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Microporous Tape and Post Surgical Scars

Hagar Mohammed Hashem El Garahy*[1], Mohamed Mahmoud Khalaf[2], Shadi Awny[3], Dina Mahmoud Nabeeh[4], Karim Ibrahim Saafan[2,5]

[1*]Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Must University, Giza, Egypt.

[2]Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Cairo University, Giza, Egypt.

[3]Department of Surgical Oncology, Faculty of Medicine, Mansoura University, Mansoura, Egypt.

[4]Department of Physical Therapy for Surgery and Integumentary system, Faculty of Physical Therapy, Benha University, Benha, Egypt.

[5]Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Horus University, New Damietta, Egypt.

***Corresponding Author:**

Hagar Mohammed Hashem El garahy

[1*]Department of Physical Therapy for Surgery, Faculty of Physical Therapy, Must University, Giza, Egypt.

Email ID: gegemouhmed@gmail.com

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ABSTRACT

Background: Post-surgical hypertrophic scars (HTS) are a common complication following surgical procedures, often leading to aesthetic concerns, functional impairments, and patient dissatisfaction. Various scar management techniques have been explored, but microporous tape has emerged as a simple, cost-effective, and non-invasive intervention that may reduce scar severity by minimizing mechanical tension and maintaining an optimal wound-healing environment.

Aim of the study: This study aimed to evaluate the effectiveness of microporous tape in improving scar characteristics and scar pliability in patients with post-surgical hypertrophic scars.

Subjects and Methods: A randomized controlled trial was conducted with Forty Four patients (19 Males and 25 Females) with post-surgical HTS were selected from AGA hospital and randomly distributed into two equal groups.Group A (Microporous tape group) received Microporous tape in addition to traditional physiotherapy (Deep friction massage and stretching exercises).Group B (Control group) received traditional physiotherapy (deep friction massage and stretching exercises). The treatment was given 3 sessions per week for eight weeks.

Outcome measures: They were assessed with Modified Vancouver Scar Scale (VSS) for scar severity and A Schiotz tonometer device for scar pliability. All measures were taken before and after 8 weeks. In Group A, microporous tape was applied directly over the scar and worn continuously for the duration of the study.

Results: Statistical analysis revealed that Group A demonstrated significantly greater improvements in VSS scores ($p = 0.001$) and scar pliability ($p = 0.001$) compared to Group B. Scar remodeling was improved in the microporous tape group due to reduced stiffness, which is associated with better collagen organization and regulation of fibroblast activity.

Conclusion: Microporous tape is an effective additional treatment for hypertrophic scars that develop after surgery, according to the results. It shows promise as an alternative to conventional scar care methods due to its ability to decrease scar tension, increase scar pliability, and improve scar aesthetics. Microporous tape is a suitable addition to post-operative care procedures because it is inexpensive and simple to apply. Additional studies should be conducted to investigate the effects over the long term and to compare it to other scar-modulating treatments.

Keywords: *Microporous tape, post-surgical hypertrophic scars, Vancouver Scar Scale, Scar pliability,and Schiotz tonometer*

1. INTRODUCTION

A scar is a visible mark left on the skin following the healing of a wound. Scarring is a natural consequence of the body's repair process and occurs following any surgical incision(1). While some scars heal as thin, inconspicuous lines, others may develop into hypertrophic scars or keloids, leading to cosmetic and functional concerns (1)

Several factors, including mechanical forces such tension inside the wound site, can cause scar development (2). Studies on animals and human clinical trials have revealed that injuries under excessive stress generate more scar tissue. Normal scars tend to be thin and flat, integrate in with the skin, have minimal fibrosis, and do not distort the neighboring tissues.

Scars, however, might be seen as abnormal when they result from either too little tissue remodeling or too much fibrosis throughout the healing process. These scars could cause patients physical pain, psychological stress, and functional limitations. The greater mechanical stress that happens during the healing phase is one key factor in the transition from a normal scar into a hypertrophic scar (2). Preventing scarring that is less than acceptable and lowering stress indicate for additional support for the scar, which can be most efficiently accomplished via taping methods(2).

Hypertrophic scars create many problems including cosmetic look, pain, itching, functional impairment, in addition to psychological stress (3). They might also create significant financial pressure given the possible high cost of therapy. These scars can also produce contractures in muscles along with connective tissue, which could limit mobility (4). Effective scar treatment is required to solve these problems and improve patient results (5).

