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The Analysis Study of Management and Outcome of Post-Surgical Scar after Plastic Surgery: A Comprehensive Systematic Review

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ABSTRACT

Background: Scarring is a common medical problem that afects patients cosmetically and can cause functional impairment and psychosocial burdens. Hypertrophic scars and keloids frequently develop afer surgical procedures. Te incidence of hypertrophic scars afer a surgical procedure is estimated to be 40–70% without adequate management, and they can signifcantly impair quality of life. **The aim:** The aim of this study to show about management and outcome of post-surgical scar after plastic surgery. **Methods:** By the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. This search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed, SagePub, and Sciencedirect were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done. **Result:** Eight publications were found to be directly related to our ongoing systematic examination after a rigorous three-level screening approach. Subsequently, a comprehensive analysis of the complete text was conducted, and additional scrutiny was given to these articles. **Conclusion:** There is a large unmet need for innovative therapeutic strategies to prevent cutaneous scarring after surgery. Despite the substantial healthcare burden of skin fibrosis, there is no “gold standard” or universally effective scar therapy, and current treatment options have limited clinical efficacy and durability. The prevention of scar development should also be included in every surgical procedure. The consideration of relaxed skin tension lines and by a traumatic intraoperative approach will have good effects on wound healing.

Keyword: Scar, post-surgical, management, surgery.

INTRODUCTION

The past decade has seen a remarkable growth in our understanding of how hypertrophic scars and keloids develop and progress. Consequently, hypertrophic scars and keloids are now known to be caused by chronic inflammation in the reticular dermis. Risk factors associated with hypertrophic scar and keloid development and aggravation have been identified, thereby aiding treatment optimization and effectiveness. Several major advancements in preventing and treating hypertrophic scars and keloids have been made, as follows. First, deprodone propionate (a stronger steroid) plaster was found to both prevent and treat hypertrophic scars and keloids very effectively. Second, surgical methods have been optimized for each body region, thereby improving cosmetic and functional outcome, safety, and recurrence rates. Third, the postoperative radiotherapy protocol has been fine-tuned, making it safer while remaining equally effective.[1]

Scars are especially likely to occur after a deep wound which extends through the dermis into the subdermal tissue. They occur with equal frequency in men and women, although injuries in adolescents and young adults generally produce worse scarring compared with those in elderly people. Hypertrophic scars and keloids frequently occur in areas of the body that are subject to stretching tension, such as the deltoid, sternal and suprapubic regions and the lower abdomen. Furthermore, people with pigmented skin are more likely to develop keloids compared to those with white skin. Hypertrophic scars and keloids are not only physically disfiguring and psychologically distressing, but they also can cause significant pain and itching.[2]

Immediate priorities for scar prevention include rapid wound closure, early debridement of dead tissue, measures to prevent or treat inflammation and infection, and provision of adequate wound dressings to establish a moist wound healing environment. The amount of preventive measures that should be applied to a newly formed wound depends on the individual patient's risk factors for scar formation (e.g., type and location of wound, age and skin type) and the level of aesthetic concern the patient has about scar formation.[2,3]

Dermatologists now have many different treatment options for the prevention and treatment of scars. These include non-invasive treatments such as silicone sheets or gels, tape, compression therapy and physiotherapy, as well as invasive treatments such as

intralesional corticosteroid injections, 5- fluorouracil injections, cryotherapy, radiotherapy and laser therapy. These treatments can be used alone or as part of combination therapies. Patients often present to dermatologists once they have a maturing or matured hypertrophic scar or keloid. In many cases, earlier consultation with a dermatologist may be more effective, since scars are often easier to prevent than to treat.[2]

METHODS

Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

Criteria for Eligibility

For the purpose of this literature review, we compare and contrast management and outcome of post-surgical scar after plastic surgery. It is possible to accomplish this by researching of the management and outcome of post-surgical scar after plastic surgery. As the primary purpose of this piece of writing, demonstrating the relevance of the difficulties that have been identified will take place throughout its entirety.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English, and it needs to determine about the management and outcome of post-surgical scar after plastic surgery. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2014, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

Search Strategy

We used " management and outcome of post-surgical scar after plastic surgery.” as keywords. The search for studies to be included in the systematic review was carried out using the PubMed, SagePub, and Sciencedirect databases.

