

Can Subcision and Suction Techniques Improve the Appearance of Post Acne Scars in Egyptian Patients?

ALZAHRAA A. ALSHATER, M.Sc.*; ATEF I. EL AKHRAS, M.D.*; ASHRAF H. ABBAS, M.D.** and HISHAM A. NADA, M.D.*

The Departments of Dermatology, Venereology & Andrology and Plastic & Reconstructive Surgery Unit, General Surgery**, Faculty of Medicine, Suez Canal University, Ismailia, Egypt*

ABSTRACT

Background: Management of atrophic post acne scars remains a challenge to the plastic surgeons and dermatologists. Minimally invasive noninvasive and techniques and combination of both are used for improvement of atrophic acne scars with varying degrees of success and disadvantages.

Methods: Fifteen Egyptian patients of skin type III-V with bilateral atrophic post acne scars were included in the study. All patients underwent subcision on the left side and subcision with repeated suctioning on the right side. All patients completed the treatment and 6 months follow-up period.

Results: In subcision-suction side, 12 (80%) patients showed improvement in their scars (20% show marked improvement and 26.7% excellent improvement) according to physician assessment. 46.7% of patients have over 50% (marked to excellent) improvement in blinded physician assessment after six months. In "subcision only" side; 12 (80%) patients showed improvement in their scars (26.7% show marked improvement and 0% excellent improvement) according to physician assessment. However, 26.7% patients have over 50% improvement in physician assessment after six months.

Conclusion: Subcision procedure with or without suction is safe, effective, simple, with minimal complications for the improvement of atrophic acne scars in patients with Fitzpatrick skin types III to V. We found that combination of the two procedures is better than subcision alone. However, we believe that these effects can be maximized when it is combined with recent lasers and/or injection techniques.

Key Words: Atrophic scars – Acne scars – Subcision – Suction.

INTRODUCTION

Acne has great variety of clinical presentations either noninflammatory or inflammatory [1]. Acne has a prevalence of over 90% among adolescents [2], and persists into adulthood in approximately 12%-14% of cases with psycho-social burden [3]. Scarring is an abnormal wound healing following the damage that occurs in the sebaceous glands during acne inflammation. Scars originate at the

site of tissue injury and may be atrophic or hypertrophic [4]. Eighty to ninety percent of people with acne scars are atrophic scars [5]. The severity of acne scars may depend on delays in treating acne patients [6]. Layton et al., reported that acne scars may occur to some degree in 95 percent of patients with acne vulgaris [7]. Goulden et al. [8] reported an incidence rate of 11% in men and of 14% in women while patients interviewed by Poli et al. [9] believed to have acne scars in 49% of cases. Early aggressive therapy may prevent scarring [10,11].

A variety of modalities have been advocated to treat acne scarring, but these techniques have limited efficacy and different risks, so a combination of different modalities is typically required to achieve successful results [12]. Orentreich & Orentreich defined subcision as a method of subcuticular undermining for the treatment of depressed cutaneous scars and wrinkles with use of a hypodermic needle [13]. The idea of subcision is to release of fibrous bands underlying scars and organization of blood subdermally [13,14].

After subcision; depression recurrence is a very common [15-17]. Re-depression starts from 2-5 days after subcision. This is due to rapid absorption of blood in the dermal pocket [18]. It is hypothesized that repeated suctioning by vacuum of the subcised scars at the recurrence period will prevent depression of the scar again by inducing repeated haemorrhage in dermal pocket, so new connective tissue formation below the scar area [18].

PATIENTS AND METHODS

This study was designed as prospective comparative split face study. Fifteen patients of both sexes with post acne atrophic scars of both sides

of the face were presented in the dermatology and plastic surgery outpatient clinics of Suez Canal University Hospital. The Research Ethical Committee approved the work and a written consent was taken from each patient. Clinical work started from January 2013 to January 2014. Inclusion criteria included the presence of bilateral atrophic facial acne scars and age older than 18 years old. Exclusion criteria were pregnancy, coagulopathy, active cystic acne, infection on the face, recent intake of systemic isotretinoin (in the past 12 months), Fitzpatrick skin type VI, history of keloid formation, pure ice pick scars, patients with unrealistic expectations. Personal and medical history and a general dermatological examination were performed for all patients. Photos were taken for all patients of the affected anatomic area sites before procedure and at the end of the treatment course with the same digital camera (Canon IXUS 125 HS, 16.1 Mega pixels). Acne scars severity was graded according to the qualitative global acne scarring grading system [19] Fig. (1).