Research indicates that collagen creation in hypertrophic scars is approximately seven times higher compared with normal healing (6), suggesting a link between an excess of collagen and the pathophysiology generating hypertrophic scarring. Usually taking three weeks to six months, scar maturation or remodeling—the third stage of wound healing—can last for years in certain situations (6). There is too much fibrosis at this time. Contractures brought on by hypertrophic scarring might result in a restricted range of motion (ROM).

Hypertrophic scars as well as keloids are both caused by fibrous tissue that has grown beyond the original wound borders(4).

Following burns and other skin damage, hypertrophic scarring is frequently seen (7). Physicians are primarily concerned with scar prevention and elimination since the degree of scarring after surgery or injury is frequently unknown. Considering the effect on patient satisfaction and quality of life, even subtle reductions in scar appearance can have a major influence on clinical significance(8).

Recent studies suggest that taping techniques can play a role in scar management by reducing mechanical stress on healing wounds. Applying tape directly over the scar has been found to decrease tension, thus modulating scar formation (9). Various types of non-stretch tapes have demonstrated effectiveness in preventing excessive scarring by minimizing scar height, discoloration, and itchiness(9). Paper tapes, in particular, have shown benefits when applied during the wound remodeling phase, as well as on mature scars, with improvements in color, thickness, and pliability being reported. Additionally, early research has indicated that high-stretch elastic tapes may aid in scar management during the remodeling phase of wound healing(10).

To the best of the authors' knowledge, limited research has specifically examined the effectiveness of microporous tape in preventing post-surgical hypertrophic scars. While previous studies have explored various scar management techniques, the role of microporous tape in modulating scar formation remains underinvestigated. Given the importance of minimizing excessive fibrosis and optimizing wound healing, it is essential to evaluate the potential benefits of microporous tape as a simple, non-invasive, and cost-effective intervention. It was hypothesized that microporous tape would reduce mechanical tension, support tissue remodeling, and improve overall scar outcomes. Therefore, this study aimed to assess the impact of microporous tape on the prevention of post-surgical hypertrophic scars.

2. METHODS

2.1 Study Design

The study was a two-armed, single-blind (assessor), parallel-group, randomized controlled trial. Randomization was conducted using a computer-generated sequence to eliminate selection bias, with allocation to the two treatment groups concealed using sealed, opaque envelopes. Participants were sequentially assigned to one of two groups: **Group A**, which received **microporous tape in addition to traditional physiotherapy** (deep friction massage and stretching exercises), and **Group B**, which received **only traditional physiotherapy** (deep friction massage and stretching exercises). A blinded assessor, who was not involved in the randomization process or treatment administration, conducted baseline and post-treatment assessments to ensure unbiased outcome measurements. The treatment intervention began following the first week of the randomization process. To maintain methodological rigor, the trial followed the **CONSORT**guidelines for randomized controlled trials, and all personnel involved were trained in standardized assessment and intervention protocols.

2.2 Ethical approval and patient consent

The study was approved by the Institutional Ethical Committee (Approval Code: [P.T.REC/012/004942]to ensure adherence to ethical standards, including patient safety and informed consent. It was also retrospectively registered in the Clinical Trial Registry (Registration Number: [NCT06768047]Prior to participation, all patients provided written informed consent after receiving a detailed explanation of the study's procedures, potential risks, and expected benefits, ensuring their voluntary participation and understanding of the intervention.

2.3Participants

Participants were recruited from AGA Hospital, where they were screened based on specific inclusion and exclusion criteria. Eligible participants included Forty Four patients (19 Males and 25 Females) with post-surgical HTS were selected from AGA hospital and randomly distributed into two equal groupsaged between 20 and 45 years, participants in this study had completely healed post-surgical hypertrophic scars following surgical procedures. The scars Were between 5 to 7 cm² to ensure uniformity in treatment outcomes.The exclusion criteria were designed to eliminate confounding factors that could impact scar healing or treatment response. Patients were excluded if they had infected post-operative wounds, wounds closed by secondary intention, a history of keloid formation, uncontrolled diabetes mellitus, uncontrolled hypertension, deep venous thrombosis (DVT), or hypersensitivity reactions to microporous tape. Patients who refused to participate or declined to provide written informed consent were also excluded.A total of 60 patients were initially screened for eligibility as shown in the flow chart (figure 1). After applying the inclusion and exclusion criteria, 44 patients met the eligibility requirements and were randomly assigned to one of the two treatment groups using a computer-generated randomization sequence, with 22 participants in each group. The study was conducted between July 2024 and October 2024 at AGA Hospital, Egypt.

