

# Relieving Tenderness Over Anatomical Snuff Box Through Penetration Enhancing Vehicles

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## Abstract

**Introduction**-De Quervain's tenosynovitis is caused by inflammation of the abductor pollicis longus (APL) and the extensor pollicis brevis (EPB) tendons, which pass through the first dorsal compartment at the radial styloid. Patients who have this stenosing tenosynovitis usually describe tenderness in the anatomical snuff box and swelling proximal to the radial styloid process as well as pain in the wrist and on the lateral side of the hand. Retention of fluid has been suspected as an initiator of this problem, which appears to be significantly more common in women. Interestingly, many women suffer from de Quervain tenosynovitis during pregnancy or the postpartum period. This study was carried out to investigate the efficacy of ketoprofen phonophoresis (ultrasound mediated topical drug penetration enhancer) in the treatment of de Quervain's tenosynovitis during pregnancy. **Methods** -This study was carried out on thirty volunteer pregnant women in the 3<sup>rd</sup> trimester complaining of de Quervain's tenosynovitis of the dominant hand. The patients were divided into 2 groups equal in numbers. Group (A) received ultrasound therapy using Fastum gel (ketoprofen 2.5%) as a coupling medium. Group (B) served as a control group and received placebo (KY inert gel) with ultrasound therapy. Each patient was treated for 4 weeks. Assessment of pain intensity for each subject was done before and after the four weeks of treatment through Present pain intensity (PPI) scale. **Results**-The intervention group showed remarkable recovery in the form of reduction in pain. ( $p < 0.005$ ) **Conclusion**-From the statistical point of view it can be concluded that ketoprofen phonophoresis has an excellent effect on relieving pain of de Quervain's tenosynovitis during pregnancy that physiotherapists should confidently be able to use it in treating such cases.

## INTRODUCTION

De Quervain's tenosynovitis is caused by inflammation of the abductor pollicis longus (APL) and the extensor pollicis brevis (EPB) tendons, which pass through the first dorsal compartment at the radial styloid (Dennis, 2001). Patients who have this stenosing tenosynovitis usually describe tenderness in the anatomical snuff box and swelling proximal to the radial styloid process as well as pain in the wrist and on the lateral side of the hand. Retention of fluid has been suspected as an initiator of this problem, which appears to be significantly more common in women. Interestingly, many women suffer from de Quervain tenosynovitis during pregnancy or the postpartum period (Schned, 1986). Pain over the thumb side of the wrist is the main symptom. The pain may appear either gradually or suddenly. It is felt in the wrist and can travel up the forearm. The pain is usually worse with use of the hand and thumb, especially when forcefully grasping things or twisting the wrist. Swelling over the thumb side of the wrist is noticed and may be accompanied by a fluid-filled cyst in this region.

There may be an occasional "catching" or "snapping" when moving the thumb. Because of the pain and swelling, it may be difficult to move the thumb and wrist, such as in pinching. Irritation of the nerve lying on top of the tendon sheath may cause numbness on the back of the thumb and index finger (Moore and Steven, 1997). There are many treatment options available to treat de Quervain's disease, including local electrotherapy massage, splintage for various lengths of time and in different positions; steroid injections with or without splintage and non-steroidal anti-inflammatory drugs (NSAIDs). (Fiona, 2006). Although non-steroidal anti-inflammatory drugs (NSAIDs) are used principally for symptomatic relieve of pain and inflammation, these drugs usually provide temporary relieve of mild to moderate pain; especially those associated by inflammation. There is an adverse reaction usually to oral NSAIDs which involve GIT, particularly erosion of gastric mucosa, dyspepsia, epigastric distress, nausea and abdominal pain. These reactions can be minimized by giving NSAIDs with meals or food antacid or large quantities of