Subcision:

Subcision was performed for all patients in both sides of the face under constant aseptic conditions, in the same facility and by the same surgical team, using identical technique.

- Disinfection: The skin was cleansed using Povidone Iodine then alcohol.
- Anaesthesia: First, the scar margins were marked with a fine-tip surgical marking pen - to prevent the scar fading after injection - and then local anesthesia was achieved with 3% Mepivacaine hydrochloride infiltrated subcutaneously without Epinephrine.
- Patients' position: The patient lay down with head resting at 45°.
- Type of needle: From 21- to 27- gauge needles were used depend on the size and shape of the scar as shown in Fig. (2-a).
- Subcision technique: We applied subcision for rolling and boxcars scars only.
- The needle was inserted subdermally 1-2mm from the target scar with the bevel upward, then release any fibrous attachments. In some scars, especially large ones, 2-3 entry sites were needed to complete undermining of scars.
- Post-operative; Oral and topical antibiotics were prescribed. Patients were instructed to minimize sun exposure, trauma, and tension to the scar site for as long as possible. Daily sunscreen was prescribed for 1 month after the procedure.

Suction:

After 3 days post subcision, the patients were examined. Suctioning was performed using 3A Health Care® aspeed 2 suction device shown in Fig. (2-b); on the right side of patient's face only every other day for 10 days. Suctioning was performed by both vertical and horizontal movement using suction device tube on flat or depressed scars only. Elevated lesions will not be suctioned until they become flat.

We started with low negative pressure on the first days of suction, then we increased it in subsequent sessions; depending on the condition of the scars. The maximum negative pressure was 0.8 Bar. Number of suctioning passes up to 8-12 passes per session. Effective suctioning caused hemorrhage in the subcised scars and led to elevation of the depressed scars above the skin surface.

Assessment:

After 6 months, The outcome was assessed by physicians and patients ratings. Degree of severity and improvement of the treated acne scars was according to clinical observations of the study subjects and review of photographs.

Grading of severity before and six months after procedure using qualitative global scarring grading system for acne scars were done according to clinical observation of the study patients. One blinded physician evaluated the degree of improvement of the treated acne scars. The observer was asked to grade each treated side based on before and after photos. The grading scale used for rating the improvement of the scar areas: (grading scale: 0 = no improvement, 1 = 1-25% (mild) improvement, 2 = 26-50% (moderate) improvement, 3 = 51-75% (marked) improvement, 4 = >75% (excellent) improvement).

Patients satisfaction measured by using the same grading scale (grading scale: 0 = no improvement, 1 = 1-25% (mild) improvement, 2 = 26-50% (moderate) improvement, 3 = 51-75% (marked) improvement, 4 = >75% (excellent) improvement). Side effects, including infection, dyspigmentation, scar formation, and acneiform eruption, were record.

Statistical data analysis:

Data were coded and entered using SPSS statistical software program (SPSS Inc.) version 20. The comparisons between groups were done using paired *t*-test for quantitative variables, Pearson chi-square tests for qualitative variables. *p*-value of 0.05 or less will be used to define the statistical significance.

RESULTS

This comparative split face study had been conducted on fifteen patients. Nine males (60%) and sex females (40%). Three patients (20%) were skin type III, eight were IV (53.3%) and four were V (26.7%). Four patients had rolling type (26.7%); four had boxcar type (26.7%) and seven had mixed types of scars (46.6%). Age ranged from 18 to 49 years with mean age 31 years. Patients had different grades of acne scars (according to qualitative global acne scarring grading system); 1 (6.7%) had mild, 6 (40%) had moderate and 8 (53.3%) had severe scars (Table 1). Both sides of all patients had similar degree of severity.

