

## Comparison of the Effects of Methyl Salicylate AsND Ketoprofen Phonophoresis in the Management of Patients with Cervical Spondylosis

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Received date: February 25, 2019; Accepted date: April 29, 2019; Published date: May 06, 2019

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### Abstract

**Background:** Topical analgesic and anesthetic agents are indicated in the treatment of pain associated with various localized muscle, joint, or skin disorders. Phonophoresis is a therapeutic modality that is frequently used. This is because it is reported or believed to enhance the percutaneous absorption of certain pharmacological agents and has been used in the treatment of such a painful condition as cervical spondylosis.

**Methods:** A total of 18 participants took part and completed the study (6 in the methyl salicylate phonophoresis group, 6 in ketoprofen phonophoresis group and 6 in the therapeutic ultrasound group:control group). The participants were recruited using sample of convenience. Outcome measures were used to collect information regarding pain, range of motion and quality of life both pre and post intervention. The data was analyzed with Statistical Package for Social Sciences (SPSS).

**Results:** Results showed statistically significant differences, improved changes in pain, range of motion and neck disability index. Methyl salicylate (NDI:  $p < 0.001$ , pain:  $p = 0.001$ , left rotation:  $p = 0.020$ ), Ketoprofen (NDI:  $p = 0.004$ , pain:  $p = 0.002$ ). Results also showed that there were no significant differences in the level of efficacy between methyl salicylate and ketoprofen phonophoresis. The two phonophoresis groups had greater clinical outcomes compared to the control group of therapeutic ultrasound.

**Conclusion:** Both methyl salicylate phonophoresis and ketoprofen phonophoresis were efficacious in the management of patients with cervical spondylosis, but methyl salicylate phonophoresis was marginally better.

**Keywords:** Phonophoresis; Cervical spondylosis; Ketoprofen; Methyl salicylate

### Background

Topical analgesic and anesthetic agents are indicated in the treatment of pain associated with various localized muscle, joint or skin disorders. Phonophoresis is a therapeutic modality that is frequently used. This is because it is reported or believed to enhance the percutaneous absorption of certain pharmacological agents and has been used in the treatment of such a painful condition as cervical spondylosis.

### Objective

To compare the effects of 2 different phonophoresis modalities- methyl salicylate phonophoresis and ketoprofen phonophoresis in the treatment of individuals with cervical spondylosis using pain, range of motion and quality of life as outcome variables.

### Participants

Eighteen people with cervical spondylosis whose ages ranged from 25-65 years participated in this study. They were assigned into three groups with six participants in each group (6 in methyl salicylate

group, 6 in ketoprofen group, 6 in ultrasound control group) after fulfilling all required inclusion criteria.

### Ethical Consideration

Ethical approval was sought and obtained from the institutional Health Research and Ethics Committee. Informed consent was obtained from participants.

### Materials

1) Two different ultrasound machines were used-one continuous mode and another pulsed mode.

a) Continuous mode was supplied by NUSONIC portable ultrasound therapy massager, made in CHINA, with output intensity of low ( $0.50 \text{ W/cm}^2$ ); medium ( $0.70 \text{ W/cm}^2$ ); high ( $0.90 \text{ W/cm}^2$ ); frequency of 1 MHZ-Continuous mode.

b) Pulsed mode was supplied by US PRO 2000 2<sup>nd</sup> Edition, made in USA with output intensity of Low ( $0.08 \text{ W/cm}^2$ ); medium ( $0.80 \text{ W/cm}^2$ ); high ( $1.6 \text{ W/cm}^2$ ); frequency of 1MHZ- Pulsed mode

2) Manual Goniometer was used to measure ranges of motion of neck movements before and after treatment

3) Visual analogue scale was used to measure pain before and after treatment

4) Neck Disability Index Questionnaire (NDI) was used to measure quality of life before and after treatment.

## Methodology

After the preliminary assessment and establishment of participants' suitability for this procedure, they were placed in prone lying position with pillow support to the head for the application of phonophoresis to the neck (Figure 1).



**Figure 1:** A participant receiving phonophoresis.

### Methyl salicylate group

Participants received mechanical traction (Figure 2), massage, exercises, manual cervical traction and had phonophoresis methyl salicylate applied on them three times per week for four weeks duration.

### Ketoprofen group

Participants received massage, exercises, manual cervical traction, mechanical traction and had phonophoresis ketoprofen applied on them three times per week for four weeks duration.

### Ultrasound control group

Participants received ultrasound with acoustic gel (non-analgesic) applied on them (Group C was the control group), massage, cervical traction and exercise three times per week for four weeks duration.



