

THE EFFECTIVENESS OF EXTRACORPOREAL SHOCK WAVE AND KINESIO TAPE TREATMENTS IN SHOULDER IMPINGEMENT SYNDROME

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ABSTRACT

Objective: The aim of this study was to compare the effects of Extracorporeal Shock Wave Therapy (ESWT) and Kinesio Taping Therapy (KT) in Shoulder Impingement Syndrome (SIS).

Material and Method: Patients were randomly divided into two groups, ESWT or KT. ESWT was performed once a week for three weeks and adjusted at a frequency of 12-15 Hz, 2-3 bars and 2500 pulses for all patients. KT was applied twice a week for three weeks. Cold pack application for 30 minutes and 3 times a day exercise program was added to the treatment. Shoulder pain evaluation, painful arc and Neer tests, The Disability of Arm, Shoulder and Hand Scale (DASH) and Wong-Baker Face Rating Scale (WBS) were used before and after treatment to evaluate the efficacy of treatment. Patients were re-evaluated at end of the treatment (3rd week) and at the 3rd month after treatment.

Results: According to DASH and WBS results, statistically significant improvement in shoulder pain, internal and external rotation pain and also in shoulder-joint function was detected in ESWT and KT groups after treatment in comparison to pre-treatment ($p<0.05$). In comparison of ESWT and KT, apart from statistically increased external rotation pain score in the KT group than in the ESWT group, there were no differences.

Conclusion: ESWT and KT therapy were effective in pain management and preserving joint functions in SIS. We concluded that adding cold application and exercise program as a combination therapy to ESWT and KT did not caused any untoward effects and the positive outcomes of this approach in the long-term combination treatment program may be more pronounced.

Keywords: Shoulder pain, extracorporeal shock wave therapy, kinesio taping. Nobel Med 2019; 15(1): 56-62

OMUZ SIKIŞMA SENDROMUNDA EKSTRAKORPORAL ŞOK DALGA VE KİNEZYO BANT TEDAVİLERİNİN ETKİNLİĞİ

ÖZET

Amaç: Bu çalışmanın amacı Omuz Sıkışma Sendromlu (OSS) hastalarda, Ekstrakorporeal Şok Dalga Tedavisi (EŞDT) ve Kinezyo bant Tedavisinin (KT) etkinliklerinin karşılaştırılmasıdır.

Materyal ve Metot: Hastalar rastgele, EŞDT ve KT olarak 2 gruba ayrılmıştır. EŞDT tüm hastalara 3 hafta boyunca haftada 1 kez olmak üzere, 12-15 Hz, 2-3 bar ve 2500 pulse olacak şekilde uygulanmıştır. KT, 3 hafta boyunca haftada 2 kez olacak şekilde yapılmıştır. Tedaviye, 30 dakikalık soğuk uygulama ve günde 3 kez olacak şekilde egzersiz programı eklenmiştir. Tedavi öncesi ve sonrası olmak üzere, omuz ağrısı, ağırlı ark testi, Neer testi, kol, omuz ve el sorunları anketi (DASH) ve Wong-Baker Yüz Oranlama Skalası (WBS) ile tedavinin etkinliği

değerlendirilmiştir. Hastalar tedavinin bitiminde (3. hafta) ve 3 ay sonra yeniden değerlendirilmiştir.

Bulgular: Tedavi öncesine göre, tedavi sonrası omuz ağrısı, iç ve dış rotasyonlarda oluşan ağrılar ve ayrıca omuz-eklem fonksiyonunda DASH ve WBS ölçekleri her iki grupta da istatistiksel olarak anlamlı iyileşme göstermiştir ($p<0,05$). EŞDT ve KT karşılaştırıldığında ise, KT'de EŞDT'den istatistiksel olarak daha yüksek görülen dış rotasyon ağrı skoru dışında, herhangi bir fark görülmemiştir.

