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Original Research Article

The Outcome of Various Treatment Modalities of Keloid and Hypertrophic Scar

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Abstract

Several types of skin injury, such as surgery, piercing, burns, lacerations, abrasions, tattoo placement, immunizations, insect bites, and any inflammatory condition, such as acne, varicella, or folliculitis, can cause keloids, which may appear months to years after the initial damage and do not have a tendency for retreat whereas hypertrophic scars often develop immediately after injury (weeks) and may regress over time. The treatment of hypertrophic and keloid scars remains an unresolved issue. Numerous therapeutic techniques have been documented, including intralesional therapy, pressure therapy, cryotherapy, radiation, surgical excision, and even combination treatments. The purpose of this study was to evaluate the efficacy of various keloid and hypertrophic scar treatments.

Aim: To study the comparative efficacy and outcome of various modalities of treatment of keloid and hypertrophic scar.

Study Area: Hind Institute of Medical Sciences, Safedabad, Barabanki, U.P.

Study Design: Analytical study. Study Groups: Five Groups.

Sample size:100 cases during the study period.

Results: It was observed that at the baseline in combined therapy, all the scores such as pigmentation [2.95±0.18], pliability [3.03±0.28], height [2.64±0.25], vascularity [2.25±0.24] and itching [2.31±0.19] were noted in patients and found comparable. A gradual decrease was observed in all the scores, and at 18 weeks, the scores were noted as pigmentation [2.03±0.14*], pliability [1.41±0.15*], height [0.24±0.06*], vascularity [0.82±0.04*] and itching [0.71±0.05*] was found.

Conclusion: Based on the findings of this study, only 5- Fluorouracil and Verapamil therapies showed side effects in patients. There was a significant mean difference in the scores among all the therapies, which showed combined therapy was best without any side effects.

Keywords: Keloid, Hypertrophic Scar, Treatment Modalities.

Introduction

Keloids which may appear months to years after the initial damage and do not have a tendency for retreat whereas hypertrophic scars often develop immediately after injury (weeks) and may regress over time [1]. It has also been reported that a hypertrophic scar which was present for 12 months and subsequently extended beyond the initial site of damage and ultimately transformed into a keloid. Unlike keloids, which are frequently resistant to therapy and have a greater recurrence rate, hypertrophic scars may respond better to treatment [2].

A patient's propensity to develop keloid or hypertrophic scars may be influenced by factors such as the location of the lesion and his or her ethnic background. Several types of skin injury, such as surgery, piercing, burns, lacerations, abrasions, tattoo placement, immunizations, insect bites, and any inflammatory condition, such as acne, varicella, or folliculitis, can cause keloids. Keloids are more prevalent in people with darker skin phototypes, with an incidence ranging from 4.5 to 16% in the Black and Hispanic populations [3].

On a histopathological level, it might be difficult to distinguish between hypertrophic scars and keloids. The epidermis of healthy skin has separated collagen bundles that run parallel to one another. In hypertrophic scars, the collagen bundles are flatter, less delineated, and organised in a wavy pattern, yet remaining oriented to the epithelial surface. In a keloid, collagen bundles are almost non-existent, and the fibres lie in sheets that are loosely aligned. There are nodular formations comprising fibroblastic cells and collagen in hypertrophic scars. These nodules are not found in normal dermis, other scars, or the majority of studied keloid [4].

Platelet degranulation and activation of the complement and clotting cascades result in the formation of a fibrin clot for haemostasis and wound healing [5]. Platelet degranulation is responsible for the release and activation of a variety of potent cytokines, including epidermal growth factor (EGF), insulin like growth factor (IGF- I), platelet-derived growth factor (PDGF), and transforming growth factor β(TGF-β), which serve as chemo-tactic agents for the recruitment of neutrophils, macrophages, epithelial cells, mast cells, endothelial cells, and fibroblasts Within 48 to 72 hours of the original injury, the healing process enters the proliferation phase, which can last up to three to four weeks, Extracellular matrix is produced by recruited fibroblasts as a framework for reparative tissue (ECM). This procollagen, elastin, proteoglycan, and hyaluronic acid-based granulation tissue provides a structural healing framework to bridge the wound and permit vascular in growth. Myofibroblasts, which contain actin filaments, contribute to the initiation of wound contraction. After the wound has been closed, the young scar will enter the final maturation phase, which can last several months. The plentiful ECM is then destroyed, and the early wound's immature type III collagen can be converted to adult type I collagen [6].

Therefore, the transformation of a wound clot into granulation tissue involves a precise balance between ECM protein deposition and

degradation, and when this process is interrupted, aberrant scarring results in the creation of either keloid or hypertrophic scars.

Existing preventative and therapeutic techniques include pressure therapy, silicone gel sheeting, intralesional Triamcinolone acetonide, cryosurgery, radiation, laser therapy, intravenous immunoglobulin (INF), 5-fluorouracil (5-FU), surgical excision, and a variety of extracts and topical medicines. Numerous of these treatments have demonstrated efficacy through extensive usage, but few have been backed by prospective trials with suitable control groups [7].

The treatment of hypertrophic and keloid scars remains an unresolved issue. Numerous therapeutic techniques have been documented, including intralesional therapy, pressure therapy, cryotherapy, radiation, surgical excision, and even combination treatments. On hypertrophic scars and keloids, the anti-inflammatory and scar-enhancing characteristics of corticosteroids have been well studied and documented. This is regarded as the initial therapeutic option for restricted keloidal and hypertrophic scars. Triamcinolone acetonide is the most often used corticosteroid in this situation, and its efficacy, utility, and limitations are well documented [8].

Compared to corticosteroids, less research has been conducted on the effectiveness of verapamil (a calcium antagonist) and the combination of verapamil and triamcinolone on hypertrophic scars and keloids. Verapamil's positive benefits on hypertrophic scars and keloids are primarily addressed empirically by inhibiting collagen formation. Verapamil appears to destroy extracellular matrix. In addition, verapamil may block platelet aggregation and reduce neutrophil activity, inhibiting inflammation [9]. The outpatient clinic of the University Medical Center of Maastricht was dedicated primarily to scar treatment and maintenance using a precise injection protocol, they anticipated that the combo therapy was resulted in significant scar improvement over time in clinical practise and suggested that the beneficial qualities of triamcinolone and verapamil could have a synergistic effect on hypertrophic scars and keloids when used in intralesional combination therapy [10]. In vivo significant clinical evidence of the efficacy of combined intralesional triamcinolone and verapamil therapy for hypertrophic scars and keloids is currently missing.