Table 1. Search Strategy

Database	**Search Strategy**	***Hits***
Pubmed	*((*"Surgery*"[MeSH Subheading] OR* "Plastic surgery*"[All Fields] OR* "Post-surgical scar*” [All Fields]) AND (*"Management*"[All Fields] OR "* Treatment*"[All Fields]) AND (*"Outcome*"[All Fields]) OR (*"Prognosis*” [All Fields]))*	8136
Science Direct	*((*"Surgery*"[MeSH Subheading] OR* "Plastic surgery*"[All Fields] OR* "Post-surgical scar*” [All Fields]) AND (*"Management*"[All Fields] OR "* Treatment*"[All Fields]) AND (*"Outcome*"[All Fields]) OR (*"Prognosis*” [All Fields]))*	12115
Sagepub	*((*"Surgery*"[MeSH Subheading] OR* "Plastic surgery*"[All Fields] OR* "Post-surgical scar*” [All Fields]) AND (*"Management*"[All Fields] OR "* Treatment*"[All Fields]) AND (*"Outcome*"[All Fields]) OR (*"Prognosis*” [All Fields]))*	164

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and cannot have been seen anywhere else.

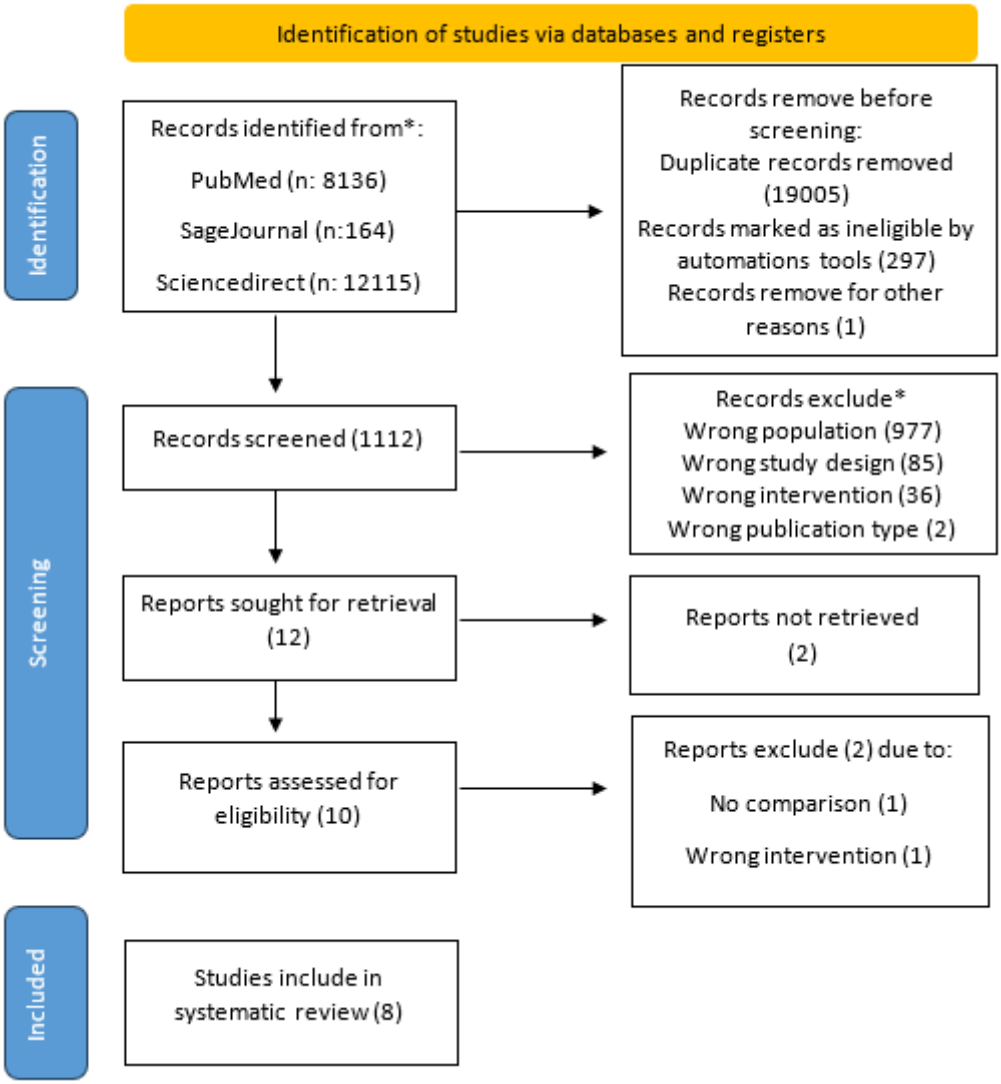

Figure 1. Article search flowchart

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

Table 2. Critical appraisal of Study

Parameters	(Lari, A et al., 2022)	(Kim, J et al., 2023)	(Chen, Z et al., 2021)	(Kurtti, A et al., 2021)	(Dastagir, K et al., 2021)	(Vogt, PM et al., 2017)	(Scott, HC et al., 2024)	(Saggini, R et al., 2015)
1. Bias related to temporal precedence Is it clear in the study what is the "cause" and what is the "effect" (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation Was there a control group?	No	No	No	No	No	No	No	No
3. Bias related to confounding factors Were participants included in any comparisons similar?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Bias related to administration of intervention/exposure Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	No	No	No	No	No	No	No	No

5. Bias related to assessment, detection, and measurement of the outcome								
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	No	No	No	No	No	No	No	No
Were the outcomes of participants included in any comparisons measured in the same way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Bias related to participant retention								