water or milk (Carpenter , 2001). Topical drug delivery may be the optimal route for the treatment of localized musculoskeletal disorders because higher drug concentrations can be achieved at the sites of clinical significance .Using physical modalities such as phonophoresis and iontophoresis improve topical drug delivery. (Rosenstein, 1999) Phonophoresis is the migration of drug molecules through the skin under the US transducer. (Tyle and Agrawala, 1989). In phonophoresis (PH), in addition to deep heating, US is used to enhance percutaneous absorption of drugs; hence it is commonly referred to as topical drug penetration enhancer.. PH was first used to treat polyarthritis of the hand by driving hydrocortisone ointment into inflamed areas in 1954. Since then it has been used in the treatment of various dermatological and musculoskeletal disorders (Kassan et al., 1996). The technique is non-invasive, well tolerated and involves minimal risk of hepatic and renal injury (Klaiman et al., 1998).

This study was carried out to investigate the efficacy of ketoprofen phonophoresis in the treatment of pain of de Quervain's tenosynovitis during pregnancy.

## METHODS

This study was carried out on thirty volunteer pregnant women in the 3<sup>rd</sup> trimester complaining of de Quervain's tenosynovitis of the dominant hand. They were selected randomly from out-patient clinic of the obstetrics Department of Kasr El-Aini University Hospital, Cairo, Egypt.. Their age was ranged from 25-35 years ( $29.16 \pm 3.07$  yrs), weight ranged from 66-95 kg ( $82.66 \pm 6.07$  kg), height ranged from 150-170 cm ( $162.46 \pm 5.59$  cm) and body mass index ranged from 29-34 Kg/m<sup>2</sup> ( $30.83 \pm 1.11$  Kg/m<sup>2</sup>) (Table1) As shown in table (1), the patients physical characteristics were compared together and no statistical difference ( $P > 0.05$ ) was observed between the two groups.

## Figure 1

Table (1) Physical characteristics of the patients in groups (A&B).

Variables	Group A		Group B		Comparison		S*
	Mean	±SD	Mean	±SD	t-value	P-value	
Age (yrs)	29.2	±3.14	29.13	±3.11	0.05	0.95	NS
Weight (Kg)	82.4	±6.99	82.93	±5.22	0.23	0.81	NS
Height (cm)	162.4	±6.18	162.53	±5.15	0.06	0.94	NS
BMI (Kg/m <sup>2</sup> )	30.66	±1.11	31.0	±1.13	0.81	0.42	NS

\* S denotes significance

Each woman was informed about the benefits and mechanism of PH in the treatment of dequervain's

tenosynovitis to gain her confidence and cooperation through the period of the study. The patients were divided into 2 groups equal in numbers: group (A) received ultrasound therapy using Fastum gel (ketoprofen 2.5%) as a coupling medium. Group (B) served as a control group and received placebo (KY inert gel) with ultrasound therapy. US was given in pulsed mode, with frequency of 3MHZ and intensity of  $0.8 \text{ w/cm}^2$  for 10 min, 3 times/ week for 4 weeks. The two groups used thumb spica splint and after the first six sessions the they received a supervised exercise program in the form of strengthening and stretching exercises for the thumb (abductor polices longus and extensor pollicis brevis muscles) repeated twice daily. The thumb spica splint was advised during the day and taken off at the night. Wrist and thumb immobilization by splinting is usually effective in reducing or eliminating irritating symptoms. Each patient was treated for 4 weeks. Assessment of pain intensity for each subject was done before and after the four weeks of treatment through Present pain intensity (PPi) scale. Pain intensity was scored as being: no pain=0, mild pain=1, moderate pain=2, severe pain=3, unbearable pain=4.

## RESULTS

Intensity of pain perception scored by PPi scale: As shown in Table (2a,b) and Fig. (1a, b, c & d and Fig 2):

In group (A): before starting the treatment program there were 9 (60%) cases who complained from unbearable pain and 6 (40%) cases complained from severe pain. After the end of the treatment program, 4 cases (26.67%) suffered from mild pain and 11 cases (73.33%) had no pain.