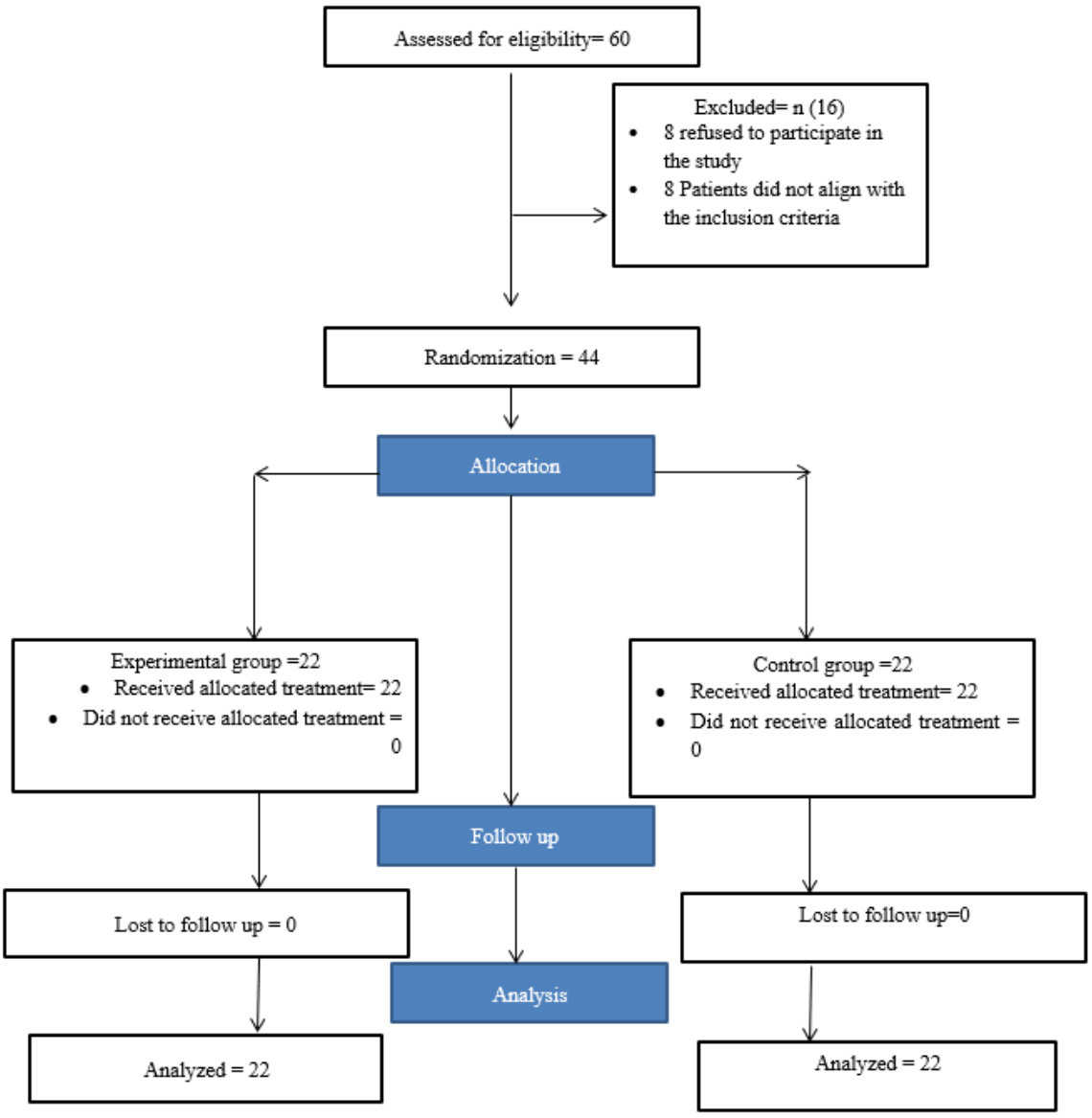

Figure 1; Randomization flow chart

2.4 Outcome Measures

The primary outcome measures for this study were scar characteristics assessed using the Modified Vancouver Scar Scale (VSS) and scar pliability measured with a Schiotz tonometer device. The VSS evaluated four scar parameters: vascularity, pigmentation, pliability, and height, with scores ranging from 0 to 13, where higher scores indicated worse scar severity. Scar pliability was objectively measured using the Schiotz tonometer, which assessed scar stiffness by applying specific pressure, with lower readings in mmHg indicating improved pliability and softer scar tissue. All measurements were recorded at baseline (pre-treatment) and after the eight-week intervention period to determine the effectiveness of microporous tape in modulating scar characteristics and improving pliability in post-surgical hypertrophic scars.