There is a statistically significant reduction in grade of acne scars ($p=0.029$, McNemar-Bowker Test) on subcision-suction side after treatment according to qualitative global scarring grading system (Table 2).

There is a statistically significant reduction in grade of acne scars ($p=0.030$, McNemar-Bowker Test) on "subcision only" side after treatment according to qualitative global scarring grading system (Table 3).

Twelve patients (80%) showed improvement in their scars in subcision suction side (20% show mild improvement, 13.3% moderate improvement, 20% marked improvement and 26.7% excellent improvement) according to physician assessment. 46.7% of patients have over 50% (marked to excellent) improvement in blinded physician assessment after six months.

In "subcision only" side; 12 (80%) patients showed improvement in their scars (13.3% show mild improvement, 40% moderate improvement, and 26.7% marked improvement) according to physician assessment. However, 26.7% patients have over 50% improvement in physician assessment after six months (Table 4).

According to patient satisfaction in subcision-suction side 3 (20.0%) patients graded their response to treatment as excellent with more than 75% improvement while in subcision group 0 (0.0%) patients graded their response to treatment as excellent. The mean of Patient satisfaction in subcision-suction side compared to subcision side was statistically significant ($p=0.029$) (Tables 6,7).

There was a highly statistically significant strong direct correlation between investigator assessment of improvement and patient satisfaction ($p<0.01$ Correlation Coefficient) in both sides (Table 8).

Table (1): Severity of acne scars according to qualitative global acne scarring grading system (before treatment).

	Frequency	Percent
Mild	1	6.7
Moderate	6	40.0
Severe	8	53.3
	15	100.0

Table (2): Grading of severity in subcision-suction (right side) before and after treatment.

	Severity after treatment			Total	p-value
	Mild	Moderate	Severe		
<i>Severity before treatment:</i>					
Mild	1 (100.0%)	0	0	1	0.029*
Moderate	4 (66.7%)	2 (33.3%)	0	6	
Severe	1 (12.5%)	4 (50.0%)	3 (37.5%)	8	

McNemar-Bowker Test. *Statistically significant.

Table (3): Grading of severity in subcision before and after treatment.

	Severity after treatment			Total	p-value
	Mild	Moderate	Severe		
<i>Severity before treatment:</i>					
Mild	1 (100.0%)	0	0	1	0.030*
Moderate	2 (33.3%)	4 (66.7%)	0	6	
Severe	0	5 (62.5%)	3 (37.5%)	8	

McNemar-Bowker Test. *Statistically significant.

Table (4): Comparison between improvements of both sides after treatment.

	Type of treatment	Subcision-Suction	Subcision	p-value
Improvement	None	3 (20.0%)	3 (20.0%)	-
	1-25%	3 (20.0%)	2 (13.3%)	1.00
	26-50%	2 (13.3%)	6 (40.0%)	0.58
	51-75%	3 (20.0%)	4 (26.7%)	1.00
	>75%	4 (26.7%)	0	0.20
	Total	15 (100%)	15 (100%)	

Fisher's exact test.

Degree of improvement:

0 = no improvement.

1 = 1-25% (Mild) 2 = 26-50% (Moderate)

3 = 51-75% (Marked) 4 = >75% (Excellent)

Table (5): Mean improvement of both sides after treatment.

Improvement	Type of treatment		p-value
	Subcision-Suction	Subcision	
Mean ± SD	2.13±1.55	1.73±1.10	0.212

Paired t-test.

Table (6): Comparison between patient satisfaction of both sides after treatment (subcision & subcision with suction).

		Type of treatment		p-value
		Subcision-Suction	Subcision	
Patient Satisfaction	None	2 (13.3%)	3 (20.0%)	-
	1-25%	1 (6.7%)	1 (6.7%)	1.00
	26-50%	5 (33.3%)	6 (40.0%)	1.00
	51-75%	4 (26.7%)	5 (33.3%)	1.00
	>75%	3 (20.0%)	0	0.196
Total		15 (100%)	15 (100%)	

Fisher's exact test

Degree of patient satisfaction:

0 = no improvement.

