pig tissue demonstrating that ultrasound could drive cortisol into skeletal muscle and

paravetebral nerve. They did not imitate the clinical application of the ultrasound, because the ultrasound head was kept stationary rather than being moved in a circular pattern. Keeping the head stationary results in pain from excessive heat. Griffin et al.[5] reported that hydrocortisone phonophoresis is superior to the ultrasound alone in alleviating pain and inflammation. Wing[6] reported a case study describing the use of phonophoretically driven hydrocortisone for a patient with temporomandibular joint dysfunction. Ciccone et al.[7] studied the effects of ultrasound and phonophoresis using an anti-inflammatory-analgesic cream(trolamine salicylate) on delayed-onset muscle soreness, and they found salicylate phonophoresis may be useful in clinical situations.

However, there were other reports that didn't show positive effects from phonophoresis. McElnay and co-workers[8] reported that ultrasound did not significantly increase the percutaneous absorption of lidocaine. Benson et al.[9] found that ultrasound did not enhance the percutaneous absorption of benzydamine under the experimental conditions of the study. Muir et al.[10] compared ultrasonically applied vs. intra-articular injected hydrocortisone levels in canine knees. They found intra-articular hydrocortisone levels obtained with phonophoresis were extremely low in comparison with those obtained with intra-articular injection.

From the literature reviews, most of the reports were anecdotal or not scientifically designed and it seems that the clinical effectiveness of phonophoresis is controversal still now. The purpose of this study was to evaluate the pain-relieving effect of indomethacin phonophoresis on temporomandibular joint pain with randomized double-blind method.

II. MATERIALS AND METHODS

1. Subjects

Twenty patients, 15 females and 5 males, who visited the Department of Oral Medicine, Kyungpook National University Hospital for the treatment of temporomandibular joint disorder served as subjects. For inclusion in the study, subjects had to have temporomandibular joint pain as a chief complaint and tenderness on palpation of temporomandibular joint. Patients with polyarthritis or rheumatoid arthritis were excluded by radiological and laboratory findings.

All subjects were randomly assigned to one of the control group(n=10) and the indomethacin group(n=10). Although average age of the control group was 18.70±4.64 years and that of the indomethacin guroup was 26.20±13.48 years, there was no statistical difference. Average body mass index was 20.12±1.11 for the control group and 20.47±2.31 for the indomethacin group(Table 1).

Table 1. Demographic characteristics of the experimental groups

	Group		P-value
	Control	Indomethacin	
Age	18.70±4.64	26.20±13.481	0.124
Sex ratio(M/F)	3/7	2/8	0.628
BMI*	20.12±1.11	20.47±2.31	0.669

*BMI : Body Mass Index

2. Equipment

SUS-2N(Shin Jin Ultrasonic, Seoul, Korea) with a fixed frequency of 1MHz and 34mm in diameter transducer head was utilized for ultrasound application. Intensity ranges from 0.8 to 1.5 W/cm^2 according to patient tolerance. The moving technique was used, as it is less likely to result in tissue burning. All treatments were given for 15 minutes.

3. Assessment of Pain Intensity

Pain intensity was assessed with subjective pain reporting and measurement of pressure pain threshold(PPT). Visual analogue scales(VAS) were used to assess subjective ratings of the subject's current pain intensity. Anchor words on the 100mm horizontal lines were 'no pain' on the left side and 'most intense pain imaginable' on the right. Subjects were asked to record their pain intensity on the lines.

For the measurement of PPT, the pressure algometer (Electronic Algometer Type I, Somedic Production, Stockholm, Sweden) was used. This instrument is a digital force gauge connected to a pressure probe with 1cm round rubber tip on its end. It is used to assess sensitivity by applying constantly increasing pressure, at a rate of 30 kPa/sec, over the TMJ until the subject first feels pressure change to pain. The subjects were instructed to push the stop button at the moment he first feels pain. Each PPT was defined by the mean of two or three trials. A double blind trial was used for the study.

4. Treatment Protocol

1) Clinical examination of each subject for temporomandibular joint was performed and the subjects were randomly assigned to one of the control group and the indomethacin group.
2) Baseline VAS and PPT were recorded for all subjects of both groups on the first day before treatment.
3) For the control group, treatment of ultrasound application using plain gel (Aquasonic®, Parker Laboratories, Inc., U.S.A.) were performed on 2 consecutive days.
4) For the indomethacin group, treatment of ultrasound application using 1% indomethacin gel (Vigel®, Chodang Pharma. Inc., Korea) were performed on 2 consecutive days.
5) Post-treatment VAS and PPT were recorded on the second day of treatment by other person who didn't know which group the subject was belong to.

5. Data Analysis

The mean VAS and PPT for each group were compared between the baseline record and the post-treatment record using paired t-test.

Ⅲ. RESULTS

While the subjective pain report expressed by VAS showed decreased pain level after application of ultrasound with or without use of indomethacin, the statistical significance was found in indomethacin group($P<0.05$), not in control group (Table 2).

The pressure pain threshold was statistically increased after application of indomethacin phonophoresis($P<0.05$), but there was no statistical differance between baseline and post-treatment PPT values in control group (Table 3).