2.5Statistical analysis

Unpaired t-test was conducted for comparison of age between groups. Chi-squared test was conducted for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups.Unpaired t test was conducted for comparison of VSS and scar pliability between groups and paired t test was conducted for comparison between pre and post treatment. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

3. RESULTS

-Subject characteristics:

Forty-four patients with post surgical hypertrophic scar participated in this study. Table (1) shows the subject characteristics of group A and B. There was no significance difference between groups in age and sex distribution ($p > 0.05$).

Table 1. Comparison of subject characteristics between group A and B:

	Group A	Group B			
	Mean±SD	**Mean±SD**	**MD**	**t- value**	**p-value**
Age (years)	39.32 ± 6.63	40.50 ± 4.16	-1.18	-0.71	0.48
Sex, n (%)					
Female	13 (59%)	12 (54.5%)		($\chi^2 = 0.09$)	0.76
Male	9 (41%)	10 (45.5%)			

SD, Standard deviation; MD, Mean difference; χ2, Chi squared value; p value, Probability value

Effect of treatment on VSS and scar pliability:

Within group comparison

There was a significant decrease in VSS and improvement in scar pliabilitypost treatment in both groups compared with that pretreatment ($p < 0.001$). The percent of change in VSS and improvement of scar pliability in group A was 48.17 and 42% respectively, and that in group B was 17.62 and 9.56% respectively. (Table 2).

Between group comparison

There was no significant difference between groups pre treatment ($p > 0.05$). Comparison between groups post treatment revealed a significant decrease in VSS and improvement in scar pliability of group Acompared with that of group B ($p < 0.01$).(Table 2).

Table 2. Mean VSS and scar pliability pre and post treatment of group A and B:

	Pre treatment	Post treatment				
	Mean±SD	**Mean±SD**	**MD**	**% of change**	**t- value**	**p value**
VSS						

Group A	10.09 ± 0.75	5.23 ± 0.61	4.86	48.17	25.66	0.001
Group B	9.82 ± 0.59	8.09 ± 0.81	1.73	17.62	9.18	0.001
MD	0.27	-2.86				
t- value	1.34	-13.22				
	p = 0.19	***p = 0.001***				
Scar pliability (mmHg)						
Group A	15.69 ± 2.73	9.10 ± 2.20	6.59	42.00	18.56	0.001
Group B	16.01 ± 2.49	14.48 ± 2.09	1.53	9.56	4.78	0.001
MD	-0.32	-5.38				
t- value	-0.40	-8.33				
	p = 0.69	***p = 0.001***				

SD**,** Standard deviation; MD, Mean difference; p value, Probability value

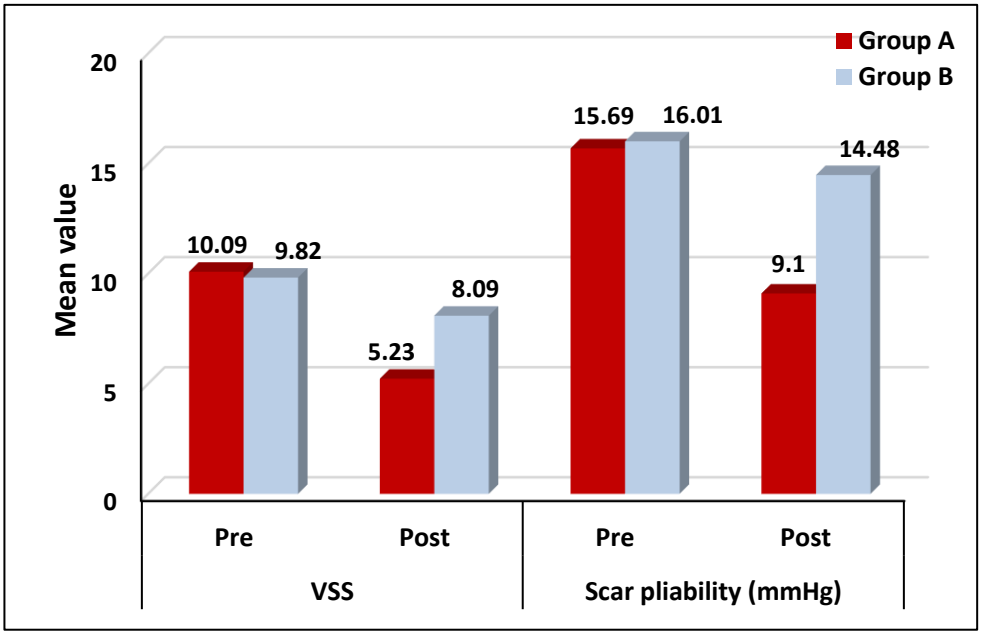

Figure 2. Mean VSS and scar pliability pre and post treatment of group A and B.