Sonuç: OSS'de EŞDT ve KT ağrı semptomunun giderilmesinde ve eklem işlevlerinin korunmasında etkin yöntemlerdir. EŞDT ve KT'ye kombine tedavi olarak soğuk uygulama ve egzersiz programı eklenmesinin herhangi bir negatif etki oluşturmadığını ve daha uzun süreli tedavi programında pozitif etkilerinin daha belirgin olabileceğini düşünmekteyiz.

Anahtar kelimeler: Omuz ağrısı, ekstrakorporeal şok dalga tedavisi, kinezyo bant tedavisi. **Nobel Med 2019; 15(1): 56-62**

INTRODUCTION

Impingement syndrome is a generic term for rotator cuff lesions encompassing all stages of tendon disease.¹ Shoulder Impingement Syndrome (SIS) occurs as a result of the compression of the supraspinatus, infraspinatus, teres minor muscle and biceps tendon, soft tissues and subacromial bursa between the coracoacromial arch and humeral head.² This condition can lead to shoulder pain. It can also cause painfully restriction of shoulder movements, when not treated. These are the main symptoms of SIS. Moreover, some structural and functional factors which narrow the subacromial space can also result in shoulder impingement. Treatment modalities for SIS generally include clinical tests such as the so-called painful arch or the Hawkins test etc. which provide initial evidence of the underlying disturbance, physical therapy, nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, and surgical intervention.³ When necessary, plain x-rays, outlet and axillary radiographs, and magnetic resonance imaging (MRI) are also used.^{1,4,5}

Extracorporeal Shock Wave Therapy (ESWT) is a high pressure sound wave used to treat injury in soft tissues and pain caused by degeneration in the musculoskeletal system. It has become a preferred treatment method in pain rehabilitation for achieving effective treatment within a short time. In fact, ESWT has been in use for treatment of musculoskeletal

disorders for more than a decade. This method is particularly preferred for the treatment of sports-related tendinopathies, such as patellar tendinopathy, proximal plantar fasciitis of the heel, calcific or non-calcific tendonitis of the shoulder and lateral epicondylitis of the elbow. ESWT is a favorable method not only because it ensures a success rate ranging from 65% to 91%, but also it does not cause significant complications.⁶ ESWT is generally applied in three sessions, one session per week for three weeks.

Another therapy, Kinesio Taping (KT) mainly acts on the nervous system, musculoskeletal system and circulatory system as a taping technique. It is primarily used for the treatment of muscle- and tendon-related problems.⁷ KT is usually applied twice a week and the tape is used for 3-4 days. Non-restrictive elastic adhesive tape is 100% cotton, hypoallergenic, latex free, and its elasticity and stretching features similar to human skin. This technique has various benefits. Some of these are pain relieving, alleviation of inflammation, structural support to joints and muscle movement, assist healing and provide support without restriction the range of movement.^{8,9}

The aim of this study was to investigate the effects of ESWT and KT on pain and function in patients with shoulder impingement syndrome in combination with cold pack application and exercise program.

MATERIAL AND METHOD

Fifty-one patients who were diagnosed with SIS in the outpatient clinic of Physical Medicine and Rehabilitation at Bakirkoy Sadi Konuk Training and Research Hospital were enrolled to this study and an informed consent was obtained from all patients. This prospective clinical study was approved by local ethics committee (2014/06/10, 2014/70).

Inclusion and Exclusion Criteria

Patients were diagnosed by physical examination, diagnostic tests including shoulder pain between 60-120° with shoulder elevation (positive painful arch test), positive NEER test, painful internal and external rotation, and pain in daily living activities. Inclusion criterias were as follows: aged 25-70 years, presented with shoulder pain which had been ongoing for at least one month. Patients were excluded who did not comply with the treatment process. Patients with calcifications and ossifications in the affected shoulder anterior-posterior (A-P) film were excluded from the study. Complete blood count, erythrocyte sedimentation rate, rheumatoid factor and CRP levels were analyzed in order to exclude infection and rheumatic conditions. Patients who had fracture in the upper extremity, malignancy, surgical procedure or avascular necrosis history in the affected shoulder, diabetes mellitus, neurological and cognitive disorders, skeletal deformities, pregnancy, pacemaker or implants, and those who get injection into the affected shoulder previously were excluded from the study.



