Ultrasound Therapy Versus Piezoelectric Shock Wave in Diabetic Frozen Shoulder

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ABSTRACT

Purpose: *This study was conducted to determine the effects of ultrasound and piezoelectric shock wave in diabetic frozen shoulder as a result of diabetes.* ***Subjects:*** *The study was conducted in the Orthopedic Unite of El Salam International Hospital in Maadi. Forty diabetic patients complaining from frozen shoulder for three months were enrolled into this study. Their mean age was 50±3.4 years and they suffered from diabetes for 10±2.7 years. They were divided randomly into two groups of equal number (1 and 2); each contained twenty patients.* ***Procedures:*** *The range of motion of shoulder joint (flexion- abduction -external rotation) and level of pain were determined at the beginning and at the end of eight weeks of treatment as three sessions per week. Group (1) received therapeutic piezoelectric shock wave and mobilizing exercises, while group (2) received ultrasound therapy and the same exercise program given to group (1).* ***Results:*** *The post treatment results revealed significant reduction in the level of pain in both groups with highly significant reduction in group (2) who received ultra sound therapy with mobilizing exercise. However, significant improvement was observed in the range of motion in both groups with highly significant improvement in group (1) receiving piezoelectric shock wave and mobilizing exercises.* ***Discussion and conclusion:*** *Piezoelectric shock wave combined with mobilizing exercises has beneficial effects on improving range of motion. However, ultrasound therapy with mobilizing exercise has a great effect on reducing the level of pain.*

INTRODUCTION

Diabetes is a chronic, multifarious disorder caused by deficient insulin or defective insulin action. It is characterized by hyperglycemia and disruption of the metabolism of carbohydrates, fats and proteins[11]. Frozen shoulder is signified by pain and stiffness in the shoulder joint; limited range of motion and pain are the most common symptoms. It also known as adhesive capsulitis[2].

Diabetic frozen shoulder seems to be the commonest type. About 20% of diabetic patients develop frozen shoulder. It seems to be related to the effect that diabetes and height blood sugar has on the collagen containing cells in the body. Collagen is a protein that is involved in making ligaments, tendons and joint capsules[6].

Calcium spots in the tendons and muscles around the shoulder are also seen more commonly in diabetic patients, this probably may be due to high blood sugar that can impair blood flow through small vessels. Alternation of the periarticular connective tissue is related to changes in blood flow. It subsequently leads to increase in cross linking of collagen[6].

Many of the studies discussed previously have noted that reduction in pain occurs with ultrasound treatment, even though the treatment was given for other purposes[1].

Pain reduction following application of ultrasound has been reported in patients with lateral epicondylitis, shoulder pain, planter fasciitis, surgical wounds, bursitis, prolapsed inter vertebral disks, ankle sprains and in various other soft tissue injuries[9].

Therapeutic shock wave was first introduced into medicine over 20 years ago for treatment of kidney stones. More recently, it has been used to treat musculoskeletal conditions such as plantar fasciitis. It is a sonic pulse characterized by broad frequency spectrum from (16-20 Hz) and wave velocities ranged between (350-1000m/sec). In contrast the frequencies in ultrasound are ranged between 1-3 MHz with 1400-1600 m/sec in velocities[4].

There are three methods of shock wave generation currently in use; electro-hydraulic, electromagnetic and piezoelectric. Piezoelectric shock wave devices pass electrical current through large numbers of piezo crystals. The resulting expansion and contraction of the piezo crystals create a shock wave. The shock wave is much focused allowing for high energy density within a defined focal volume[3].

To regain the normal extensibility of shoulder capsule and tight muscular tissues, passive stretching of the shoulder capsule by means of mobilization technique has been recommended[12].

The aim of this study was to determine the effects of ultrasound and piezoelectric shock wave in diabetic frozen shoulder.

SUBJECTS, MATERIALS AND METHODS

Subjects

This study was conducted on 40 patients with diabetic frozen shoulder. They were chosen from both sexes (28 females and 12 males) with mean age 50±3.4 years. They were presented with diabetic frozen shoulder for three months and suffered from diabetes from 10±2.7 years. Before participation, all subjects were examined clinically by an internalist and orthopedist to exclude any other disorders which may alter the results. All of them did not receive any physical therapy program prior to the participation in the study.

Patients were arranged randomly into two groups (1, 2), each contained 20 patients. Group 1 (12 females - 8 male) received therapeutic piezoelectric shock wave and mobilizing exercises, while group 2 (16 females - 4 male) received ultrasound therapy with the same exercise therapy given to group 1.