4. DISCUSSION

The findings of this study had significant clinical implications for the management of hypertrophic scars following surgical procedures. Hypertrophic scarring is a common complication of surgery, particularly in areas of high tension or where the skin has been subjected to significant trauma. These scars are not only aesthetically displeasing but can also lead to functional impairments, such as restricted movement and discomfort, which can significantly impact a patient's quality of life. So it is essential to have efficient management measures for scar prevention and treatment.

The study found that scar outcomes were greatly improved with adding the use of microporous tape to traditional physiotherapy. Scar pliability was improved as well as the Vancouver Scar Scale (VSS) scores were shown to decrease significantly.

The scar pliability of both groups was evaluated prior to the intervention. This is an important component in deciding the functional along with aesthetic results of scar medication. Scar pliability was 15.69 ± 2.73 mmHg in Group A and 16.01 ± 2.49 mmHg in Group B. A p-value of 0.69 indicates that there was no statistically significant difference among the groups

pre-treatment, as the mean difference among the two groups was -0.32 mmHg. This provided more evidence that the scar pliability of the two groups was similar before treatment, which strengthened the argument that any variations seen after treatment were due to the intervention itself and not to any inherent differences.

Randomized controlled trials adhere to the concepts of minimizing baseline discrepancies among groups, which is supported by the lack of a substantial difference pre-treatment. This parity is vital because it proves that the intervention, and not pre-existing problems, is responsible for the observed results after treatment.

Although scar pliability improved significantly in both groups following the surgery favoring Group A. Group A's mean scar pliability after treatment was 9.10 ± 2.20 mmHg, which is a 42% decrease from the value before treatment. Group B, on the other hand, showed a mere 9.56% decrease in scar pliability after treatment, with an average of 14.48 ± 2.09 mmHg. There was a 5 mmHg difference in scar pliability increase among the two groups, which was statistically significant ($p=0.001$). The results show that the intervention had a far greater impact on scar pliability in Group A.

Numerous mechanisms are probably involved in the positive effects of microporous tape. The first step in treating hypertrophic scarring is using microporous tape, which gently applies mechanical support to the incision while it heals. This may aid in scar flattening and avoid the over-deposition of collagen. Scar tissue is believed to undergo fibroblast activity modulation in response to mechanical tension, which in turn reduces collagen formation and promotes more ordered fiber alignment (9). Consistent with (11), which emphasized the significance of mechanical compression in lowering scar hypertrophy, the preceding findings were encouraging. Microporous tape's gentle compressive force has the potential to regulate fibroblast activity, which in turn may decrease collagen production and increase collagen fiber organization(11).

Additionally, the tape aids in keeping the wound moist, which is recognized to promote epithelialization and decrease the possibility of scar hypertrophy. Scar treatment benefits from moist wound healing because it speeds up the healing process, promotes autolytic debridement, and reduces the inflammatory response (12). Consistent with earlier studies (13), this one shows that keeping the area moist improves scar outcomes via facilitating better cellular migration and decreasing the probability of hypertrophic scarring.

Additionally, microporous tape may lessen exposure to irritants as well as mechanical stress, which may increase inflammation and lead to aberrant scar development, by forming a protective barrier. Hypertrophic scars are largely caused by chronic inflammation; therefore, treatments that reduce inflammation are anticipated to have a positive effect on scar outcomes (14). Lastly, pruritus (itching) and pain are common complaints among patients having hypertrophic scars. Scratching just makes things worse. Patients may feel more comfortable and be more likely to follow scar management procedures if they use microporous tape, which protects the scar from outside irritants and reduces friction while worn (15). This conclusion is corroborated by (16), who pointed out that treatments that alleviate scar itching are vital for increasing patient adherence and final results. Scar care regimens are more likely to be adhered to by patients when using microporous tape because of its function in reducing discomfort.

On par with other well-known techniques including pressure garments in along with silicone gel sheeting, the study indicated that microporous tape significantly enhanced scar treatment.