Figure. The application of Kinesio tape

Therapy Applications

The patients were randomly divided into two groups. Group 1 received Extracorporeal Shockwave Therapy (ESWT Group), and Kinesio taping Therapy (KT Group) was applied to Group 2. The ESWT device (STORZ Medical Masterpuls MP100-SWISS brand) was set at a frequency of 12-15 Hz, 2-3 bars and 2500 pulses. KT was applied twice a week and each patient received a total of 6 KT therapies in total. Kinesio Tex, kinesio tapes were used. Y and I-shaped strips were used for all patients. Y-strips were taped with two tails, whereas I-strips had no cut down the middle of the tape. All Y-strip applications were with paper off tension from insertion to origin of stated muscles. Applying of tapes directly to the skin as it comes off the paper backing is called "Paper-off tension". For the first strip application, the arm of the patient was externally rotated and horizontally adducted for the first tail of Y-strip to anterior deltoid, whereas internally rotated and horizontally adducted for the second tail to posterior deltoid. The second Y-strip was applied from the thoracic spine to the medial border of the scapula with approximately 50% stretch (tension). Patient position for the second strip application was a combination of contra-lateral cervical side bending and the arm reaching behind the back as if reaching into the contra-lateral backside pocket. For the I-strip application, firstly mechanical correction was performed, patients upper extremities were externally rotated while at the side and then moved into shoulder flexion and slight horizontal adduction as the end of the tape was applied with no stretch. Then, I-strip applied to coracoid process from the anterior to the posterior deltoid with approximately 50% to 75% stretch (tension) and downward pressure applied to the tape at the region of perceived tenderness (Figure).⁸

Cold pack therapy was applied for 30 minute on affected shoulder skin with its fabric cover until the end of the treatment. An exercise program (including range of motion exercises, Codman's pendulum exercises and finger ladder exercises) was also given to all patients. The patients did the exercises 2 sets, 10 repetitions and 5 seconds rest between sets at the clinic and two times (with 12 hours interval) at home.

The primary outcome measures were the Disability of Arm, Shoulder and Hand Scale (DASH)^{10,11} and the Wong-Baker Faces Pain Rating Scale (WBS).¹² Also Neer and painful arc tests and shoulder range of motion (ROM) and shoulder pain with Visual analogue scales (VAS) (1-10 cm) were evaluated prior to the treatment, at the end of the treatment (3rd week) and 3 months after the treatment.

Statistical Analysis

Statistical analysis were performed using the NCSS 2007 statistical software (Utah, USA) program. Independent Samples and Mann Whitney U test were used to evaluate the descriptive statistics (mean, standard deviation, median, frequency, ratio). Friedman test was used for evaluating variables with no normal distribution, and the Wilcoxon signed test was used for post hoc binary comparisons. McNemar test and Binomial distribution were used in evaluations of qualitative data according to follow-up. Fisher's exact test was used in comparison of gender according to treatment scheme. The results were evaluated in a confidence interval of 95% and a significance level of $p < 0.05$.

RESULT

Fifty-one patients (41 women and 10 men) are involved in this study. 19 patients received ESWT, 32 patients received KT treatment. The patients aged between 26 and 69 years (mean age: 47.47 ± 10.12 years). Age and sex distributions did not show any statistically significant difference between two groups ($p > 0.05$) (Table 1). In comparison of all scales between ESWT and KT groups, apart from statistically significant increased external rotation pain score in the KT group than in the ESWT group, there were no significant differences between these therapies.

