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RESEARCH ARTICLE

SHOCK WAVE THERAPY VERSUS KINESIO TAPING IN PATIENTS WITH HYPERTROPHIC SCARS

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ABSTRACT

Purpose: This study evaluated and compared the therapeutic effects of shockwave therapy (SWT) and kinesio tape on scar tonometry and modified Vancouver scar scale (MVSS) measurements in patients with post burn hypertrophic scar. **Methods:** Riester Schiötz tonometer and MVSS were used for assessment of hypertrophic scars pre and post treatments. Thirty patients of both sexes (20-40 years) complaining of post burn hypertrophic scars participated in the study. Patients were randomly allotted into two groups equivalent in number; every group consisted of 15 patients. Group A (7 males and 8 females) received Chattanooga shock wave therapy (Intelect Radial Pressure Wave), 100 impulses at 0.037 mJ/mm² /cm. Total energy applied for each impulse was 3.5 mJ, with a frequency of 4 Hz or 240 impulses/minute. The average time for each session was 5-10 minutes. Treatment was performed every two weeks for two months plus the physical therapy program. Group B (6 males and 9 females) received kinesio taping. The tape was applied to clean, degreased skin three days for 12 weeks plus the physical therapy program. Data was obtained from the two groups about scar tonometry and MVSS before starting the treatment as a pretreatment record and at the end of the eighth week of treatment as a post treatment record. **Results:** Results revealed that kinesio tape showed significant decrease in the tonometer and MVSS compared to the shock wave therapy ($p < 0.05$). **Conclusion:** The results of the current study offer preliminary support for the premise that kinesio taping could be beneficial for treatment of post burn hypertrophic scars.

INTRODUCTION

Hypertrophic scarring following surgical procedures, trauma, and especially burn is a great concern for patients and a challenging problem for clinicians (Lee *et al.*, 2020). Hypertrophic scarring is the main negative outcome following deep partial-thickness wounds and burns. These scars are unsightly, deforming and may reduce, but never totally disappear (Taghiabadi *et al.*, 2015). A hypertrophic scar caused by the excessive deposition of collagen results in an exaggerated wound healing response with a progressive increase in collagen synthesis (Choi *et al.*, 2013). These scars are usually characterized by inflammation, excessive fibroblast proliferation, and abnormal deposition of extracellular matrix proteins. Both hypertrophic scar and keloids usually develop within one to three months after an injury, trauma, or surgical incision (van der Veer *et al.*, 2009). Many therapeutic modalities have been described as pressure therapy, cryotherapy, radiotherapy, surgical excision, and even combinations of the earlier mentioned therapies (Berman *et al.*, 2006).

Shock waves have been shown to increase blood supply to the treated area. In addition, they manipulate inflammatory processes, stimulate fibroblasts to rebuild injured tissues, promote a linear pattern of healing in tendons and ligaments, decrease pain (Fioramonti *et al.*, 2012). The propagating wave increase the tissue density and, as a consequence, transmit direct mechanical perturbations to the tissue with effects on cell membrane polarization, radical formation, cell proliferation, and growth factor production (Rosso *et al.*, 2015). Kinesiotaping is a therapeutic tool developed by Japanese Chiropractor Dr. Kenzo Kase in the 1970's with the intention to alleviate pain and improve the healing in soft tissues (Kahanov, 2007).

The major aims of the tape application involved eliminating such limitations and achieving multidirectional skin motion as well as flattening the scar, reducing its color intensity and size (Karwacinska *et al.*, 2012). The purpose of this study was to evaluate and compare between the therapeutic effects of SWT and kinesio taping on scar tonometry and MVSS measurements in patients with post burn hypertrophic scar. So, this study may assist in planning an optimal and ideal treatment protocol for such cases.

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MATERIALS AND METHODS

Subjects: The current study was done on 30 subjects of both sexes (13 males and 17 females) with age 20-40 years complaining of immature post burn hypertrophic scar. Power test showed that this sample size is needed for the study (95%). Patients were randomly allocated into three equal groups. Group (A) consisted of 15 patients who received shock wave therapy. Group (B) contained 15 patients who received the kinesio tape. Both groups received the same physical therapy program (stretching and ultrasonic).

Equipment: The study equipment was divided into measuring and therapeutic equipment.

Measuring tools:

- Tonometer.
- Modified Vancouver scar scale.

Therapeutic equipment:

- Shock wave therapy.
- Kinesio taping.

Procedures: The evaluation was conducted before the beginning and after eight weeks of treatment. All study participants had a single scar site which was deemed the worse by both patient and clinician. Within this scar site, a 1 cm circle site is then selected and marked (with a stencil and marker pen) for evaluation within this area on each participant. Detailed analysis of the present hypertrophic scar including thickness, size, pigmentation, pliability, color and firmness. Medical history included drugs used and current illness. All patients were informed about the nature and the effect of the treatment and measurement devices. The patients instructed to report any side effects during management. All patients received the same medical treatment.