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Statistical conclusion validity								
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

RESULT

Using reputable resources like Science Direct, PubMed, and SagePub, our research team first gathered 20415 publications. A thorough three-level screening strategy was used to identify only eight papers as directly relevant to our ongoing systematic evaluation. Next, a thorough study of the entire text and further examination of these articles were selected. Table 1 compiles the literature that was analyzed for this analysis in order to make it easier to view.

Table 1. The litelature include in this study

Author	Origin	Method	Sample	Result
Lari, A et al., 2022[4]	Kuwait	In an online survey,	303	A total of 303 responses were obtained from

		surgeons were asked about the extent to which various patient and technical factors affect the importance of scar cosmesis.		surgeons across six specialties. Based on the survey, the importance of scar cosmesis was rated highest among plastic surgeons and obstetricians and gynecologists, and lowest among orthopedic and vascular surgeons. Compared with surgeons in private practice, publicly employed surgeons' rating of the importance of cosmesis was lower. The patient's request for a cosmetic outcome was the most highly rated factor. Regarding the influence of patient demographics on surgeons' attitudes, scar cosmesis in young and female patients was favored in comparison with older and male patients. Factors that reduced the importance of cosmesis were emergency and late-night surgeries followed by lengthy procedures, large incisions, and busy operative lists.
Kim, J et al., 2023[5]	Korea	We performed a retrospective study and identifed patients with postthyroidectomy scars who presented to the Scar Laser and Plastic	1043	Te study included a total of 1043 patients in the main dataset: 109 (10.5%), 705 (67.6%), and 229 (22.0%) had mild, moderate, and severe degrees of scar severity, respectively, according to the initial clinical presentation. When comparing the clinical variables between