According to WBS, the improvement of three weeks after the treatment results was found statistically significant, when compared to pretreatment, in ESWT and KT groups ($p = 0.001$, $p < 0.01$). There was a significant difference between post-treatment (3rd weeks) and three months after treatment in both groups ($p = 0.001$, $p < 0.01$) (Table 2).

Shoulder pain, painful arc, internal rotation and external rotation pain showed statistically significant improvement after ESWT and KT treatments in comparison to pre-treatment ($p < 0.01$). The improvement of three months after treatment was also statistically significant, when compared with pre-treatment ($p < 0.01$). There was no significant difference between three weeks and three months after treatment in both groups ($p > 0.05$). External rotation pain scores were significantly higher in the KT group than in the ESWT group ($p = 0.019$, $p < 0.05$). The Neer test was statistically significant ($p < 0.01$) between two groups in terms of recovery before treatment and three weeks after treatment. The rates of recovery after three months in comparison to pre-treatment were also statistically significant ($p < 0.01$). However, there was no significant difference between post-treatment and three months after treatment ($p > 0.05$) (Table 3).

Table 1. Demographic features of patients

	Treatment		p
	ESWT(n)	ESWT(n)	
Age; mean±SD	49.84±8.46	46.06±10.86	0.200
Gender, n (%)	Men	5 (26.3)	5 (15.6)
	Women	14 (73.7)	27 (84.4)

^bStudent-t Test ^aFisher's exact test
ESWT: Extracorporeal shockwave therapy **SD:** standard deviation

Table 2. Evaluation of Wong-Baker Faces Pain Rating Scale according to therapy type

		Treatment	
		ESWT(n)	KT(n)
Before Treatment	Min-Max	3-5	2-5
	Mean±SD	4.21±0.79	4.09±0.78
	Median	4.00	4.00
After 3 weeks	Min-Max	0-4	0-4
	Mean±SD	1.89±1.29	1.97±1.09
	Median	2.00	2.00
After 3 months	Min-Max	0-2	0-3
	Mean±SD	0.58±0.77	0.88±0.87
	Median	0	1.00
		p	
Before Treatment-After 3 weeks		0.001*	0.001*
Before Treatment-After 3 months		0.001*	0.001*
After 3 weeks-After 3 months		0.001*	0.001*

Wilcoxon Rank Test * $p < 0.01$
ESWT: Extracorporeal shockwave therapy, **KT:** kinesio taping, **SD:** standard deviation, **Min-Max:** minimum-maximum

After evaluation of DASH questionnaire, there was a statistically significant difference in DASH scores between pre-treatment and after treatments in both two groups ($p < 0.01$) (Table 4).

DISCUSSION

This study was performed for the effects of ESWT and KT, which are new therapy methods on pain in shoulder impingement syndrome in combination with cold pack application and exercise program. We found that when exercise therapy was combined with KT plus cold pack, there was a strong improvement in a short time (after 3rd weeks) period.

Conservative therapy and surgery are two different treatment options in shoulder impingement syndrome. Medications, physiotherapy and exercise are more often used conservative therapies.¹³ Exercise therapy is a regimen of physical activities that are performed on daily basis, even at home, to prevent possible soft