Materials

For evaluation:

- X-ray (Dur 511) apparatus: For screening the shoulder joint by plain X-ray.
- Manual goniometer: For measuring range of motion of flexion, abduction and external rotation of shoulder joint.
- Visual analogue scale (VAS): For measuring pain. It is a graphic rating scale, quick and simple test completed by the patient. This scale consists of a line, usually 10 cm. in length, the extremes which are taken to represent the limits of the pain experience. One end is defined as "no pain" and the other as "severe pain".

For treatment

- Ultrasound (Phyaction 190 I): with a frequency of 3 MHz.
- Piezoelectric shock wave (Piezo LT-DX): with a frequency of 16-20 Hz.

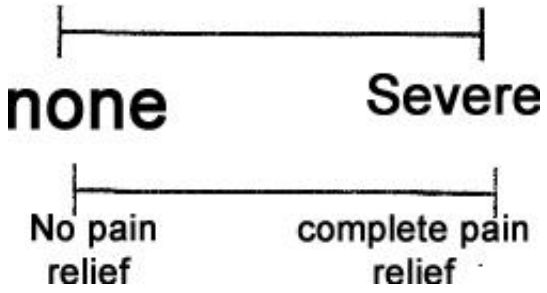
Methods

For evaluation

- Evaluation of shoulder started by using X-ray; which was taken from antro-posterior

and lateral views from standing position, to insure proper viewing of the shoulder joint.

- Evaluation of range of motion of shoulder flexion with mean 67.32±22.14º, abduction with mean 48.32±19.45º and external rotation with mean 30.52±12.7º by using manual goniometer, from sitting position.
- Evaluation of pain was done by using visual analogue scale. Each patient was asked to mark the line at a point corresponding to the severity of the pain.



This was done before and after eight weeks of treatment to determine the physiological and mechanical effects of the program.

For treatment

Patients underwent physical therapy program 3 days / week for two months, as follows:

- From sitting position, piezoelectric shock wave was applied on the shoulder joint by five continues shocks at each point around the contour of the joint.
- From the same position, the ultrasound was applied on the shoulder joint and shoulder girdle muscles for controlling pain and destruction of adhesion.
- From the same position, the mobilizing exercise was applied on the shoulder joint by putting it in available loosed pack position, applying oscillatory technique as 5-6 oscillation / cycle within the limit of pain for 20 minute.

RESULTS

The raw data of shoulder range of motion (flexion-abduction-external rotation) and level of pain were statistically treated to determine the mean and standard deviation of each measuring variable for the two groups 1 and 2, before and after eight weeks of treatment. Student's t-test was then applied to examine the significance of treatment conducted for each group.

- Level of Pain:

Comparing the mean values of pain level indicate no significant differences between the two groups 1and 2 pre treatment, (P> 0.05). Significant improvement was observed, when comparing the pre and post treatment mean values of each group. The pre and post treatment mean values for group 1 were 8.15±0.786 and 1.95±0.998, respectively (P< 0.0001), while, the pre and post treatment mean values for group 2 were 8.05±0.825 and 1.6±1.1, respectively (P< 0.0001). However, highly significant improvement was observed in group 2, when comparing the post treatment mean values of the two groups (P <0.0001), table 1 and figure 1.

- Shoulder flexion (degree):

Comparing the mean values of shoulder flexion indicate no significant differences between the two groups 1and 2 pre treatment, (P> 0.05). Significant improvement was observed, when comparing the pre and post treatment mean values of each group. The pre and post treatment mean values for group 1 were 64.25±22.09° and 158.3±2.75°, respectively (P< 0.0001), while, the pre and post treatment mean values for group 2 were 70.4±22.19° and 140.7±4.4°, respectively (P< 0.0001). However, highly significant improvement was observed in group 1, when comparing the post treatment mean values of

the two groups (P <0.0001), tables 2-3 and figures 2-3.

- Shoulder abduction (degree):

Comparing the mean values of shoulder abduction indicate no significant differences between the two groups 1and 2 pre treatment, (P> 0.05). Significant improvement was observed, when comparing the pre and post treatment mean values of each group. The pre and post treatment mean values for group 1 were 50.05±19.11° and 167.2±4.64°, respectively (P< 0.0001), while, the pre and post treatment mean values for group 2 were 46.6±19.8° and 158.9±3.7°, respectively (P< 0.0001). However, highly significant improvement was observed in group 1, when comparing the post treatment mean values of the two groups (P <0.0001), tables 2-3 and figures 2-3.