		Surgery Center in the Yonsei Cancer Hospital, Seoul, Republic of Korea, from September 2015 to December 2021.		these severity groups, the following factors showed signifcant diferences: BMI, date afer surgery, minimally invasive thyroidectomy (MIT), modifed radical neck dissection (MRND), transaxillary approach, itching/pain, adhesion/ tightening, and induration/edema
Chen, Z et al., 2021[6]	China	Te present study was approved by the Institutional Review Board of the First Afliated Hospital of Zhengzhou University. Te local ethics committee of our hospital approved this study, which conformed to the provisions of the Declaration of Helsinki.	22	. One half of the incision was injected with a low dose (4 U) of BTxA, and the other half was injected with a high dose (8 U). The scars were then evaluated at postoperative 6 months using the modifed Stony Brook Scar Evaluation Scale (mSBSES), and patient satisfaction was evaluated using the Visual Analogue Scale (VAS). The occurrence of complications or adverse events was also recorded. Twenty patients completed the study and were analyzed. Compared with the low-dose sides, the high-dose sides had signifcantly better mSBSES scores and signifcantly higher VAS scores ($p< 0.01$, respectively). No serious adverse reactions or post-injection complications were observed. Immediately after the operation, high-dose BTxA (that is within the therapeutic range)

				injection improved the appearance of postoperative scar more than low-dose injection.
Kurtti, A et al., 2021[7]	USA	CURES (Cutaneous Understanding of Red-light Efficacy on Scarring) was a randomized, mock-controlled, single-blind, dose-ranging, split-face phase II clinical trial.	30	There were no significant differences in scar pliability between treated and control scars. At certain fluences, treated scars showed greater improvements in observer rating and scar pliability, reflected by greater reductions in induration, from baseline to 6 months compared to control scars. Treatment-site adverse events included blistering (n=2) and swelling (n=1), which were mild and resolved without sequelae
Dastagir, K et al., 2021[8]	Germany	Based on a retrospective analysis of 1427 patients who presented for treatment of a variety of scars, we developed an algorithm for scar management and treatment.	1427	Conservative treatment procedures such as scar massage and compression therapy using compression dressings or scar plasters containing silicone are gold standard therapies to obtain flat, soft, and aesthetically acceptable scars. Furthermore, for functional rehabilitation, physiotherapy and occupational therapy remain integral treatment pillars. Naturally, scar tissue shows spontaneous improvement whilst maturing. Therefore, scar revision usually will be performed after 6 to 12 months upon formation.
Vogt, PM et al., 2017[9]	Germany	We worked out the most	-	This article provides modern plastic and

		common surgical approaches and treatment algorithm for a stepwise and effective approach. Part of this algorithm is a seven-step surgical approach.		reconstructive surgery concepts with an algorithm for scar management.
Scott, HC et al., 2024[10]	Australia	A purposely designed self-report online survey was emailed to current members of the Australian Hand Therapy Association (*n* = 958). Data collected included demographics, intervention techniques, conditions treated and protocols, scar assessment and knowledge and training about scar massage as a	116	A total of 116 completed questionnaires were received (a response rate of 12.1%). All respondents used scar massage as part of their clinical practice with 98% to improve soft tissue glide (*n* = 114), 92% for hypersensitivity (*n* = 107), and 84% to increase hand function (*n* = 97). Only 18% (*n* = 21) of respondents used standardised outcome measures, and most therapists had learned scar massage from a colleague (81%).

		clinical intervention.		
Saggini, R et al., 2015[11]	Italy	Patients were informed about the procedures and purpose of the study and they were required to give written informed consent before participating.	70	Histopathological examination revealed significant increase in dermal fibroblasts in each active treatment group (i.e., groups A, B and C), as well as in neoangiogenetic response and type-I collagen concentration; likewise, in each active treatment group, significant qualitative improvement of dermal collagen was observed, with a finer and more fibrillar appearance. Staining with picrosirius red indicated that treatment with ESWT resulted in a collagen fiber arrangement parallel to the skin surface and replacement of type III collagen with type I collagen (thus restoring the physiologic relationship between type I and III collagens).