Table 2. Comparison between baseline and post-treatment by VAS for the control and the indomethacin group

Group	VAS		P-value
	Baseline	Post-treatment	
Control	49.55±17.99	43.50±14.81	0.2603
Indomethacin	60.27±14.90	46.44±12.10	0.009

Table 3. Comparison between baseline and post-treatment by PPT for the control and the indomethacin group

Group	PPT		P-value
	Baseline	Post-treatment	
Control	169.32±38.61	179.01±44.37	0.4635
Indomethacin	167.39±64.43	195.87±67.80	0.0054

Ⅳ. DISCUSSIONS

Ultrasound includes mechanical vibrations in excess of the range audible to the human ear (above 16,000 vibrations/sec or 16kHz). It is a propagated periodic disturbance in an elastic medium that causes the component atoms of the medium to vibrate about their positions of equilibrium and cause propagation of energy. Therapeutic ultrasound is not a new form of treatment. In medicine, osteopathy, chiropractic treatment, and physical therapy, the use of ultrasound at power levels capable of causing heating and biologic effects is extensive and considered to be the most prevalent source of ultrasonic irradiation to humans.[11,12] The objectives of ultrasound treatment are to accelerate healing, increase the extensibility of collagen fibers, decrease joint stiffness, provide pain relief, improve mobility, and reduce muscle spasm.[13,14]

Ultrasound energy is rapidly attenuated in air. Therefore in order to be effective, it must be transferred efficiently from the ultrasound transducer into the skin. The transmission characteristics of topical proprietary preparations containing drugs suitable for use with ultrasound have recently been investigated. Gel formulations were found to be the most suitable coupling agents.[15]

Although the ultrasound therapy has been introduced as an adjunct treatment modality for the managememt of temporomandibular joint disorders, its clinical use was defined chiefly to the treatment of muscle symptoms more than temporomandibular joint symptoms. Esposito et al.[16] reported that therapeutic ultrasound can be used effectively to alleviate discomfort of myofascial pain-dysfunction syndrome(MPDS) that does not respond to occlusal splint therapy and it is most successful in alleviating muscle symptoms and least effective in reducing symptoms associated with the disk. Grieder et al.[17] also reported that ultrasonic therapy alone was not effective in relieving symptoms of temporomandibular joint dysfunction.

In this study, temporomandibular joint pain was not decreased significantly with ultrasound therapy alone. It is consistent with the result of the previous study.[17] However, Grieder et al.[17] pointed the ultrasound therapy itself would be of some benefit in hastening and making more effective the relief of temporomandibular joint pain when used as an adjunct to the accepted modalities of treatment, such as occlusal splint therapy, heat applications, acupuncture and muscle-conditioning exercises.

However, phonophoresis is quite different from simple ultrasound therapy in the respects that drug is delivered to deep tissues by ultrasound energy and the clinical effect would be associated with the phamacologic action of the drug. The exact mechanism of phonophoresis is still unknown, but there are several theories which explains the mechanism of action. Ultrasound causes mechanical disturbance in an absorbing medium and mechanical energy is continually converted into heat. This thermal change is thought to mediate phonophoretic drug delivery.[18,19] However, control experiments that show whether heat alone can have similar effect are lacking. The effect of ultrasound on a biological system may also be associated with cavitation, the formation of small gaseous inclusions.[20,21] Cavitation may cause mechanical stress, temperature elevation, or enhanced chemical reactivity causing drug transport. One theory suggests that ultrasound affects the permeation of the stratum corneum lipid structure as the limiting step in permeating through the skin.[18,22]

Although phonophoresis may have some benefits over simple ultrasound therapy or intra-articular injection of drug, the clinical reports of its use for the treatment of joint problems are scarce and the results are not consistent. Wing[6] described the clinical effect of hydrocortisone phonophoresis on the patient who had temporomandibular joint pain, but Muir et al.[10] compared ultrasonically applied vs. intra-articular injected hydrocortisone levels in canine knees, and found intra-articular hydrocortisone levels obtained with phonophoresis were extremely low than those obtained with intra-articular injection.

In the present study, after application of indomethacin phonophoresis over painful TMJ, the subjective pain reporting was significantly decreased, as well as the pressure pain threshold was significantly increased. However, such changes were not found in the control group. These results suggested indomethacin phonophoresis would be effective to relieve temporomandibular joint pain.

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국문초록

인도메타신을 이용한 음파삼투요법에 의한 측두하악관절부 동통의 완화효과

경북대학교 치과대학 구강내과학 교실

신 순 문 · 최 재 갑

이 연구의 목적은 측두하악관절통에 있어서 인도메타신 포노포레시스의 동통완화효과를 평가하기 위한것이다.

측두하악관절통을 가진 20명의 환자들이 이 연구에 참여했다. 10명은 인도메타신을 이용하여 초음파 치료를 받았고 다른 10명은 순수 초음파 치료용 젤을 이용하여 초음파 치료를 받았다. 동통완화효과를 평가하기 위해서 치료전과 치료후에 유추지수와 압력통각역치를 이중맹검법으로 평가하였다.

실험결과는 다음과 같다.

인도메타신을 이용하여 초음파 치료를 받은 군은 유추지수와 압력통각역치에서 다 유의한 동통의 감소를 보였다. 반면에 대조군에서는 치료후에 유추지수와 압력통각역치에서 동통의 감소를 보였지만 통계적으로 유의하지 않았다. 이 결과는 측두하악관절통에 있어서 단순한 초음파 치료보다 포노포레시스가 더 효과적이라는 것을 의미한다.