Hence, the purpose of this study was to evaluate the efficacy of various keloid and hypertrophic scar treatments.

Review of Literature

Keloids are the outcome of improper wound healing caused by trauma or inflammation to the skin. Genetic and environmental factors contribute to the formation of keloids. Individuals of African, Asian, and Hispanic heritage with darker complexion have a higher occurrence rate. Keloids are caused by fibroblasts that produce excessive amounts of collagen and growth factors due to hyperactivity [11].

Current and emerging treatment strategies

Numerous investigations on hypertrophic scar and keloid formation have led to a variety of therapeutic strategies to prevent or reduce hypertrophic scar and keloid formation such as

Prophylaxis, Pressure therapy, Gel silicone sheeting, Flavonoids etc.

Current treatment strategies

Intralesional corticosteroid injections.

Since the mid-1960s, intralesional steroid injections have acquired popularity as one of the most prevalent methods to attenuate

hypertrophic scar and keloid formation, whereas topical administration of corticosteroid-containing creams has been utilised with different degrees of efficacy. In most cases, two or three injections of triamcinolone acetonide (TAC, 10 to 40 mg/mL) are sufficient, but injections may be continued for six months or longer. Response rates were highly diverse, ranging from 50 to 100 percent, and recurrence rates from 9 to 50 percent. Importantly, intralesional corticosteroid injections were the greatest effect on younger keloids, which entirely flattened when treated alone. In older scars and keloids, corticosteroids were partially soften and flatted scars and provided symptomatic relief. It has been suggested that the injections could be administered alone or in combination with other treatments [12,13].

Cryotherapy

Excessive scars have been treated using cryotherapy alone and in conjunction with other therapies. Particularly, the combination of cryotherapy and intralesional TAC injections appears to result in a significant improvement of hypertrophic scars and keloids. Cryotherapy is recommended prior to intralesional TAC injections since success rates appear to be increased in this order [14].

It is hypothesised that cryotherapy induces vascular damage, which may result in anoxia and, eventually, tissue [15] In a study which was employed contact or spray cryosurgery with liquid nitrogen and success rates were ranged from 32% to 74% after two or more sessions, while hypertrophic scars responded more effectively than keloids. However, cryotherapy's effectiveness was restricted to the treatment of minor scars [16].

Radiotherapy

In scar reduction protocols, x-rays, electron-beam therapy, and low- or high-dose-rate brachytherapy have been utilised with favourable outcomes, primarily as adjuncts to surgical removal of keloids. The effects of radiation on keloids are believed to be mediated through the suppression of neovascular buds and proliferating fibroblasts, which results in decreased collagen production. 93 Electron beam irradiation is often initiated between 24 and 48 hours after keloid excision, and the total dose is limited to 40 Gy over the course of multiple administrations to prevent adverse effects including as hypo- and hyperpigmentation, erythema, telangiectasia, and atrophy [17,18].

Laser therapy

Since the debut of laser therapy for keloids in the mid-1980s, the therapeutic use of an increasing number of lasers with varying wavelengths has been studied, with varying degrees of success. The 585-nm pulsed-dye laser (PDL), which has been acknowledged as a good therapeutic alternative for the treatment of younger hypertrophic scars and especially keloids, has been yielded the most promising outcomes so far [19]. For the treatment of hypertrophic scars and keloids, nonoverlapping laser pulses at fluences ranging from 6.0 to 7.5 J/cm2 (7-mm spot) or 4.5 to 5.5 J/cm2 (10-mm spot) have been advised. Two to six treatments were required to effectively improve scar colour, height, pliability, and texture. It was suggested that the 585-nm PDL treatment induces neocollagenesis, collagen-fiber heating with dissociation of disulfide bonds and subsequent collagen-fiber realignment, decreased fibroblast proliferation, and release of histamine and other substances that affected fibroblast activity. Transient hyper- or hypopigmentation and blistering were adverse effects on 1–24% of individuals have also been reported to have hyperpigmentation. The most frequent adverse effect of 585-nm PDL therapy was postoperative purpura, which lasted between 7 and 10 days [20].

Emerging Therapies

Injections of IFN. The potential therapeutic value of IFN therapy for the treatment of aberrant scars is based on the action of IFN on the production of collagen types I and III. IFN-α2b has been hypothesised to have antiproliferative activities, and it may ameliorate the pathologic characteristics of dermal fibrosis either directly or by counteracting the actions of TGF-β and histamine. In severely burned patients, systemic treatment of IFN-2b reduced the clinical appearance of hypertrophic scars and decreased the Vancouver Burn Scar Assessment score. It has been reported that intralesionally administered IFN-2b (1.5×106 IU twice day for 4 days) reduced keloid growth by 50% in 9 days, making it significantly more efficient than intralesionally injected corticosteroid. Injections of IFN-2b three times weekly into hypertrophic scars also resulted in statistically significant improvement and sustained reductions in serum TGF-β levels [21-24].

Bleomycin.

Bleomycin sulphate, an additional anticancer drug discovered to directly reduce collagen production via decreased activation by TGF-β1 , was first explored as a scar-reduction agent in the mid-1990s. It has been documented that, after providing three to five intralesional injections of bleomycin over the course of one month, full regression was found in 69.4% of the keloids. Similar outcomes were observed in subsequent investigations, including a significant improvement in hypertrophic scar and keloid height and pliability, as well as a reduction in erythema, pruritus, and pain [25,26].

5-Fluorouracil (5-FU).

5-FU is a pyrimidine analogue used in cancer chemotherapy as an antimetabolite. Intracellular conversion of 5-FU to its active form is believed to directly promote fibroblast apoptosis by blocking DNA synthesis in quickly proliferating and metabolising cells.

In a prospective, randomised trial involved 28 consecutive patients with keloids of varying size and duration, weekly intralesional 5-FU injections (50 mg/mL) for 12 weeks reduced scar size by at least 50% in the majority of patients, with no patient demonstrating failure to respond to therapy or recurrence of symptoms during the 24-month follow-up period [27].