DISCUSSION

Plastic surgeons play an important role in both the prevention and the treatment of unaesthetic scar formation following operations, trauma, burns or infections. Estimates indicate that each year around 100 million people in the developed world acquire scars following elective surgery and surgery for trauma. Of these, approximately 15% have excessive or unaesthetic scars. Scarring can also be a major source of dissatisfaction after a purely cosmetic surgical procedure such as aesthetic breast surgery. Furthermore, a recent survey indicated that 91% of patients who underwent a routine surgical procedure would value any improvement in scarring.[12,13]

Excessive scarring can have unpleasant physical, aesthetic, psychological and social consequences. Physical symptoms may include itching, stiffness, scar contractures, tenderness and pain. The psychosocial effects of unaesthetic scarring include diminished self-esteem, stigmatization, disruption of daily activities, anxiety and depression.[12,14]

Treatments to improve the function, texture, contour, and color of the skin have been around since at least the sixteenth century. Several modalities exist for the treatment of suboptimal scars. These include the use of silicone gel sheets, resurfacing with electrosurgical instruments (electrobrasion), manual or mechanical dermabrasion, chemical peels, subcutaneous incisionless surgery (subcision), intralesional steroid injection, laser, and, lastly, excisional modalities and/or surgical rearrangement of skin. Thorough understanding of the benefits and potential complications of each of these techniques helps physicians individualize care for their patients with suboptimal surgical scars.[15,16]

Several other studies were nonrandomized, not properly controlled, or did not have blinded evaluators. Some of those studies found that onion extract gel resulted in decreased scar width, decreased scar erythema, decreased pruritus, and overall improved scar appearance. Other studies found that onion extract was no more effective than antibiotic ointment for scar prevention and less effective than silicone gel sheeting. For the treatment of established hypertrophic scars and keloids, Koc et al found that intralesional steroid combined with topical onion extract resulted in improved scar pruritus and height compared with steroids alone.[17,18]

In a prospective, blinded RCT, Chan et al found that silicone gel was superior to control in the prevention of hypertrophic scarring after median sternotomies, resulting in improved pigmentation, vascularity, pliability, height, pain, and pruritus. Lee et al found that silicone gel was superior to onion extract for the prevention of hypertrophic scars in the rabbit ear. Similarly, Karagoz et al found that both silicone gel and silicone sheets were superior to onion extract gel in the prevention of hypertrophic scarring after burns. In a prospective study of women undergoing bilateral reduction mammoplasty, CruzKorchin et al treated the incisions on 1 breast, but not the other, with silicone sheeting. The rate of hypertrophic scars was much lower when silicone sheeting was used (25% vs 60%).[17,19]

Intralesional injections of corticosteroids have been a mainstay of treatment for keloids and hypertrophic scars. It is the preferred first-line treatment for keloids and the second-line treatment for hypertrophic scars. Intralesional injection of triamcinolone acetonide acts by promoting collagen degradation and inhibiting fibroblast growth, therefore inhibiting collagen production. This mechanism is especially important in keloid scars because keloid fibroblasts produce three to four times as much collagen as normal skin cells or nonpathologic scar fibroblasts.[20,21]

Plasma medicine, a rapidly developing interdisciplinary feld, has already developed as a new innovative approach for biomedical and clinical applications. Emerging evidence suggests that non-thermal plasma (NTP) is potentially benefcial for bacteria disinfection, blood coagulation, and cancer therapy. NTP has also been shown to play a role in wound healing. However, there are limited experimental studies on the application of NTP to inhibit scar formation.[22,23]

Numerous therapeutic options are available for postoperative scar management with varying levels of evidence and success rates. Because no single treatment modality emerges as the definitive treatment option in creating the ideal scar, each patient and each wound must be handled uniquely. Optimizing scar appearance is a process that spans from the preoperative period to scar maturation, and regardless of which treatment plan is employed, basic principles of wound care must be maintained.[24,25]

CONCLUSION

In conclusion, there is a large unmet need for innovative therapeutic strategies to prevent cutaneous scarring after surgery. Despite the substantial healthcare burden of skin fibrosis, there is no “gold standard” or universally effective scar therapy, and current treatment options have limited clinical efficacy and durability. The prevention of scar development should also be included in every surgical procedure. The consideration of relaxed skin tension lines and by a traumatic intraoperative approach will have good effects on wound healing.

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