Measurement procedures

Scar assessment using tonometer: Riester Schiötz tonometer is a highly precise tonometer with perfect reading of the scale with red pointer. All vital parts are made of stainless steel. It includes three weights (5.5 g, 7.5 g, 10 g / 0.19 oz, 0.27 oz, 0.35 oz) and conversion table. Reliable and durable. It comes with a black deluxe case with velvet hook inserts. The tonometer was placed at the scar site and a weight of 10 gm was used. The measurements from the two groups were seen from the conversion table, collected and documented for comparison.

Scar assessment using the Modified Vancouver Scar Scale (MVSS): It included scar pigmentation (0 normal color, 1 — hypopigmentation, 2 per pigmentation), vascularity (0 — normal color, 1 — pink, 2 — pink to red, 3 — red, 4 — red to purple, 5 — purple), pliability (0 — normal, 1 — supple, 2 — yielding, 3 — firm, 4 — banding-rope tissue, 5 — contracture), and height (0 — normal/flat, 1: < 2 mm, 2: 2–5 mm, 3: > 5 mm). Total score range between 0 and 14; a score of 0 indicates normal skin. Patients in both groups were asked to complete the scale before and eight weeks after treatment. The scale data for the two groups were collected and documented for comparison.

Treatment procedures

Procedures of shock wave therapy: The patient to be treated was lightly clothed. Each subject was asked to assume a relaxed position. The patient was informed about the device and its action. The study protocol consisted of 100 impulses at 0.037 mJ/mm²/cm total energy applied for each impulse was 3.5 mJ, with a frequency of 4 Hz or 240 impulses/minute. The average time for each session was 5-10 minutes. Treatment performed every two weeks for two months (Fioramonti *et al.*, 2012).

Procedures of kinesio taping: The tape was applied on condition that the wound was completely healed. The tape was applied to clean, degreased skin. Treatment performed every three days for 12 weeks. The stretch of the tape ranged from 25% to 100% and depended on an individual evaluation. The patient was positioned in maximal muscular and fascial/skin elongation of the area of the scar. UNCUT taped in direction for pull to come in toward scar for reducing mechanical tension at scar line. The tape was anchored tape then place with 25-50% paper tension. The tape was placed in direction of desired movement of scar to assist with decreasing adhesions to underlying tissue or structures. Over lapped pieces were applied to cover entire scar area. Put clearance above scar to encourage lymph clearance if needed. Time between applications should be increased as scar responded and matured (Karwacinska *et al.*, 2012).

Data analysis: In the current study, data for scar tonometry and MVSS measures (pre and post treatment) for group A (shockwave therapy) and group B (kinesio taping) were collected and statistically analyzed using IBM SPSS Statistics version 23.0 (IBM Co., Armonk, NY, USA). Results were expressed as mean ± standard deviation (SD). Chi-square test was used to compare gender distribution between both groups. Unpaired student t-test was used to compare the mean values of age between both groups. Paired t test was conducted to compare the mean values of the two measures (pre and post treatment) for scar tonometry and MVSS within each group. Unpaired t-test was used to compare the post treatment means between both groups. Results were considered statistically significant at P-values < 0.05. A power calculation was performed for the first part of the study which was aimed at testing the reliability of a panel of objective scar measurement tools. The power calculation showed that a minimum of 30 subjects was required.

Ethical approval: The research related to human use has complied with all the relevant national regulations and institutional policies. It has followed the tenets of the declaration of Helsinki, and has been approved by the ethical committees of faculty of physical therapy, Cairo University NO.

Informed consent: Informed consent has been obtained from all individuals included in this study.

RESULTS

Subject characteristics: Thirty patients complaining of post burn hypertrophic scar completed this study. The mean values ages were 30.2 ± 1.3 and 31.5 ± 1.4 for the first and second groups respectively. They were divided into two equal groups of 15 patients. In group (A); 7 males and 8 females participated in the study.

Table 1. Comparison of subject’s characteristics among the two groups of the study

$\bar{x}\pm SD$				
	Group (A)	Group (B)	P	Sig
Age (years)	30.2 ± 1.3	31.5 ± 1.4	0.871**	NS
Males/Females	7/8	6/9	0.623**	NS

N.B: \bar{x} = mean, SD=standard deviation, **= non-significant, NS= non-significant

Table 2. Mean scartometry scores pre and post treatment application in the two groups of the study

	Group (A)	Group B
Tonometry	$\bar{x}\pm SD$	
Pre- treatment	32.1± 1.2	35.4± 1.3
Post treatment	17.6± 1.4	13.8± 1.4
DF	29	12
T value	7.014	8.025
P value	0.04	0.001
Sig.	S	S

N.B: X=mean, SD=standard deviation, MD= mean deviation P value=level of significance. *=significant.