In group (B): before starting the treatment program there were 4 (26.67%) cases who complained from unbearable pain, 11 (73.33%) and cases complained from severe pain. After the end of the treatment program, 8 cases (53.33%) suffered from unbearable pain, 3 cases (20%) suffered from severe pain, 1case (6.66%) suffered from moderate pain, 2 cases (13.33%) suffered from mild pain and 1case (73.33%) had no pain.

In group (A), the PPi scores pre- treatment ranged between (3-4) scores with a mean value of ( $3.6 \pm 0.5$ ) and at the end of the treatment program it ranged between (0-1) scores with a mean value of ( $0.26 \pm 0.45$ ). There was a highly significant decrease of pain ( $P > 0.0001$ ). The percentage of improvement was 92.5%

In group (B), the PPi scores pre- treatment ranged between (3-4) scores with a mean value of ( $3.26 \pm 0.45$ ) and at the end

of the treatment program, it ranged between (0-4) scores with a mean value of ( $3 \pm 1.36$ ). There was no statistical difference ( $P < 0.05$ ). The percentage of improvement was 7.9

Table (2a): The percentage of pain intensity scored by PPi scale before starting and after the end of the treatment sessions in groups (A) and (B).

**Figure 2**

PPi scale	Group (A)				Group (B)			
	Pre treatment		Post treatment		Pre treatment		Post treatment	
	No. of cases	%	No. of cases	%	No. of cases	%	No. of cases	%
No pain	-	-	11	73.33 %	-	-	1	6.66%
Mild pain	-	-	4	26.67 %	-	-	2	13.33 %
Moderate pain	-	-	-	-	-	-	1	6.66%
Sever pain	6	40%	-	-	11	73.33 %	3	20%
Unbearable pain	9	60%	-	-	4	26.67 %	8	53.33 %

**Figure 3**

Table (2b): The mean value of PPi before starting and after the end of the treatment sessions in groups (A) and (B).

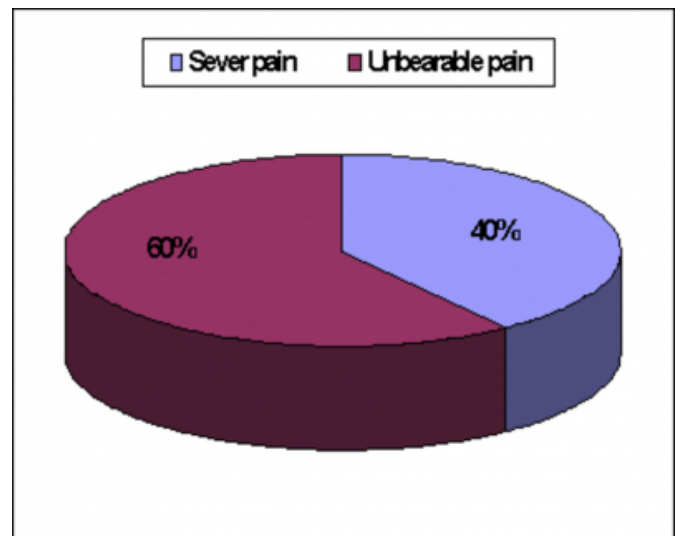
Present Pain Intensity	Group A (Study Group)		Group B (Control Group)	
	Pre treatment	Post treatment	Pre treatment	Post treatment
Mean	3.6	0.26	3.26	3.0
±SD	±0.5	±0.45	±0.45	±1.36
Mean difference	3.33		0.26	
DF	14		14	
t-value	20.91		0.74	
P-value	0.0001		0.46	
S*	HS		NS	
Percentage of change (%)	92.5%		7.97%	

\* S denotes significance

Fig.(1): The percentage of pain intensity scored by PPi scale before starting and after the end of the treatment sessions in groups (A) and (B).