Nine patients with clinically diagnosed keloids and HTS were treated using topical mitomycin C (1 mg/mL) for 3 min after shaving excision. The Vancouver Scars Scale, patient satisfaction, and side effects were evaluated six months following treatment. At each monthly appointment, the keloids and HTS were photographed. The effect of intralesional mitomycin C (1 mg/mL) on the regression of keloids in two patients was investigated. Applying mitomycin C to the base of shaved-off keloids and HTS produced positive outcomes. None of the nine patients were dissatisfied with the treatment's outcome, while six were ecstatic. Mitomycin C intralesional therapy yielded unsatisfactory results [28].

Treatment options included excision and grafting [split thickness autograft (STAG) or full thickness autograft (FTAG)], excision and grafting with steroid injection, excision and primary closure, or excision and primary closure with steroid injection. Patients were only included if there was a 12-month or longer follow-up. One hundred ten individuals were recognised as having a keloid scar. 26 patients were treated with excision and skin grafting, whereas 8 patients were treated with a steroid and surgical regimen. For surgical and steroid-treated patients, treatment ranged from intra-

operative injections to injections administered at 6-week intervals post-surgery. One to three injections were administered based on the discretion of the providing surgeon. Clinical endpoints chosen by the administering surgeon comprised (1) no additional improvement in scar maturation or (2) no improvement. Return of a raised scar consistent with a keloid scar was characterised as a recurrence. The recurrence rate was 87.5% for patients treated with surgery and steroids and was 80% for surgery alone. There was no statistical significance to this difference. compared to previously reported series involving non-burn-related keloids, steroid use does not significantly reduce the recurrence of burn-related keloids in children. This stresses that burn-related keloids respond differently to traditional treatments that have been effective for keloid scars caused by other sources of injury. Burn burns resulting in keloid scars should be treated with a consistent and successful therapy algorithm [29].

The effectiveness of PDL versus Nd:YAG laser in hypertrophic scar and keloid. In a prospective, randomised split-scar trial, twenty patients with hypertrophic scars and keloids were involved. Half of each scar was treated with a 595-nm PDL while the other half was treated with a 1064-nm Nd:YAG. Each patient underwent six laser treatment sessions separated by one month. Using the Vancouver scar scale, scars were examined at baseline and one month after the last laser treatment (VSS). One month following the last laser treatment, the final total VSS examination of treated sites by PDL and long pulsed Nd:YAG laser demonstrated substantial improvements ($p<0.001$), with the average percentage of improvement in the total VSS being 55.14 percent for PDL and 65.4 percent for Nd:YAG laser. For total VSS, however, there were no statistically significant differences between PDL and long pulsed Nd:YAG laser treated sites ($p=0.074$). This was a single-center, uncontrolled trial with a small sample size and subjective outcome measurement. Both pulsed dye laser and long pulsed Nd:YAG laser treatments for keloids and hypertrophic scars result in significant improvement with no discernible difference between the two modalities [30].

Fifty-eight patients with hypertrophic scars (n = 31) and keloid scars (n = 27) were included. A particular injectable therapy protocol was implemented. Five follow-up moments, with a maximum follow-up of nearly two years, were selected. Using the Patient and Observer Scar Assessment Scale, the effects of combination therapy on scar pliability, thickness, alleviation, vascularization, surface area, pain, and pruritus were evaluated (POSAS). After treatment with the combo therapy, both keloid and hypertrophic scars show rapid and lasting healing. In keloids, all POSAS components

exhibited a reduction in scar score, while scar relief, discomfort, itching, and surface area considerably improved ($P<0.05$). In hypertrophic scars, pigmentation, vascularization, pliability, thickness, discomfort, and surface area showed significant improvement. In both keloids and hypertrophic scars, POSAS scores decreased significantly between baseline and 3–4 months, 4–6 months, and >12 months after therapy initiation. This study demonstrates that the combination of triamcinolone and verapamil results in a considerable and durable scar improvement [31].

One hundred patients into five treatment groups of 20 patients in each. Different modalities were administered, including intralesional triamcinolone acetonide, intralesional triamcinolone acetonide with hyaluronidase, intralesional verapamil hydrochloride, intralesional radiofrequency, and intralesional radiofrequency with

triamcinolone acetonide. The treatments for Groups 1, 2, and 3 were administered at 3-week intervals for a total of eight applications or until complete flattening, whichever came first. In groups 4 and 5, therapy was administered every six weeks for four cycles or until complete flattening. All patients were followed at three-week intervals for statistical comparison purposes. In total, 16 patients completed the study in each of the five groups (1, 2, 3, 4, and 5). Groups 1, 2, and 5 had clearance rates of 75%, 687.5%, and 75%, respectively, while groups 3 and 4 had clearance rates of 0% and 11.76%, respectively ($P<0.01$, Chi-square test). Keloids can be effectively treated with intralesional triamcinolone acetonide, intralesional triamcinolone acetonide with hyaluronidase, and intralesional radiofrequency with triamcinolone acetonide. However, intralesional triamcinolone acetonide with hyaluronidase is safer and has fewer adverse effects than the other two treatments [32].

A retrospective study included 35 Korean patients. Each patient was treated with the nonablative fractional erbium-glass laser at 1,550 nm, followed by the ablative fractional carbon dioxide laser at 10,600 nm. The laser treatment was immediately followed by intralesional triamcinolone injection and superficial cryotherapy. Using the Vancouver Scar Scale (VSS) score and the 7-point patient self-assessment score, the therapeutic efficacy was evaluated. The average total and subcategory VSS scores demonstrated statistically significant gains. The ratings for height and pliability shown the most substantial and rapid improvements to the combined therapy. After a single session of combination therapy, patients reported significant reduction in itching, pain, and mobility restrictions. Only one patient was reported to have a recurrence one year after discontinuation of the combined treatment among twenty patients. Throughout the follow-up period, no notable adverse effects were found. The combination of fractional lasers, superficial cryotherapy, and intralesional triamcinolone injection is safer and more successful than separate procedures [33].