Table 3. Mean MVSS scores pre and post treatment application in the two groups of the study

	Group (A)	Group B
MVSS	$\bar{x}\pm SD$	
Pre- treatment	7.5± 2.4	7.5± 1.4
Post treatment	2.6± 1.2	1.5± 1.1
DF	5	6
T value	9.015	6.015
P value	0.02*	0.002*
Sig.	S	S

N.B: X=mean, SD=standard deviation, MD= mean deviation P value=level of significance *=significant.

Table 4. Comparison between post treatment mean values of scar tonometry and MVSS among the two groups using unpaired t test

	Group	Mean ±SD	S.E mean	DF	t-value	P-value	Sig
Scar tonometry	Group A	17.6± 1.4	0.35	9	7.025	0.001 < 0.05	H. S
	Group B	13.8± 1.4	0.26				
MVSS	Group A	2.6± 1.2	0.52	2	8.015	0.001	H. S
	Group B	1.5± 1.1	0.3				

N.B: X=mean, SD=standard deviation, MD= mean deviation P value=level of significance *=significant.

In group (B), there were 6males and 8females. All groups were homogeneous with no statistically significant difference between them regarding age and sex.

Results regarding tonometry: For group A, there was significant reduction in scar tonometer scores in post treatment values compared with the pretreatment values (P-value < 0.05). For group B, there was significant reduction in scar tonometer scores in post treatment values compared with the pretreatment values (P-value < 0.05). Comparison of post treatment values between both groups showed a statistically high significant reduction in group B (kinesio taping) post treatment scar tonometry mean values compared with group A (shockwave therapy) (P-value < 0.05).

Results regarding MVSS: For group A, there was significant reduction in scar MVSS scores in post treatment values compared with the pretreatment values (P-value < 0.05). For group B, there was significant reduction in scar MVSS scores in post treatment values compared with the pretreatment values

(P-value < 0.05). Comparison of post treatment values between both groups showed a statistically high significant reduction in group B (kinesio taping) post treatment scar MVSS mean values compared with group A (shockwave therapy) (P-value < 0.05).tables 1,2,3, and 4 represent the statistical results of the study.

DISCUSSION

The current study was carried out to examine the effect of applying shock waves therapy and kinesio taping on tonometry and MVSS in patients with post burn hypertrophic scar. Kinesio tape showed significant decrease in the tonometer and MVSS scores (p < 0.05) in comparison with SWT. Up to the knowledge of the author, no previous researches compared the effects of shockwave therapy and kinesio taping in patients with post burn hypertrophic scar. These findings are consistent with the following previous studies which reported that kinesio taping is beneficial in treating the post burn hypertrophic scar. Moortgat *et al.* (2015) evaluated the therapeutic efficacy of kinesio tape (KT) and deep friction massage using ultrasonography and modified Vancouver scar scale (MVSS). The comparison of scar thickness values between the two groups after eight weeks of treatment revealed significant difference in favor of the kinesio taping group compared with deep friction massage group.

The kinesio taping group had a percentage of improvement of 34.64 % after eight weeks of treatment while the improvement of deep friction massage group was 14.71%. Atkinson *et al.* (2005) studied seventy patients who had undergone cesarean section. Patients in the control group received no postoperative intervention. Patients in the treatment group applied paper tape to their scars for 12 weeks.

Scars were assessed at six weeks, 12 weeks, and six months after surgery using ultrasound to measure intradermal scar volume. Scars were also assessed using the international clinical recommendations. Paper tape significantly decreased scar volume by a mean of 0.16 cm, (95 per-cent confidence interval, 0.00 to 0.29 cm). In the treatment group, one patient developed a hypertrophic scar and four developed stretched scars only after the tape was removed. The odds of developing a hypertrophic scar were 13.6 times greater in the control than in the treatment group (95 percent confidence interval, 3.6 to 66.9). Daya (2011) reported that post burn scar undergone some form of modulation in response to the taping. Thickness of the scar was 1-12 mm before treatment. Twenty-nine (96%) scars demonstrated a decrease with a range of 20 % to 75 %, a mean of 39 %. One scar demonstrated an increase of 60 %. Twelve (29%) scars demonstrated no changes. The average percentage reduction for the entire series was 25.5% (n=42) with a standard deviation of 25.8% and a range of +60% to -75%. This represented a highly statistically significant overall decrease (p<0.001).