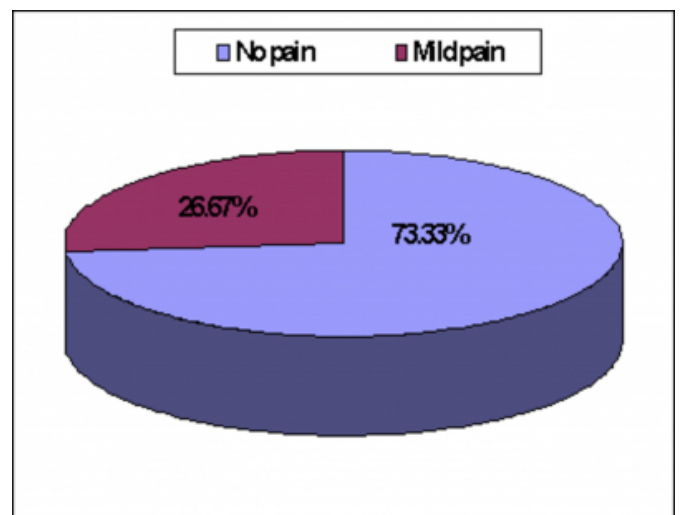
**Figure 4**

1(a) Before the treatment program, group A



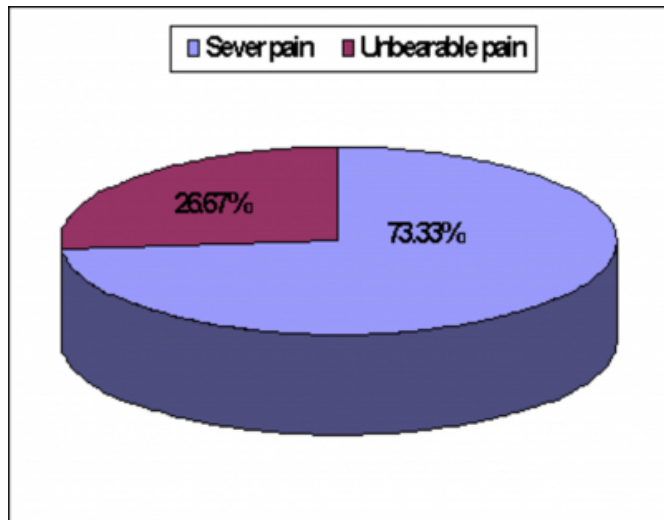
**Figure 5**

1(b) After the treatment program, group A



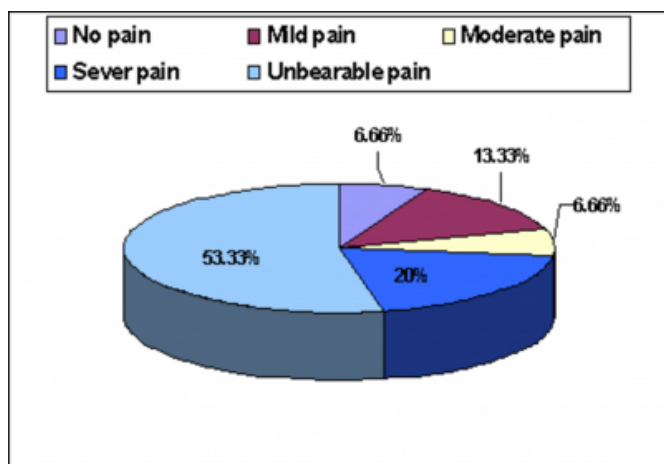
**Figure 6**

1(c) Before the treatment program, group B



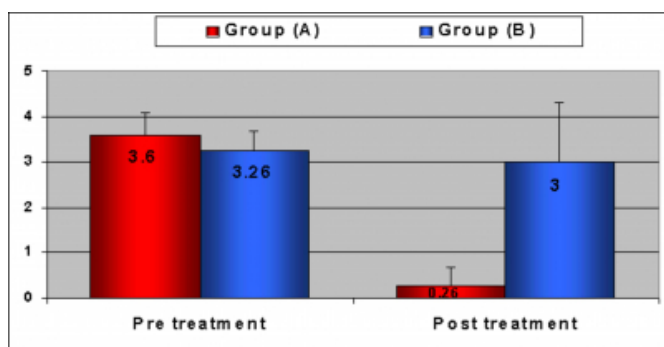
**Figure 7**

1(d) After the treatment program, group B



**Figure 8**

Fig. (2): The mean value of PPI before starting and after the end of the treatment sessions in groups (A) and (B).