**Figure 2:** A participant receiving mechanical cervical traction.

## Results

Table 1 shows the socio-demographic characteristics of the study participants. Their ages ranged from 25-65 years. Two-thirds 4 (66.66%) were below 46 years of age in both the Control and Methyl salicylate gel groups. There was equal distribution of male and female in each group with each group comprising 3 males and 3 females. The ethnic groups of the participants were Igbo and Yoruba with Igbos being 3 in the control group and 2 in each of the methyl salicylate and ketoprofen groups while Yorubas being 3 in the control group and 4 in each of the methyl salicylate and ketoprofen groups. The religious distribution covered Christianity and Islam. There were 6 Christians in the control group and 2 in each of the methyl salicylate and ketoprofen groups. There was no Muslim in the control group but there were 4 Muslims in each of the methyl salicylate and ketoprofen groups.

Table 2 shows the comparison between the pre and post-test of variables for the methyl salicylate gel group with significant differences  $p=0.001$ ,  $p=0.001$  and  $p=0.020$  in NDI, pain and left rotation respectively.

Table 3 shows the comparison between the pre- and post-test of variables for the ketoprofen gel group with significant differences  $p=0.004$ ,  $p=0.002$  in NDI and pain respectively.

Table 4 shows the comparison between the pre and post-test of variables for the control group with significant difference  $p=0.004$  in NDI.

Table 5 shows the comparison of the change in mean of variables between the different gel groups using the non-parametric Kruskal-Wallis test. There were no significant differences across the groups.

Variable	Control n (%)	M. salicylate n (%)	Ketoprofen n (%)
Age range (years)			
25-35	2 (33.33)	3 (50.00)	1 (16.67)
36-45	2 (33.33)	1 (16.67)	2 (33.33)
46-55	1 (16.67)	1 (16.67)	1 (16.67)
56-65	1 (16.67)	1 (16.67)	2 (33.33)
Total	6 (100.00)	6 (100.00)	6 (100.00)
Mean age= 41.17 ± 11.73 years			
Gender			
Male	3 (50.00)	3 (50.00)	3 (50.00)
Female	3 (50.00)	3 (50.00)	3 (50.00)
Total	6 (100.00)	6 (100.00)	6 (100.00)
Ethnicity			
Igbo	3 (50.00)	2 (33.33)	2 (33.33)
Yoruba	3 (50.00)	4 (66.67)	4 (66.67)
Total	6 (100.00)	6 (100.00)	6 (100.00)
Religion			
Christian	6 (100.0)	4 (66.67)	4 (66.67)
Islam	0 (0.00)	2 (33.33)	2 (33.33)
Total	6 (100.00)	6 (100.00)	6 (100.0)
M. salicylate: Methyl salicylate			

**Table 1:** Socio-demographic characteristics of participants.

Variables	Pre-test (n=6)	Post-test (n=6)	t	p
	Mean ± SD	Mean ± SD		
NDI	39.33 ± 11.84	16.33 ± 7.31	8.17	0.001*
Pain	5.0 ± 1.67	2.67 ± 1.21	7	0.001*
Flexion (0)	34.67 ± 14.45	41.50 ± 7.31	1.94	0.11
Extension (0)	43.33 ± 13.29	48.50 ± 9.77	2.17	0.083
Right lateral flexion (0)	36.67 ± 6.06	38.33 ± 6.83	1.58	0.175
Left lateral flexion (0)	32.50 ± 6.89	37.0 ± 6.48	1.96	0.107
Left rotation (0)	62.50 ± 13.32	73.83 ± 8.84	3.35	0.020*
Right rotation (0)	65.83 ± 17.72	69.67 ± 11.60	1.23	0.273
*p value significant at p<0.05				

**Table 2:** Comparison between the pre- and post-test of variables for the Methyl salicylate gel group.

Variables	Pre-test (n=6)	Post-test (n=6)	t	p
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	Mean ± SD	Mean ± SD		
NDI	35.33 ± 12.44	15.33 ± 7.76	5.13	0.004*
Pain	5.83 ± 0.98	2.83 ± 0.75	5.81	0.002*
Flexion (0)	31.33 ± 14.58	38.33 ± 14.01	2.48	0.056
Extension(0)	42.50 ± 10.45	50.50 ± 6.89	2.51	0.054
Right lateral flexion (0)	33.50 ± 10.93	36.50 ± 11.66	1.84	0.126
Left lateral flexion (0)	34.33 ± 13.13	37.33 ± 12.53	1.75	0.14
Left rotation (0)	64.50 ± 14.12	69.17 ± 12.01	2.06	0.094
Right rotation (0)	60.83 ± 23.96	65.0 ± 20.49	1.27	0.259
*p value significant at p<0.05 NDI: Neck disability index, SD: Standard Deviation				