Goodridge (2011) presented an ease report ideating the effectiveness of kinesiio taping. The study involved the application of kinesiio taping to manage a hypertrophic abdominal scar resulting from three surgeries. Treatment reduced the height of this scar to 2 mm, effected a change in the scar pigmentation, improved pliability and motor functions, and significantly reduced pain. Karwacinska *et al.* (2012) in their study group, 37 patients declared that the application of kinesiio taping improved the cosmetic outcome and perception of the scar after three weeks; 10 patients who had undergone treatment observed such changes after six weeks; five patients indicated positive results after nine weeks, and two patients after 12 weeks. On the basis of the questionnaire results, personal observations and taken measurements, it can be concluded that the application of kinesiio taping is effective for hypertrophic scar, keloid and contracture scar.

Moortgat *et al.* (2016) examined the effect of kinesiio taping on minimizing scar tension. Twenty patients showed a statistically significant difference in the scores for dispensability before tape application ($M=0.63$, $SD=0.23$) and after tape application ($M=0.93$, $SD=0.25$); $t(19) = -6.969$, $p = .000$. This corresponds to a reduction of tension in the middle of the scar site with 47%. Applying kinesiio taping around the surface of the scar and thus altering mechanical forces on the skin is a newly developed therapy to reduce tension on burn scars and can therefore decrease post burn hypertrophic scar. Mahmoud *et al.* (2016) carried out a study on 40 adult patients suffering from scar contractures which caused immature hypertrophic scar in different areas of body as a result of burn injuries. Patients were randomly assigned into two equal groups. Group A received extracorporeal shock wave therapy (ESWT) and traditional physical therapy program (deep friction massage and stretching exercises) and group B received traditional physical therapy program. The assessment approaches were: ultrasonographic measurement of scar thickness and macroscopic evaluation according MVSS. Patients underwent sessions of extracorporeal shock wave therapy twice a week for six weeks. There was a significant decrease in the scar thickness in the study group post treatment compared with pretreatment ($p = 0.0001$).

While there was a significant decrease in scar thickness in group A post treatment compared to that of group B ($p = 0.0001$). Laura *et al.* (2009) compared between the effects of different doses of extracorporeal shock wave therapy on normal fibroblast proliferation in vitro. one hour after the shock-wave treatment, the cell viability showed an apparent decrease related both to the energy and the number of impulses applied: a constant decrease was observed in relation to the number of impulses (300, 1,000, 2,000) with a maximum reduction in viability at 2,000 impulses (viability 18%) while there was no statistically significant association between energy levels (0.11 and 0.22 mJ/mm^2) and fibroblast viability. The authors concluded that shock waves had a dose-dependent destructive effect on cells in suspension, but they also seemed to have a dose-dependent stimulatory effect on cell proliferation. Extracorporeal shock wave therapy of 500 and 1000 shots elicited inhibitory effects on tendinitis repair and during evaluation of the effect of various extracorporeal shock wave therapy treatment schedules on the healing of collagenase-induced Achilles tendinitis and investigation of biochemical and biomechanical properties of healing tendons; Rats with the collagenase-induced Achilles tendinitis were given a single ESW treatment at 0.16 mJ/mm^2 energy flux

density, with different number of shots. Low number (200) of impulses restored biomechanical and biochemical characteristics of healing tendons 12 weeks after treatment, while 500 and 1000 shots elicited inhibitory effects (Chen *et al.*, 2004). Experimental study with extracorporeal shock wave therapy was performed in 16 patients with post burn scars contractures, hypertrophic scars, or keloids twice a week for six weeks. After the first session, scars appeared more pliable, and color mismatch was less evident. At the end of the study period, patients reported that scars were less painful, less stiff, and thinner. Scar color became more similar to that of the surrounding skin and the texture less firm; the overall appearance was improved, and the patients considered their experience to be more acceptable. Movement also became less impaired. According to the VSS, scar appearance improved 3 points for three patients (18.75%), 2 points for eight patients (50%), 1 point for two patients (12.5%), and 0 points for three patients (18.75%). Finally, the author concluded that extracorporeal shock wave therapy is a feasible and cost-effective treatment in the management of post burn pathologic scars (Paolo *et al.*, 2012).

CONCLUSION

The kinesiio taping reduced the scar tonometry and MVSS measures in patients with post burn hypertrophic scar in comparison with SWT. So, these results suggest that kinesiio taping could be a useful therapeutic modality and assists in the rehabilitation process by helping the physiotherapists to know which type of treatment modality would be more beneficial in treating patients with post burn hypertrophic scar. Therefore, it could provide knowledge regarding improving functions and consequently providing a good work and daily living performance of those patients.

LIMITATIONS

Disclosure statement: No author has any financial interest or received any financial benefit from this research.

Conflict of interest: The authors state no conflict of interest.

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