## DISCUSSION

The present study reveals that there was a highly significant

decrease ( $P < 0.001$ ) of present pain intensity (PPI) scores, ( $P < 0.001$ ) after the end of the treatment program. The obtained results agreed with those reported by Cabak et al., (2005), who carried out a study to examine the therapeutic effects of phonophoresis with ketoprofen in gel form in patients with medial and lateral epicondylitis of the elbow. They found that the positive effects of phonophoresis using a pharmacologically active gel with ketoprofen were shown to be highly significant. The pain symptoms in the elbow resolved in most of the patients. The results of this study are also supported by Koeke et al., (2005), who carried out a comparative study to detect the efficacy of topical application of hydrocortisone, therapeutic ultrasound and phonophoresis on the tissue repair process of rat tendons. They concluded that US stimulates the acceleration of tissue repair processes and induces the transdermal delivery of hydrocortisone in a therapeutic concentration on the tendon. Also, the results agreed with those reported by Barbara et al., (2003), who carried out a study to examine the influence of US on the transdermal delivery of ketoprofen in humans and to compare the concentrations found after continuous and pulsed application. They confirmed that phonophoresis of topically applied ketoprofen (Fastum gel) can result in high local tissue concentrations. Although a statistical difference was not found, it would appear from the results that pulsed ultrasound provided the most effective conditions for delivering ketoprofen to certain subcutaneous tissues. These results are similar to findings of White (1991), who studied the effects of topical non-steroidal anti-inflammatory drugs (NSAIDs) in the treatment of inflammatory musculoskeletal disorders. The study showed clinical improvement and reduction of painful and inflammatory symptoms of traumatic injuries of soft tissues, joints, osteoarthritis of knee and muscular pain. He reported that adjunct therapy using ultrasound was useful and that topical NSAIDs are particularly useful for the short-term treatment of acute musculoskeletal pain and inflammation and have less and less serious, side effects than oral NSAIDs. Airaksinen and Venalainen (1993), in their study compared the difference between using Ketoprofen 2.5% gel and placebo gel in the treatment of acute soft tissue injuries. They reported that pain was significantly relieved in the ketoprofen group which is safe and superior to placebo in the treatment of soft tissue injuries. In addition, Gevi and Merlo (1983), found that systemic absorption of the active drug after cutaneous application of 5% gel of ketoprofen lysine in 5 healthy volunteers was very low (about 1%). A clinical trial was carried out on 30 sporting patients with various