**Table 3:** Comparison between the pre- and post-test of variables for the Ketoprofen gel group.

Variables	Pre-test (n=6)	Post-test (n=6)	t	p
	Mean ± SD	Mean ± SD		
NDI	42.67 ± 20.93	19.0 ± 13.61	5.08	0.004*
Pain	5.50 ± 1.87	4.17 ± 1.72	2.39	0.062
Flexion (0)	39.17 ± 5.81	38.67 ± 12.99	0.16	0.878
Extension (0)	44.67 ± 10.42	45.83 ± 11.14	0.67	0.532
Right lateral flexion (0)	37.83 ± 3.19	38.50 ± 5.96	0.25	0.81
Left lateral flexion (0)	37.0 ± 4.47	38.33 ± 5.16	1.51	0.191
Left rotation (0)	71.67 ± 7.53	73.33 ± 7.53	1.58	0.175
Right rotation (0)	70.83 ± 12.01	71.67 ± 8.17	0.35	0.741
*p value significant at p<0.05 NDI: Neck disability index, SD: Standard Deviation				

**Table 4:** Comparison between the pre- and post-test of variables for the control group.

	Acoustic	M. salicylate	Ketoprofen	H	p*
	Mean ± SD	Mean ± SD	Mean ± SD		
NDI	23.67 ± 11.41	23.0 ± 6.90	20.0 ± 9.55	2.13	0.773
Pain	1.33 ± 1.37	2.33 ± 0.82	3.0 ± 1.26	3.81	0.1
Flexion (0)	0.5 ± 7.56	6.83 ± 8.61	7.50 ± 7.42	2.45	0.28
Extension (0)	1.17 ± 4.26	5.17 ± 5.84	8.0 ± 7.82	2.5	0.221
Right lateral flexion (0)	0.67 ± 6.46	1.67 ± 2.58	3.0 ± 4.0	1.74	0.82

Left lateral flexion (0)	1.33 ± 2.16	4.50 ± 5.61	3.0 ± 4.20	1.55	0.50 1
Left rotation (0)	1.67 ± 2.58	11.30 ± 8.29	4.67 ± 5.54	1.01	0.06 1
Right rotation (0)	0.83 ± 5.84	3.83 ± 7.63	4.17 ± 8.01	1.53	0.69 8
*p-value was tested using the non-parametric Kruskal-Wallis test M. salicylate: Methyl salicylate; SD: Standard Deviation; NDI: Neck Disability Index					

**Table 5:** Comparison of the change in mean of variables between the different gel groups.

## Discussion

The significant differences observed in clinical outcome measures for the experimental groups can be attributed to the therapeutic effect of both ultrasound and the drugs. This is in conformity with a study in which phonophoresis was used to treat polyarthritis of the hand by delivery of hydrocortisone ointment into inflamed areas in 1954 [1] and since then, has been reported to be used in the treatment of various dermatological and musculoskeletal disorders [1-4] with positive outcomes. Aiyejusunle et al. [5] claimed that the depositor effect of drugs is what sustains the analgesic effect of iontophoresis, so if in this current study, phonophoresis was superior to therapeutic ultrasound it may possibly be due to the depositor effect of drugs which sustains their analgesic effect and allows for sustainability of the effect of drugs. The depth of penetration of a drug is said to depend on the drug's mass (which is inversely proportional to its molecular weight) hence a lower drug mass would lead a better permeability through the ultrasound waves [6]. Methyl salicylate has a molecular weight of 152.2 g/mol and ketoprofen has a molecular weight of 254.281 g/mol [6], but in this study methylsalicylate had better clinical outcomes compared to ketoprofen. Therefore this study is not in agreement with the aforementioned statement. The mean age (41.17 years) of the participants in this study indicates that cervical spondylosis is not limited to the elderly but can occur at a younger age. This is consistent with a study by Cai et al. [7]. It is probably associated with genetic differences, geocultural factors and occupational demands [8]. However, this study presents with some limitations: 1) Inadequate sample size, 2) Inadequate stratification of study participants for data analysis, 3) Paucity of publication on ketoprofen phonophoresis. It is hereby suggested that further research should be undertaken to address these aforementioned deficiencies which, if done, will help the generalizability of the study and give greater credibility to the future use of the interventions in this study in clinical practice.

## Conclusion

Both methyl salicylate phonophoresis and ketoprofen phonophoresis were efficacious in the management of patients with cervical spondylosis, but methyl salicylate phonophoresis was marginally better.

## Recommendation

The knowledge of quality of life for patients with chronic neck pain obtained through the use of NDI questionnaire may help physiotherapist evaluate and develop rehabilitation programs to improve quality of life. Further, the study results showed that methyl salicylate and ketoprofen phonophoresis are effective for relieving pain, improving range of motion of the cervical spine, improving NDI score. Together, these results can be informative for both clinicians and patients with cervical spondylosis in selecting appropriate types of treatment based on their preference of any of the two topical gels.

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