- Shoulder external rotation (degree):

Comparing the mean values of shoulder abduction indicate no significant differences between the two groups 1and 2 pre treatment, (P> 0.05). Significant improvement was observed, when comparing the pre and post treatment mean values of each group. The pre and post treatment mean values for group 1 were 31.6±12.88° and 44.1±2.1°, respectively (P< 0.0001), while, the pre and post treatment mean values for group 2 were 29.45±12.52° and 41.3±2.7°, respectively (P< 0.0001). However, highly significant improvement was observed in group 1, when comparing the post treatment mean values of the two groups (P <0.0001), tables 2-3 and figures 2-3.

Table (1): Showed the mean values of pain pre-treatment and post treatment for group 1 and 2.

Group	X±SD pre treatment	X±SD post treatment	t-value	P-value
Group 1	8.15±0.786	1.9±0.998	8.7	<0.0001
Group 2	8.05±0.825	1.6±1.1	6.2	<0.0001

Table (2): Showed the mean values of shoulder flexion, abduction and external rotation (degree) pre-treatment and post treatment for group 1.

Parameter	X±SD pre treatment	X±SD post treatment	t-value	P-value
Flexion	64.25±22.09°	158.3±2.75°	14.21	<0.0001
Abduction	50.05±19.11°	167.2±4.64°	11.71	<0.0001
Ext. rotation	31.6±12.88°	44.1±2.1°	10.97	<0.0001

Table (3): Showed the mean values of shoulder flexion, abduction and external rotation (degree) pre-treatment and post treatment for group 2.

Parameter	X±SD pre treatment	X±SD post treatment	t-value	P-value
Flexion	70.4±22.19°	140.7±4.4°	12.97	<0.0001
Abduction	46.6±19.8°	158.9±3.7°	10.04	<0.0001
Ext. rotation	29.45±12.52°	41.3±2.7°	9.7	<0.0001

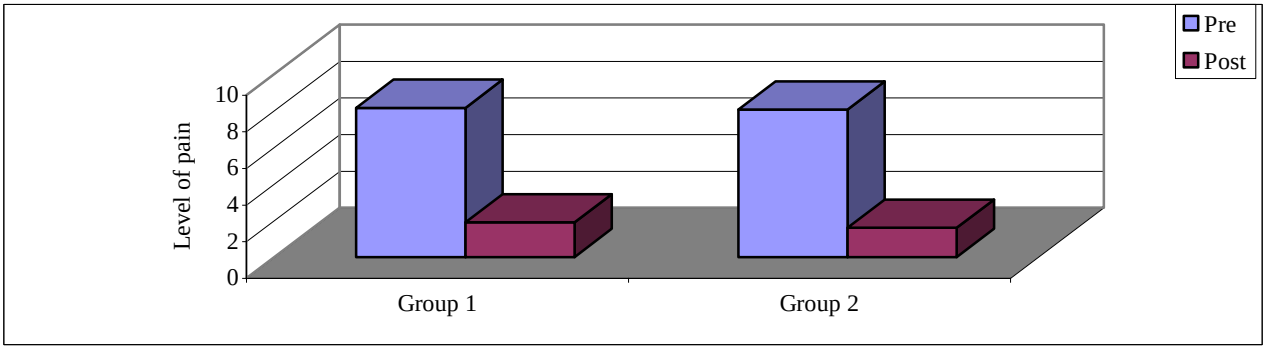


Fig. (1): Illustrates the mean values of level of pain (degree) pre treatment and post treatment for groups 1 and 2.