traumatological affections. Spontaneous pain, pain at passive movement and at oppression, swelling were evaluated before and after treatment. The new dosage form was endowed with a high analgesic and anti-inflammatory activity after topical use. Therapy was most effective against spontaneous pain with patients in sports injury and very good results were obtained regarding swelling reduction which confirmed its high anti-edema activity. The gel was well-tolerated with neither topical nor systemic side effects being reported. It was concluded that 5% ketoprofen gel was very useful both as a resolutive and as a supporting therapy of surgery, plaster, or electromedical applications. The results of our study are also supported by Klaiman et al., (1998), who carried their research to determine whether pain response after phonophoresis (PH) differs from the pain response after ultrasound (US) alone on forty-nine subjects with soft tissue injuries including epicondylitis, tendinitis, and tenosynovitis who were randomly assigned (double blinded technique) to PH or US treatment groups. Both groups received 8 min of continuous US three times per week for 3 wks. For the PH group a gel containing 0.05% fluocinonide was used as a coupling agent. An identical inert gel was used for the US group. They found that at the end of 3 wks of treatment, both groups combined showed a significant decrease in pain level and an increase in pressure tolerance ( $P < 0.05$ ), but there were no differences between groups from the onset of treatment to the end of week 3 (VAS: US 5.5-1.9, PH 5.0-2.0; algometry (involved limb): US 4.7 lb-7.1 lb, PH 5.1 lb-6.6 lb). They concluded that US results in decreased pain and increased pressure tolerance in selected soft tissue injuries. The addition of PH with fluocinonide does not augment the benefits of US used alone. These results are in agreement with Saadet et al., (2009), who carried a study to compare the effectiveness of pulsed and continuous diclofenac gel phonophoresis with topical diclofenac gel treatment on eighty patients with knee osteoarthritis were randomly assigned to 4 groups. The first group received continuous diclofenac gel phonophoresis, the second group received pulsed diclofenac gel phonophoresis, the third group received diclofenac gel with sham ultrasound, and the fourth group received acoustic gel applied with sham ultrasound for one month. They found that both modalities of phonophoresis were shown to improve pain at rest, pain in activity and physical function scores compared to the other treatments. Also Grahame (1995), confirmed the efficacy of topical NSAIDs in the treatment of acute soft-tissue injury and chronic soft-tissue overuse lesions. Topical NSAIDs may, therefore, be seen as an effective alternative to local

steroid injection in cases of soft-tissue rheumatism. Safety profile of topical NSAIDs is good, Skin reactions are rare and this apparently applies to all topical NSAIDs currently available. It is logical to treat a local pathological lesion with a local therapy, provided the agent is delivered effectively to the target organ or tissue. In addition, Campbell and Dunn (1994), who carried out a study on one hundred patient who presented to the accident and emergency department with an acute ankle sprain to determine the efficacy of topical ibuprofen cream by using a double-blind placebo controlled design in a single type of soft-tissue injury. The subjects were given either topical ibuprofen cream or a placebo cream in addition to the standard management of the department. Patients kept diaries recording walking ability and pain visual analogue scales for resting, standing and walking. A total of 51 patients returned diaries that were suitable for analysis. Patients using the topical ibuprofen cream had significant reduction in pain scores over the first 48 h of treatment. The obtained results agreed with those reported by Grace et al., (1999), who carried out a study on seventy patients in a double blind, randomized, placebo-controlled, parallel group 2 week clinical trial to determine the efficacy of topical 2% diclofenac in lecithin organogel in the treatment of pain associated with mild to moderate osteoarthritis (OA) of the knee. Patient responses to disease-specific total score and aggregated subscale scores revealed significant improvement ( $p < 0.5$ ) on the aggregated total score, pain, stiffness, and physical function subscales from baseline to post-treatment for the active treatment group compared to the placebo group. Analysis of gain scores also revealed significant improvement with active versus placebo treatments. Also the results are supported by Bareggi et al., (1998), who carried out a study to compare skin and plasma levels of ASA and SA after topically administered ASA/diethyl ether mixture (ADE) and oral administration of aspirin. in acute herpetic neuralgia and post herpetic neuralgia. Oral ASA (500 mg) or topical ADE (750 mg) was administered to 19 patients and the analgesic effect was assessed by means of a visual analogue scale (VAS). After ADE application, the analgesic effect was very rapid and VAS scores were lower than at baseline. Pain significantly decreased by 82.6% after topical and 15.4% after oral ASA. After ADE, 95% of the patients had excellent or good pain relief, but after oral administration 79% had a poor response. They concluded that the analgesic effect can be obtained only after topical administration because by this route the skin levels of ASA are much higher than after oral administration. The mechanism is exclusively local; there

are no active drugs in plasma after topical administration.