The effectiveness of combination therapy with non-ablative fractional laser and intralesional steroid injection. In total, 38 individuals with hypertrophic scars or keloids were assessed between May 2015 and June 2017. 21 patients in the control group received steroid injections alone, while 17 patients in the combined group received steroid injections and 1550-nm erbium-glass fractional laser treatment simultaneously. The combined group averaged significantly fewer treatment sessions than the control group (6.95 versus 5.47, $P = .042$). The patient's scale in the combined group was significantly different (14.62 vs 22.82, $P = .005$); however, the observer's scale was not statistically different (17.92 vs 20.55, $P = .549$). The recurrence rate was 38.1% (8/21) in the control group and 35.3% (6/17) in the combination group, with no significant difference ($P = .859$) between the two groups. However, the average time of remission was statistically longer in the combined group (3.00 months versus 4.17 months, $P = .042$). Combination therapy with non-ablative fractional laser and intralesional steroid injection shown superior efficacy for the treatment of hypertrophic scars and keloids with fewer treatment sessions, higher patient satisfaction, and longer remission durations [34].

The efficacy of fractional CO2 laser, long-pulsed Nd:YAG laser and their combination in the treatment of hypertrophic scars and keloids on clinical, histopathological, and biochemical basis. Thirty individuals with hypertrophic scars and keloids participated in the study. Each patient had three scars randomly assigned to I Fractional CO2, (ii) Nd:YAG laser, and (iii) Combined CO2 and

Nd:YAG laser treatments. For each treatment location, four sessions were administered 4–6 weeks apart. Clinical evaluation was performed using the Vancouver Scar Scale (VSS) and the Patients were observer Scar Assessment Scale before and one month after the last session (POSAS). Utilizing routine hematoxylin and eosin, Masson's trichrome, and Orcein stains, the appearance and pattern of dermal collagen and elastic fibres were evaluated. Image analysis was utilised to quantify the collagen and elastic fibre density. Using enzyme-linked immunosorbent assays, tissue levels of transforming growth factor- I (TGF-β I) and TGF-β III were evaluated biochemically. Following therapy with the three employed methods, both the VSS and POSAS exhibited considerable improvement. In terms of look and pattern, collagen fibres exhibited a significant improvement, although density remained unaffected. The improvement in the density of elastic fibres was only significant in fractional CO2 (treatment area A). Hypertrophic scars improved much better with fractional CO2 laser, however there was no significant difference in improvement between the three modalities for keloids. TGF-β I levels decreased significantly following treatment in all treatment modalities, although TGF-β III levels increased marginally in all treatment modalities. Significantly more adverse effects were observed in treatment area C (combined treatment). The Nd:YAG laser with a long pulse duration is an effective and safe treatment for hypertrophic scars and keloids. Hypertrophic scars respond better to fractional CO2 laser, while keloids respond similarly to fractional CO2 and Nd:YAG laser treatments. Combining medications in the same session did not result in a substantial increase in efficacy, and the incidence of adverse effects was increased [35].

In a study 160 cases were categorized into four groups of each group-containing 40 cases. Group A (control) was treated intralesionally with triamcinolone, Group B with verapamil, Group C with 5-fluorouracil, and Group D with platelet-rich plasma. The clinical response of patients was evaluated based on a decrease in the patient and observer scar assessment scale (POSAS) from baseline through the conclusion of treatment. The mean baseline POSAS score for Group-A was 91±10.98 SD; for Group-B, it was 90±10.85; for Group-C, it was 89±10.06; and for Group-D, it was 92±8.44. After 24 weeks, the POSAS scores for Group-A were 36±12.74, Group-B was 29±10.91, Group-C was 39±13.74, and Group-D was 36±12.74. There was a statistically significant difference between groups. The most successful treatment for keloids was intralesional verapamil, followed by platelet-rich plasma and intralesional triamcinolone acetonide. 5-fluorouracil was less effective [36].

Aim & objectives

Aim

To study the comparative efficacy and outcome of various modalities of treatment of keloid and hypertrophic scar.

Objectives

Primary

- To evaluate the correlation between treatment response and the duration, size and number of lesionszz

Secondary

- To study the adverse effects of the various modalities used

Material & Methods

Study Area: Hind Institute of Medical Sciences, Safedabad, Barabanki, UP

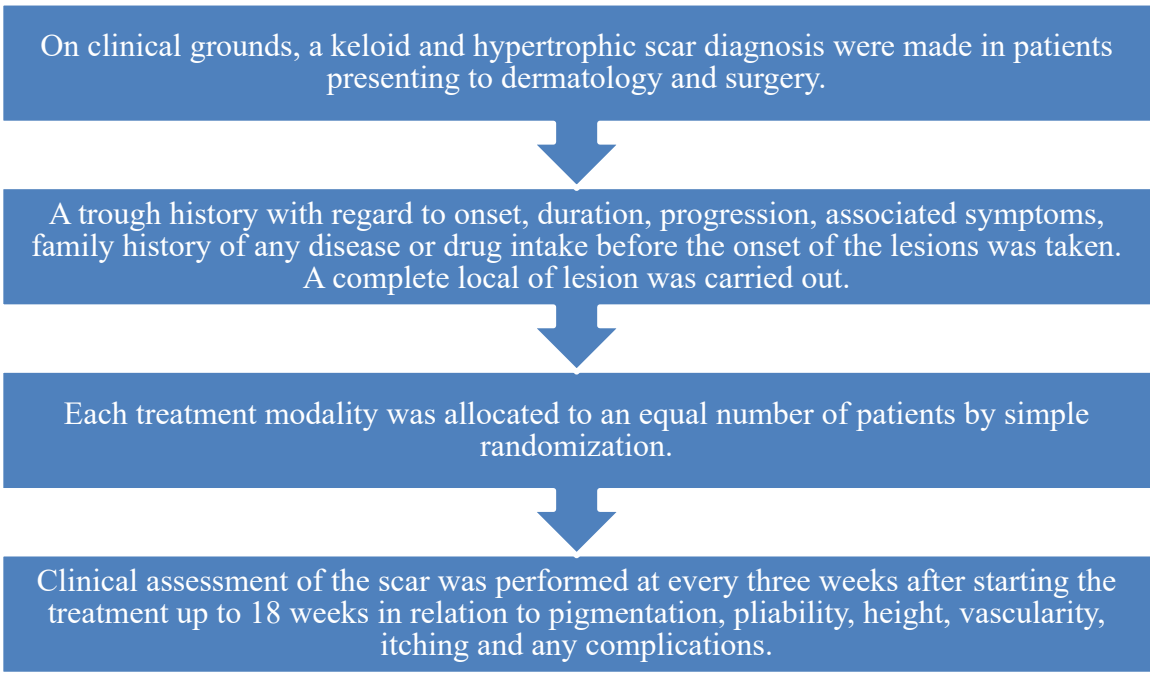
Study Design: Analytical study

Sample size:100 cases during the study period.