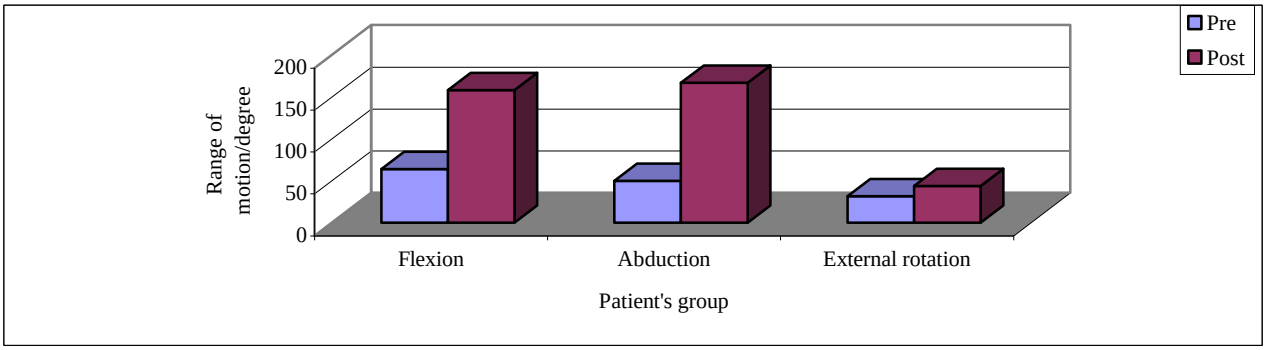


Fig. (2): Illustrates the mean values of flexion, abduction and external rotation (degree) pre treatment and post treatment for groups 1.

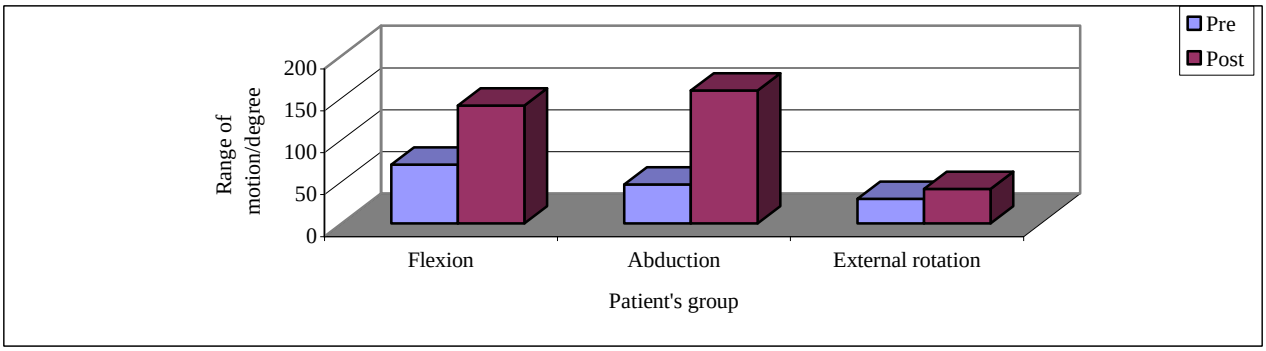


Fig. (3): Illustrates the mean values of flexion, abduction and external rotation (degree) pre treatment and post treatment for groups 1 and 2.

DISCUSSION

The aim of this study was conducted to determine the effects of ultrasound and piezoelectric shock wave in diabetic frozen shoulder.

There is little evidence to support or refute the efficacy of common interventions for shoulder pain and limitation of motion. As

well as the need for further well designed clinical trials, more researches are needed to establish a uniform method of defining shoulder disorders (frozen shoulder) and developing outcome measures which are valid, reliable, and responsive in affected people[13].

Few literatures are available concerning the effect of piezoelectric shock wave on pain as physiological parameter or on range of motion as a mechanical parameter.

The results of the current study agree with Ludger et al.,[10] who reported that, shock wave by all it's generations has a beneficial effect on shoulder functions, as well as on self rated pain and diminished size of calcifications.

Comparing the pre and post treatment results of the two groups indicated, highly statistical significant improvement in both groups regarding range of motion after receiving a condensed physical therapy program (piezoelectric shock wave with mobilization) for group 1 and (ultrasound with mobilization) for group 2. However, the highly statistical significant improvement was observed in group 1.

The findings of the results come in agreement with Grob et al.,[7] who found that about 60-80% of shoulder pain and stiffness was disappeared after application of shock wave for 1 month.

The results of the study confirm the findings of Yeim et al.,[14] who studied the effect of ultrasound on shoulder disorders. He mentioned that, ultrasound reduced the percentage of shoulder pain by about 60% when applied 5 days /week for 3 weeks.

Comparing the pre and post treatment results of pain measurement of the two groups, showed that there was highly statistical significant improvement in both groups .However, the highly statistical significant improvement was observed in group 2.

The results of the study agree with Gerold et al.,[5] who concluded that, after receiving about 24 session of ultrasound there was a great decrease in pain and greater improvement in quality of life.

Several mechanisms have been proposed that might explain this pain reduction. Ultrasound is thought to elevate the threshold for activation of free nerve endings through thermal effects. Heat produced by ultrasound in large diameter myelinated nerve fibers may reduce pain through the gating mechanism. Ultrasound may also increase nerve conduction velocity in normal nerves, creating a counter-irritant effect through thermal mechanisms[1].