Silicone gel sheeting is among the most efficient treatments for hypertrophic scars. This occlusive therapy softly pushes down on scars, just like microporous tape does to maintain wounds moist. Research indicates that silicone gel sheeting can significantly reduce scar thickness and significantly improve pliability (13). Particularly with regard to VSS scores and pliability, this study indicated that microporous tape was as effective as silicone gel in improving scar results. Though silicone gel has been around longer, microporous tape is equally as effective. Moreover, the tape's capacity to stay in place for lengthy periods and its simplicity of usage could make it more practical than silicone gel sheets (13)

Constant pressure is provided by pressure garments, hence their use is another frequent method for preventing and treating hypertrophic scars. This approach tremendously helps burn patients as it causes flattening and softening of scar tissue. Patients may find pressure garments difficult to wear, and they may lower their compliance (17). Findings of this study indicate that microporous tape delivers a comparable compressive effect while adding convenience, especially in areas where clothing might not be available. Microporous tape may be a better option than pressure garments for people who have pain or trouble utilizing them because of the considerable decrease in VSS scores and enhancement of pliability.

Additional treatments that are frequently utilized to enhance scar pliability include laser therapy and injections of corticosteroids. These treatments address the underlying scar tissue, which significantly decreased scar thickness and enhance pliability, according to research (17). However, there is a risk of increased cost, more invasiveness, and adverse effects with these methods. Less invasive procedures, such as the one studied here, may provide a safer, more cost-effective option with comparable advantages in regard to scar pliability, given the notable improvement seen in Group A.

Based on the findings of this study, microporous tape could be incorporated into post-operative care regimens for patients who are at high risk for getting hypertrophic scars. It is easy to apply and effective. Hypertrophic scarring is more common in patients with darker skin, those having surgeries on high-tension areas (like the sternum, shoulders, or knees), along with individuals who have a history of having hypertrophic scarring.

Microporous tape has the ability to heal a wide variety of wounds, not limited to those caused by surgery but also by trauma, burns, and other similar conditions. The advantages shown in this study imply that microporous tape could potentially lessen the occurrence of severe scarring in these other situations as well. This is in line with the results of the study (18), which highlighted the significance of rapid and efficient scar treatment in avoiding hypertrophic scars in burn victims. Hypertrophic scars can form on a wide range of wound types; however, by using microporous tape early on in the healing process, this risk can be reduced (18).

Microporous tape has several benefits, one of which is that it is more affordable than other scar control treatments. Despite their effectiveness, silicone gel sheeting as well as pressure garments can be quite costly and difficult for patients to constantly wear. In contrast, microporous tape is cheap, simple to apply, and undetectable when worn beneath clothes. The effectiveness of any scar management program depends on patient compliance, and this improves it. Consistent with previous research, this study found that patients are more likely to follow through with treatments if they are simple and easy to incorporate into their everyday lives(19).

It appears that the intervention used—probably microporous tape in combination with traditional physiotherapy—provides a better method for controlling hypertrophic scars than traditional physical therapy alone, based on the significant increases in scar pliability seen in Group A. This study's results corroborate those of previous research showing that scar treatments that include compression and moisture retention have a positive effect.

Significant clinical implications arise from these findings. For patients who are at risk of hypertrophic scars, the intervention that was employed in Group A could be suggested as a standard part of post-operative treatment. This approach is appealing to patients and healthcare practitioners together due to its non-invasiveness, low cost, and convenience of use. Additional research into the treatment's potential long-term effects and comparisons to other well-established scar care methods could be conducted in the future.

Although these results show promise, there were some limitations to this study. There was no way to evaluate scar remodeling over the long term due to the brief follow-up period and the limited sample size, both of which limit the results' generalizability. To assess the long-term efficacy of microporous tape in the treatment of hypertrophic scars, future research should use bigger samples and longer follow-up periods**.**

5. CLINICAL IMPLICATIONS

Patients who are susceptible of hypertrophic scarring after surgery should have microporous tape included in their postoperative scar care programs because of its efficacy, cost, and ease of use. Potentially increasing patient satisfaction as well as treatment adherence, it offers a practical substitute for or supplement to a more costly scar treatment.

6. CONCLUSION

According to the results of this study, microporous tape can effectively and non-invasively treat hypertrophic scars that have developed after surgery. It may be a practical and cost-effective alternative in clinical settings due to its capacity to lessen scar severity and increase pliability. To determine its effectiveness in comparison to other well-established scar treatment techniques and to investigate its long-term consequences, additional research is necessary.

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