Study groups

Group1	Combined Therapy	19 Patients
Group2	Triamcinolone Therapy	20 Patients
Group3	Verapamil Therapy	20 Patients
Group4	5-Flurouracil Therapy	21 Patients
Group5	Compression Therapy	20 Patients

Flowchart of study protocol



- A complete physical, systemic examination and basic investigations like complete hemogram, blood sugar, LFT, KFT, HIV1 and 2 and HbsAg, ECG, and Chest x-ray were carried out at the commencement of treatment.
- Primarily scars were treated with different intralesional therapy like Triamcinolone acetonide,5fluorouracil, Verapamil), compression and combined therapy.
- Clinical assessment of the scar was measured in parameters like.
- **PIGMENTATION**

0- Normal
1- Hypopigmentation
2- Mixed
3- Hyperpigmentation

- **PLIABILITY**

0- Normal
1- Supple(Flexible with minimal resistance)
2- Yielding (Giving way to pressure)
3- Firm(Inflexible,resistant to manual pressure)
4- Banding (rope-like tissue that blanches)

5- Contracture (permanent shortening of scar-producing deformity)

- **HEIGHT**

0- Normal
1- Less than 2 mm
2- 2 to 5 mm
3- More than 5mm

- **VASCULARITY**

0- Normal
1- Pink
2- Red
3- Purple

- **ITCHING**

0- No itchy sensation
1- Sometimes, itchy
2- Moderately itchy, tolerable
3- Severe intolerable, constant itching

- **THE COMPLICATIONS OF THERAPY LIKE**

1- Atrophy
2- Telangiectasia
3- Necrosis
4- Ulceration
5- Blistering

Results

100 patients with keloid and hypertrophic scar of > 6 months were enrolled as per inclusion and exclusion criteria.

In this study the majority of the patients were aged between 13- 22 years [37(37.00%)], followed by 23-32 years [24.00%]. The mean age was noted [30.77±12.74]. Statistically, a significant difference was observed in age-wise distribution [p=0.0037*]. Males [58(58.00%)], followed by females [42(42.00%)]. Statistically, a non-significant difference was observed in gender [p=0.2564].

On the basis of occupation, it was found that the student was [43(43.00%)], followed by housewife [25(25.00%)], shopkeeper [11(11.00%)], self-employed [5(5.00%)], and so on. Statistically, a significant difference was observed in occupation [p<0.0001*]. The mean onset of the lesion was also found 2.87±3.45.

It has also been found that the majority of the patients had no pain [84(84.00%)], while 16 patients had a history of pain. Statistically, a significant difference was noted in the history of pain [p<0.0001*].

It was also observed that the most of the patients had a history of itching [65(65.00%)], followed by patients who had no itching [35(35.00%)]. Statistically, a significant difference was observed in the history of itching [p=0.0319*].

Burning sensation was [51(51.00%)], followed by those who did not [49(49.00%)]. Statistically, a non-significant difference was observed in the history of burning sensation [p=0.8875]. It has been observed that the majority of the patients had no history of ulceration [83(83.00%)], followed by those who had [17(17.00%)]. Statistically, a significant difference was observed in the history of ulceration [p<0.0001*].] No history of discharge from their scars were

observed in [93(93.00%)]. At the same time, 7 patients had a history of discharge. Statistically, a significant difference was also observed in the history of discharge from scar [p<0.0001*]. Most of the patients were non traumatised [76(76.00%)], while [24(24.00%)] patients had a history of trauma. Statistically, a significant difference was observed in the history of trauma [p=0.0001*]. Only 2 patients had Varicella infection, while the majority of them had no such infection [98(98.00%)]. Statistically, a significant difference was observed in the history of varicella infection [p<0.0001*]. History of acne [98(98.00%)], followed by the who had a history of acne [2(2.00%)]. Statistically, a significant difference was observed in the history of acne [p<0.0001*]. History of infected skin lesions were [98(98.00%)], followed by the patients who had a history of infected skin lesions [2(2.00%)]. Statistically, a significant difference was observed in the history of acne [p<0.0001*]. Most of the patients had no history of surgery [86(86.00%)], while the least patients had a history of surgery [14(14.00%)]. Statistically, a significant difference was observed in the history of surgery [p<0.0001*]. The majority of the patients had no family history of keloid and hypertrophic scars [53(53.00%)], [47(47.00%)] patients had a family history. Statistically, a non-significant difference was observed in family history [p=0.6712].

It was also found that Non-vegetarian patients were [90(90.00%)], followed by vegetarian [10(10.00%)]. Statistically, a significant difference was observed in the dietary habit [p<0.0001*]. The majority of the patients had no such addictive habits [91(91.00%)], followed by patients who were alcoholic [4(4.00%)], smokers [3(3.00%)] and alcoholic+smokers [2(2.00%)]. Statistically, a significant difference was observed in addiction [p<0.0001*].

It was also observed that the most of the patients had no history of treatment [88(88.00%)], followed by patients who had treatment [12(12.00%)]. Statistically, a significant difference was observed in addiction [p<0.0001*].

This study also revealed that the normal BMI was in 49(49.00%) patients, followed by overweight patients [37(37.00%)]. Statistically, a significant difference were observed in BMI and overweight[p<0.0001*].

Site of the lesion in enrolled patients were as Chest [48(48.00%)], followed by hand [15(15.00%)], face [14(14.00%)], shoulder [8(8.00%)] and so on. Statistically, a significant difference was observed in the site of the lesions [p<0.0001*].