Table 3. Evaluation of findings according to therapy type											
Treatment	Shoulder pain		Painful arc		External Rotation		Internal Rotation		Internal Rotation		
	ESWT (n) (%)	KT (n) (%)	ESWT (n) (%)	KT (n) (%)	ESWT (n) (%)	KT (n) (%)	ESWT (n) (%)	KT (n) (%)	ESWT (n) (%)	KT (n) (%)	
Before Treatment	No	0	1 (3.1)	0	6 (18.8)	6 (31.6)	9 (28.1)	7 (36.8)	17 (53.1)	-	-
	Yes	19 (100)	31 (96.9)	19 (100)	26 (81.3)	13 (68.4)	23 (71.9)	12 (63.2)	15 (46.9)	19 (100)	32 (100)
After 3 weeks	No	16 (84.2)	22 (68.8)	16 (84.2)	26 (81.3)	17 (89.5)	23 (71.9)	17 (89.5)	25 (78.1)	13 (68.4)	16 (50.0)
	Yes	3 (15.8)	10 (31.3)	3 (15.8)	6 (18.8)	2 (10.5)	9 (28.1)	2 (10.5)	7 (21.9)	6 (31.6)	16 (50.0)
After 3 months	No	16 (84.2)	24 (75.0)	18 (94.7)	25 (78.1)	19 (100)	24 (75)	17 (89.5)	25 (78.1)	15 (78.9)	17 (53.1)
	Yes	3 (15.8)	8 (25.0)	1 (5.3)	7 (21.9)	0	8 (25)	2 (10.5)	7 (21.9)	4 (21.1)	15 (46.9)
					° $p=0.019^*$						
P											
Before Treatment- After 3 weeks		0.001	0.001**	0.001**	0.001**	0.001**	0.001**	0.002**	0.008**	0.001**	0.001**
		**									
Before Treatment- After 3 months		0.001	0.001**	0.001**	0.001**	0.001**	0.001**	0.002**	0.008**	0.001**	0.001**
		**									
After 3 weeks- After 3 months		0.500	1.000	0.500	1.000	0.500	1.000	0.500	1.000	0.500	1.000

McNemar Test, **: $p < 0.01$, **e:** Fisher's exact test, ***:** $p < 0.05$ **ESWT:** extracorporeal shockwave therapy, **KT:** kinesio taping

tissue adhesions and to maintain and enhance the range of motion of the neck and shoulder joints, which have been restricted due to pain. The cold pack used for injuries cools the skin and subcutaneous tissues, results in hemodynamic changes with anti-inflammatory action of the deep tissues.¹⁴ In this study, the cold pack method was used as an effective method to reduce the severity of pain.

ESWT is common and effective method to manage chronic tendon conditions related to elbow and shoulder and to modulate pain in heel. Although there are numerous studies in the literature suggesting the use of ESWT, there are still unanswered questions on the use and effectiveness of ESWT.

Several studies have suggested that one of the mechanisms is to increase nitric oxide (NO) levels with neuronal NO synthase in reducing pain. NO limits calcium entry while activates the potassium channel of the cell membrane and causes cell hyperpolarization. NO increase the rate and volume of blood circulation with vascular effects and reduce the effect of inflammatory mediators.¹⁵⁻¹⁷

Santamato *et al.* has demonstrated that ESWT can generate favorable results in the treatment of subacromial impingement syndrome (SAIS). When focused ESWT was applied in combination with isokinetic exercise to rehabilitate the rotator cuff in patients with SAIS, it provided greater reduction in pain, better recovery in functions and muscle endurance in the short to medium term as compared to ESWT alone.¹⁸

In this study, ESWT was applied in accordance with the procedure recommended by the manufacturer. In all the tests and scales that we evaluated for improvement, there was a significant short-term change and a decrease in patient complaints.

Taping is a method which is generally used in shoulder rehabilitation in combination with other physiotherapy methods. The principal aim of taping is to minimize pain and enhance functional recovery.¹⁸⁻²⁰ A large number of elastic and rigid tapes (bands) have been developed. Kinesio tape is an elastic tape, which is commonly preferred to improve pain, inflammation, muscle activity and circulation

while supporting rehabilitation applications.^{10,21} In that study, the researchers aimed to compare the efficacy of Mobilization with Movement (MWM) and KT techniques with a supervised exercise program in patients with shoulder pain. The main outcome measures of that study included active pain-free shoulder abduction and flexion, which were evaluated at the baseline and on the 5th and 10th days of treatment. There was significantly greater improvement in active pain-free shoulder range of motion in the group treated with MWM and KT.²² When the findings of this and our study are taken into consideration, it can be concluded that MWM combined with KT, exercise program and cold pack application may be more effective and rapid in the rehabilitation of the range of motion augmentation in patients with rotator cuff lesion or SIS.