About the role of intensive mobilization techniques in the treatment of adhesive capsulitis, Henricus et al.,[8] reported that, after 3 months of treatment of mobilization in adhesive capsulitis, there was increase in active range of motion in flexion, abduction and external rotation.

Conclusion

The piezoelectric shock wave with mobilization has a great effect on improvement of the active range of shoulder movements. Ultrasound with mobilization has a significant effect on reducing of pain.

REFERENCES

1- Bishop, S., Draper, D. and Knight, K.: Human tissue temperature rise during ultrasound treatment. Pad, J. Athi. Train; 39(2): 126-131, 2004.
2- Bulgen, Y., Binder, A. and Dutton, J.: Frozen shoulder, prospective clinical study. 43(3): 353-360, 1998.
3- Chen, H.S, Chen, L.M., and Huang, T.W.: Treatment of painful heel syndrome with shock wave. clin. Orth. Rel. Res; 387: 41-46, 2001.

4- Chung, B. and Wiley, P.: Extracorporeal shock wave therapy. Sports Med.; 34: 851-865, 2002.
5- Gerold, R., Celal, B. and Karl, L.: Ultrasound therapy for calcific tendonitis of the shoulder. Physiotherapy; 340:1533-1538, 1999.
6- Gordon, C.: An explanation of the frozen shoulder-diabetes connection. Diabetes; (3): 1275-1280, 2004.
7- Grob, M., Sattler, A. and Haake, M.: The value of radiotherapy in comparison with extra corporal shock wave therapy for supraspinatus tendenitis. Onkol; 178: 314-320, 2002.
8- Henricus, M., Wim, R. and Bart, J.: End range mobilization techniques in adhesive capsulitis of the shoulder joint. Phys. Med. Rehabil.; July (13): 35-59, 2000.
9- Kramer, J.: Ultrasound: evaluation of its mechanical and thermal effects. Arch. Phys. Med. Rehabil.; 65: 223-227, 1997.
10- Ludger, G., Michael, H. and Markus, M.: Extra corporal shock wave therapy for treatment of calcifying shoulder. 290(9): 2573-2580, 2003.
11- Muth, J.: Protein principles for diabetes. 1st Beatable, part one; 1: 720-755, 1998.
12- Rozing, R. and Cornelia, C.: Mobilization technique in patient with frozen shoulder. National Taiwan University Magazine. 2: 137-143, 2000.
13- Sally, G.: Systematic review of randomized controlled trials of interventions for painful shoulder. 31(16): 354-360, 1998.
14- Yien, K., Yasmine, U. and Aye, B.: Adding ultrasound in the management of soft tissue disorders of the shoulder. Phys. Ther.; 20: 136-140, 2003.

الملخص العربي

العلاج بالموجات فوق الصوتية مقابل الموجات التصادمية على تيبس الكتف السكري

تبحث هذه الدراسة تأثير الموجات التصادمية والموجات فوق الصوتية على تيبس الكتف السكري . أجريت هذه الدراسة على أربعين مريضاً ممن كان متوسط أعمارهم 50± 3.4 بوحدة العظام بمستشفى السلام الدولي بالمعادي . وقد تم تقسيمهم عشوائيا إلى مجموعتين:المجموعة الأولي (1) احتوت علي 20 مريضاً تم علاجهم باستخدام الموجات التصادمية مع تمرينات المرونة وكذلك تلقت المجموعة الثانية (2) العلاج بالموجات فوق الصوتية مع تمرينات المرونة المشابهة للمجموعة (1) لمدة شهرين بواقع ثلاث مرات أسبوعياً . وقد اشتملت القياسات التي أجريت لكل مريض قبل وبعد البرنامج العلاجي على مدى حركة الكتف في الاتجاهات المختلفة وكذلك مستوى الألم . وقد أظهرت هذه التجربة نتائج ذات دلاله إحصائية عالية عند مقارنه نتائج ما قبل وبعد البرنامج العلاجي في صورة تحسن في مدى الحركة لمفصل الكتف وكذلك في تحسن مستوى الألم لكلا من المجموعتين .ولكن التحسن الأعلى في مدى حركه مفصل الكتف كان في المجموعة الأولى (1) بينما كان معدل تحسن الألم الأعلى في المجموعة الثانية (2) . ومن هنا يتضح أن استخدام الموجات التصادمية و الموجات فوق الصوتية مع تمرينات المرونة لهم تأثير ايجابي واضح في صورة زيادة مرونة وحركه مفصل الكتف المتيبس وانخفاض مستوى الألم .