Yielding palpation [40(40.00%)], followed by the firm [36(36.00%)]. Yielding consistency was observed in most of the patients [40(40.00%)]. All enrolled patients were recorded with normal warmth [100(100.00%)]. No patient had a lesion on nails. Statistically, a significant difference was observed in palpation and consistency.

The biochemical parameters were recorded and found that the mean Haemoglobin was [12.50±1.36], the mean blood sugar [110.96±16.68], blood urea [28.18±6.32], SGPT [38.27±6.73], serum albumin [4.11±0.34] .

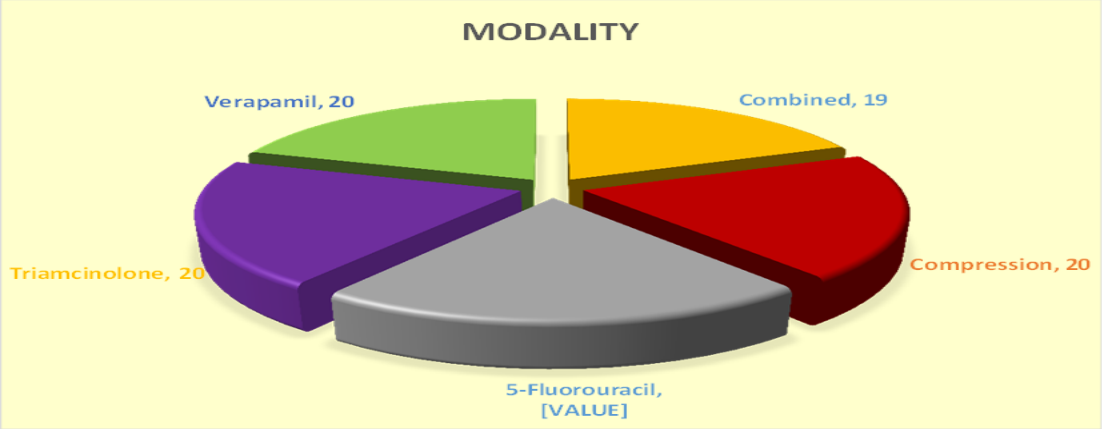


Figure 2: Different modality of treatment in enrolled patients

It was found that the 21(21.00%)] patients had 5-Fluorouracil therapy, while 20(20.00%)] patients had compression therapy. Triamcinolone therapy was done in 20(20.00%)] patients and Verapamil therapy in 20(20.00%)] patients. At baseline, no side effects or responses were observed during any therapies. At the same time, blistering was noted in 1 patient in 5-Flurouracil therapy at 3 weeks. At 18 weeks, atrophy and telangiectasia were also found in 5-Fluorouracil therapy.

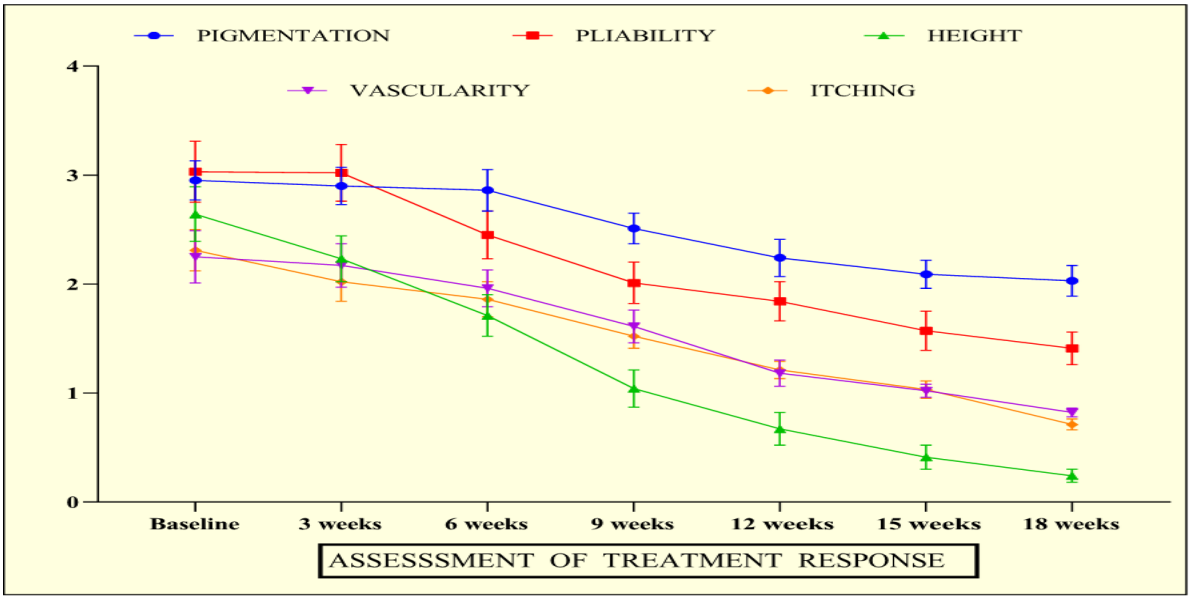


Figure 3: Assessment of combined therapy response in enrolled patients

It was observed that at the baseline, in combined therapy, all the scores such as pigmentation [2.95±0.18], pliability [3.03±0.28], height [2.64±0.25], vascularity [2.25±0.24] and itching [2.31±0.19] were noted in patients and found comparable. A gradual decrease was observed in all the scores, and at 18 weeks, the scores were noted as pigmentation [2.03±0.14*], pliability [1.41±0.15*], height [0.24±0.06*], vascularity [0.82±0.04*] and itching [0.71±0.05*] was found.