A study examined patients with SIS suffering from shoulder pain lasting more than 6 weeks.²¹ In that study, patients were allocated into two groups: one group was treated with exercises and manipulative therapy, while the other group was treated with exercise therapy in combination with a rigid or elastic tape applied over the scapula. In the second week, greater improvement was observed in shoulder pain and range of motion problems of the group in which scapular tape was used.²¹ In our study, the kinesiio (elastic) tape was applied with exercise therapy and cold pack application. I-shaped strip was applied on coracoid process from the anterior to the posterior deltoid with approximately 50% to 75% stretch (tension). Our short-term results were similar with this study, but our long-term results (three months) were more effective in healing. Similar to our results, Kaya, *et al.* made a comparison between home exercise therapy plus KT and physiotherapy in patients suffering from SIS-induced shoulder pain for an average duration of 6 months. They stated that pain- and function-related problems of the patient group receiving KT application significantly improved in the first and second weeks.²² KT has been suggested to improve the circulation of blood and lymph through adhesion to the skin surface and the recovery of elastic fibers, thereby reducing the effect of inflammatory mediators and relieving tender tension and reducing pain.²³

Exercise therapy when combined with KT plus cold pack revealed strong improvement in a short time period in our study. Shoulder external rotation pain was reduced statistically significantly at three months after treatment, when compared to three weeks after treatment.

Table 4. Evaluation of Disability of Arm, Shoulder and Hand Scale according to therapy type

		Treatment	
		ESWT(n)	KT(n)
Before Treatment	Mean	44.03(14.49)	47.34(17.09)
	Min-Max	25.00-80.83	19.16-78.30
	Median	42.50	47.08
After 3 weeks	Mean	29.07(19.04)	34.50(21.98)
	Min-Max	10.00-74.16	0-73.33
	Median	21.66	29.99
After 3 months	Mean	11.62(12.38)	15.59(14.51)
	Min-Max	0-37.50	0-50
	Median	10.00	16.67
		p	
Before Treatment-After 3 weeks		0.001*	0.001*
Before Treatment-After 3 months		0.001*	0.001*
After 3 weeks-After 3 months		0.001*	0.001*
Wilcoxon Test, *: $p < 0.01$, ESWT: Extracorporeal shockwave therapy, KT: kinesiio taping, Min-Max: minimum-maximum			

In the present study, we divided our patients into two groups with the aim of comparing the short-term and long-term outcomes of ESWT and KT in patients presented with shoulder impingement syndrome. ESWT and KT in our study decreased pain complaints due to movements. Strong benefits in all of study scales were observed in a short time period. According to DASH and WBS results, statistically significant functional improvement was observed not only to pre-treatment, but also between 3 weeks post-treatment and 3 months post-treatment.

Patients who underwent ESWT and KT were compared statistically after 3 weeks and 3 months after treatment. Healing and pain reduction was found to be equal in both groups.

Although our patients experienced mild local pain and redness during ESWT application, no major side effects occurred during the study, which require any intervention. KT has been suggested to be a painless but effective treatment technique.

CONCLUSION

ESWT and KT therapies in combination with cold pack and exercise were found effective in patients with shoulder impingement syndrome. More effective results can be achieved in the treatment with the addition of strengthening exercises to the exercise program under supervision of physiotherapists. Multicentric studies are needed.

Authors Contribution

Mualla Biçer Gençbay conceived, designed and did statistical analysis and editing of manuscript, Nilgün Işıksaçan, Pınar Kasapoğlu, Murat Koşer, Kerametdin Pekediş and Mualla Biçer Gençbay did data collection and manuscript writing, Nilgün Işıksaçan,

Pınar Kasapoğlu, Murat Koşer, Mualla Biçer Gençbay, Kerametdin Pekediş, Özlem Akbaş did review and final approval of manuscript.

*The authors declare that there are no conflicts of interest.

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