The results of the study are contradicted with the work of Nagrale et al., (2009), who carried out a study on sixty patients to compare the effectiveness of deep transverse friction massage with Mill's manipulation (Cyriax physiotherapy) versus phonophoresis with supervised exercise and static stretching in managing lateral epicondylalgia. The control group received phonophoresis with diclofenac gel over the area of the lateral epicondyle for 5 minutes combined with supervised exercise. The experimental group received 10 minutes of deep transverse friction massage followed by a single application of Mill's manipulation. Both groups received treatment 3 times per week for 4 weeks. The results of this randomized clinical trial demonstrated that Cyriax physiotherapy was found to provide a superior benefit in terms of pain, pain-free grip, and functional status when compared to a treatment regimen consisting of phonophoresis with supervised exercise and static stretching in managing lateral epicondylalgia. Also the results of the study are contradicted with the work of Stasinopoulos and Stasinopoulos (2004), who carried out a study on thirty patients to compare the effectiveness of an exercise programmed, pulsed ultrasound and transverse friction in the treatment of chronic patellar tendinopathy. Patients were randomized into three groups. Group (A) was treated with exercise programme. Pulsed ultrasound was given to group (B). Group (C) received transverse friction. All patients received three treatments per week for four weeks. The results suggested that the exercise programme was more effective treatment than ultrasound and transverse friction in decreasing pain. The obtained results agreed with those reported by Baskurt et al., (2003) who carried out a study on 61 patients who had lateral epicondylitis to compare the effectiveness of naproxen (10%) applied by topical iontophoresis or by phonophoresis in the treatment of lateral epicondylitis. They patients randomized into two groups. The researchers treated one group with phonophoresis using a nonsteroidal anti-inflammatory drug (10% naproxen) and treated the second group with 10% naproxen iontophoresis. Patients in both groups were treated by other physiotherapy methods (cold pack, progressive strengthening and stretching exercises). Results indicated that pain scores decreased, functional status improved and grip strength significantly increased in both groups after treatment ( $p < 0.05$ ), but there were no statistical differences between groups before or after treatment ( $p > 0.05$ ). The obtained results agreed with those reported by Gerold et al., (1998) who carried out a study on 45 patients with mild to

moderate bilateral carpal tunnel syndrome as verified by electroneurography to assess the efficacy of ultrasound treatment for mild to moderate idiopathic carpal tunnel syndrome, they designed a randomized, double blind, "sham" controlled trial with assessments at baseline, after 2 weeks and 7 weeks treatment, and at a follow up assessment 6 months later (8 months after baseline evaluation). 20 sessions of ultrasound (active) treatment (1 MHz, 1.0 W/cm<sup>2</sup>, pulsed mode 1:4, 15 minutes per session) applied to the area over the carpal tunnel of one wrist, and indistinguishable sham ultrasound treatment applied to the other. The first 10 treatments were performed daily (5 sessions/week); 10 further treatments were performed twice weekly for 5 weeks. Results showed an improvement in actively treated than in sham treated wrists for both subjective symptoms ( $P < 0.001$ ) and electroneurographic variables (motor distal latency  $P < 0.001$  and sensory antidromic nerve conduction velocity  $P < 0.001$ ). Effects were sustained at 6 months follow up, physical functioning, hand grip and finger pinch strength had improved significantly with active treatment at the end of treatment and at 6 months followed up, results suggest there are satisfying short to medium term effects due to ultrasound treatment in patients with mild to moderate idiopathic carpal tunnel syndrome.

### **CONCLUSION**

From the statistical point of view it can be proved that ketoprofen phonophoresis has an excellent effect on relieving pain of de Quervain's tenosynovitis during pregnancy and that physiotherapists should confidently be able to use it in treating such cases. This therapy is safe and effective, there are no systemic side-effects or harm to the growing fetus as the technique is essentially non invasive. The modus operandi of phonophoresis, mechanism, including ultrasound application, concentration and type of topical drug used and adjunct exercise protocol are all equally important variables in determining the success outcomes of de Quervain's disease in pregnant females.

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