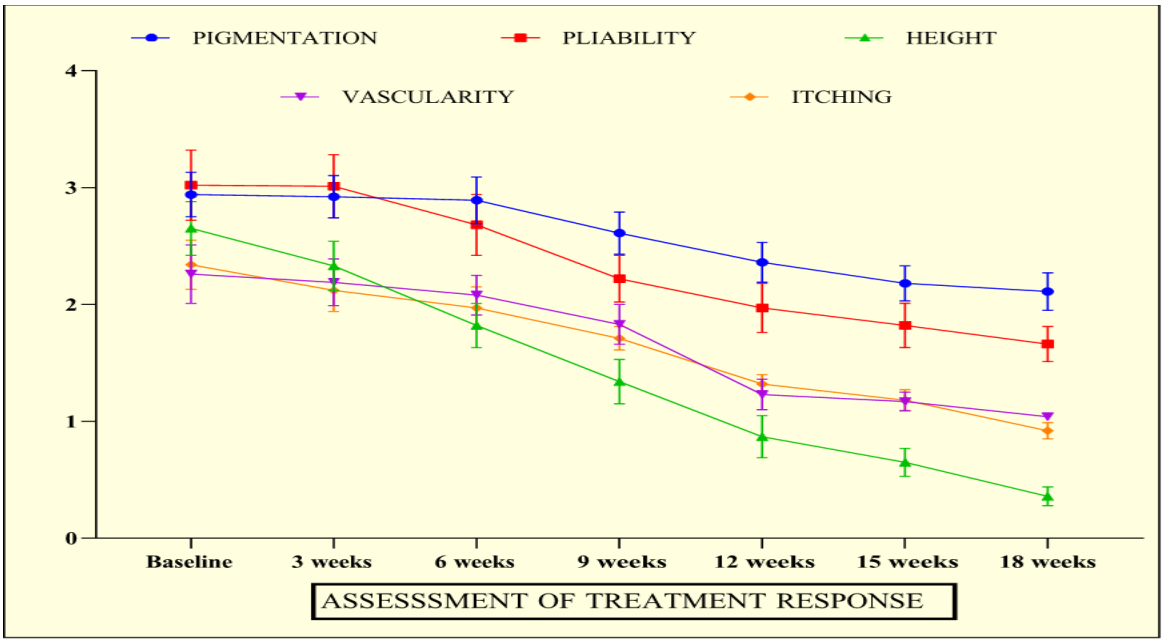


Figure 4: Assessment of triamcinolone therapy response in enrolled patients

At the baseline, in triamcinolone therapy, all the scores such as pigmentation [2.94±0.19], pliability [3.02±0.30], height [2.65±0.23], vascularity [2.26±0.25] and itching [2.34±0.21] were noted in patients and found comparable. A gradual decrease was observed in all the scores, and at 18 weeks, the scores were noted as pigmentation [2.11±0.16*], pliability [1.66±0.15*], height [0.36±0.08*], vascularity [1.04±0.03*] and itching [0.92±0.07*] was observed.

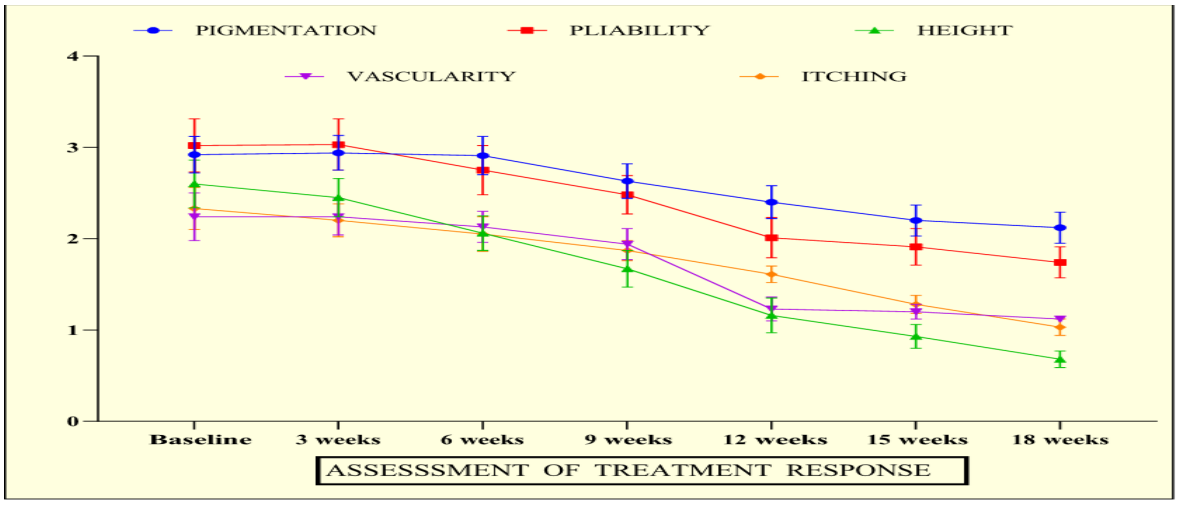


Figure 5: Assessment of verapamil therapy response in enrolled patients

At baseline, in verapamil therapy, all the scores such as pigmentation [2.92±0.20], pliability [3.02±0.29], height [2.60±0.26], vascularity [2.24±0.26] and itching [2.33±0.23] were noted in patients and found comparable. A gradual decrease was observed in all the scores, and at 18 weeks, the scores were noted as pigmentation [2.12±0.17*], pliability [1.74±0.17*], height [0.68±0.09*], vascularity [1.12±0.03] and itching [1.03±0.09*] was observed.

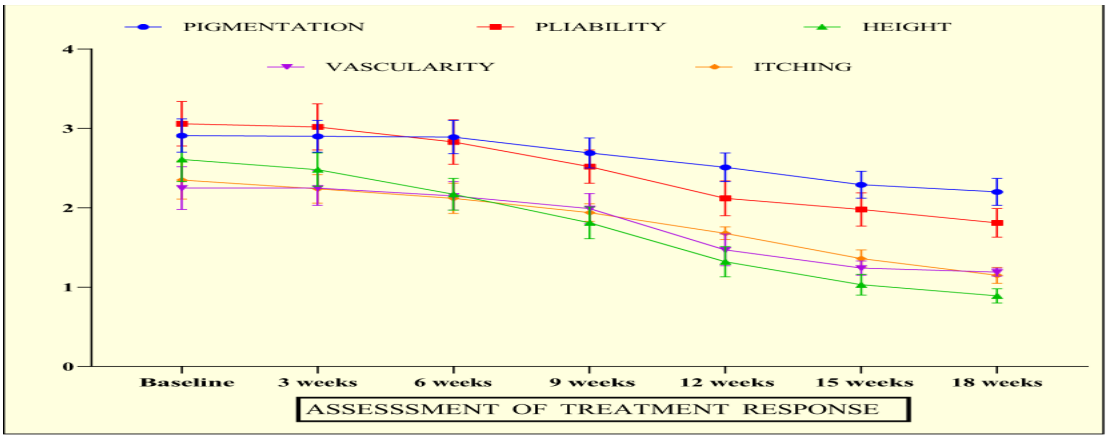


Figure 6: Assessment of 5-fluorouracil therapy response in enrolled patients

At baseline, in 5-fluorouracil therapy, all the scores such as pigmentation [2.91±0.21], pliability [3.06±0.28], height [2.61±0.28], vascularity [2.25±0.27] and itching [2.35±0.24] were noted in patients and found comparable. A gradual decrease was observed in all the scores, and at 18 weeks, the scores were noted as pigmentation [2.20±0.17*], pliability [1.81±0.18*], height [0.89±0.09*], vascularity [1.19±0.05] and itching [1.15±0.10*].

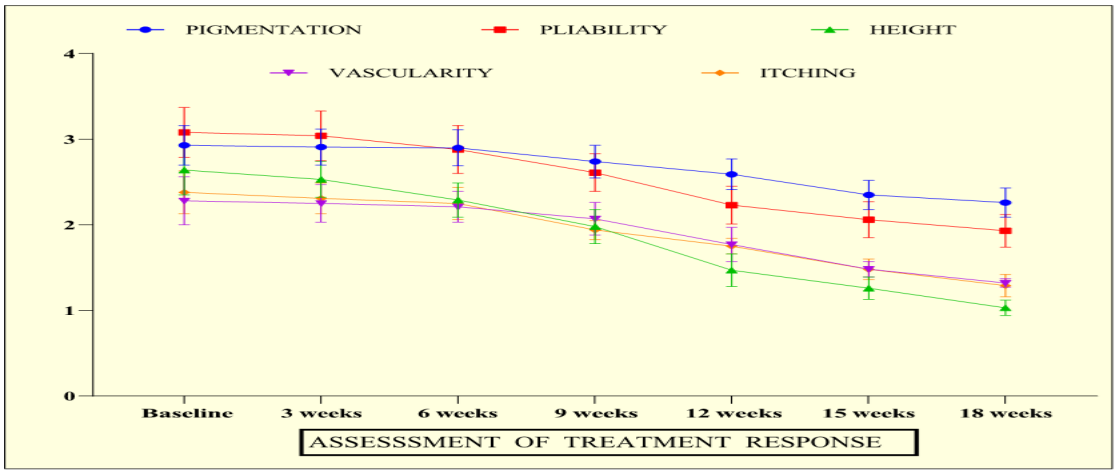


Figure7: Assessment of compression therapy response in enrolled patients

At baseline, in compression therapy, all the scores such as pigmentation [2.93±0.23], pliability [3.08±0.29], height [2.64±0.29], vascularity [2.28±0.28] and itching [2.38±0.25] were noted in patients and found comparable. A gradual decrease was observed in all the scores, and at 18 weeks, the scores were noted as pigmentation [2.26±0.17*], pliability [1.93±0.19*], height [1.03±0.09*], vascularity [1.32±0.05*] and itching [1.29±0.13*]. A gradual decrease in mean differences between all the scores was noted in all the treatment modalities. But a maximum mean difference was observed in combined therapy as compared to the rest of the therapy.

Discussion

Aggarwal A *et al.* documented a mean age of 30.41 years, where most of the patients were male, followed by females [37]. A similar study has also been documented that mean age of 28 years; in contrast to our study, the majority of the patients were females [n=33],

followed by males [n=25] [36]. In contrast, the earlier study showed that the mean age of the patients was [22.6±8.1], ranging from 5 to 35 years. 11 patients (55%) were female, and 9 (45%) were male. It was reported that the 9 of 14 patients (64.28%) with a positive family history of keloids had spontaneous keloids, compared to 22 of 66 patients (33.33%) with a negative family history [37].

In the present study, the majority of the patients [21(21.00%)] had 5-Fluorouracil therapy, followed by compression therapy [20(20.00%)], Triamcinolone therapy. [20(20.00%)], Verapamil therapy [20(20.00%)] and combined therapy [19(19.00%)]. Kant SB *et al.*used combined intralesional therapy of triamcinolone and verapamil in their study [45]

In contrast, Aggarwal A *et al.* used adjuvant therapy for scar treatment. In the present study, at baseline, no side effects or responses were observed during any therapies [37]. At the same time, blistering was noted in 1 patient in 5-Flurouracil therapy at 3 weeks. At 9 weeks, Telangiectasia was noted in 1 patient in verapamil therapy. At 18 weeks, atrophy and telangiectasia were also found in 5-Fluorouracil therapy. In a study by Kant SB *et al.*, one individual developed scar hardening. Another patient experienced mild scar indentation [36].

In a study by Aggarwal A *et al.*the average rate of adverse effects was observed in 50% (n=8) patients in the triamcinolone acetonide group. 43.75% (n=7) of patients in the hyaluronidase group, 26.66% (n=4) in the verapamil hydrochloride group, 52.94% (n=9) in the radiofrequency group, and 60% (n=9) in the intralesional radiofrequency combination group [37].

The efficacy of triamcinolone has been proven by several research; verapamil is considered separately from triamcinolone. Triamcinolone is the top standard of non-surgical treatment for hypertrophic scars and keloids. However, verapamil was a promising alternative to triamcinolone in treating hypertrophic scars and keloids [8].

Conclusion

The present study aimed to evaluate the efficacy of various keloid and hypertrophic scar treatments. Several studies supported our observations, while a few opposed them. Based on the findings of this study, only 5-Fluorouracil and Verapamil therapies showed side effects in patients. Assessment of all the treatments showed a significant decrease in all the scores such as pigmentation, pliability, height, vascularity and itching.

Still, there was a significant mean difference in the scores among all the therapies, which showed combined therapy was best as no side effects were noted in combined therapy, followed by triamcinolone, verapamil, 5-fluorouracil and compression alone. No side effect was found in compression therapy, but this therapy's efficacy was low compared to other therapies.

However, this study has significant limitations, including small sample size, and results based on a single tertiary care hospital that may not be generalized for all settings.

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