1 = 1-25% (Mild) 2 = 26-50% (Moderate)

3 = 51-75% (Marked) 4 = >75% (Excellent)

Our study also showed that 3 (75.0%) patients with rolling acne scars, 1 (25.0%) patient with boxcar scars and 3 (43.0%) patients with mixed scars had more than 50% improvement in subcision-suction side. While in subcision side 2 (50.0%) patients with rolling acne scars, 0 (0.0%) patients with boxcar scars and 2 (28.0%) patients with mixed scars had more than 50% improvement, however the relation between type of scars and improvement of both sides was statistically insignificant (Table 9).

Table (7): Mean patient satisfaction of both sides after treatment.

Patient satisfaction	Type of treatment		p-value
	Subcision-Suction	Subcision	
Mean ± SD	2.33±1.29	1.86±1.12	0.029*

Paired t-test. *Statistically significant.

Table (8): Comparison between mean improvement and patient satisfaction in both sides.

Type of Treatment	Patient Satisfaction		p value
	Correlation Coefficient r		
Improvement:			
Subcision-Suction	0.647		0.029*
Subcision	0.692		0.004*

*Statistically significant.

Our results showed that (66.7%) of patients with Fitzpatrick skin type III, (62.5%) of patients with Fitzpatrick skin type IV and (0.0%) of patients with Fitzpatrick skin type V had more than 50% improvement in subcision-suction side. While in subcision side (67.0%) of patients with Fitzpatrick skin type III, (25.0%) of patients with Fitzpatrick skin type IV and (0.0%) of patients with Fitzpatrick skin type V had more than 50% improvement, with statistically significant relation in both sides (p=0.011 & 0.016) (Table 10).

Table (9): Relation between type of scars and improvement of both sides.

Group	Type of scare	Improvement					Total	p-value
		None	<25%	25-50%	51-75%	>75%		
Subcision-Suction	Rolling	0	1 (25.0%)	0	2 (50.0%)	1 (25.0%)	4	0.356
	Boxcar	2 (50.0%)	1 (25.0%)	0	1 (25.0%)	0	4	
	Mixed	1 (14.3%)	1 (14.3%)	2 (28.6%)	0	3 (42.9%)	7	
Subcision	Rolling	0	0	2 (50.0%)	2 (50.0%)	0	4	0.663
	Boxcar	2 (50.0%)	1 (25.0%)	1 (25.0%)	0	0	4	
	Mixed	1 (14.3%)	1 (14.3%)	3 (42.9%)	2 (28.6%)	0	7	

Fisher's exact test.

Table (10): Relation between Fitzpatrick skin type and improvement of both sides.

Group	Type of skin	Improvement					Total	p-value
		None	<25%	25-50%	51-75%	>75%		
Subcision-Suction	III	0	1 (33.3%)	0	2 (66.7%)	0	3	0.011*
	IV	0	1 (12.5%)	2 (25.0%)	1 (12.5%)	4 (50.0%)	8	
	V	3 (75.0%)	1 (25.0%)	0	0	0	4	
Subcision	III	0	0	1 (33.3%)	2 (66.7%)	0	3	0.016*
	IV	0	1 (12.5%)	5 (62.5%)	2 (25.0)	0	8	
	V	3 (75.0%)	1 (25.0%)	0	0	0	4	

Fisher's exact test.

*Statistically significant.

o Bruising, Oedema was observed in all cases on both sides and resolved gradually within 4-7 days on the left side and 7-15 days on the right side.

o No hypertrophic scars was observed on all patients even with skin type V.

Fig. (1): Goodman and Baron qualitative scar grading system.

Grade	Level of disease	Clinical features
1	Macular	These scars can be erythematous, hyper- or hypopigmented flat marks. They do not represent a problem of contour like other scar grades but of colour.
2	Mild	Mild atrophy or hypertrophic scars that may not be obvious at social distances of 50cm or greater and may be covered adequately by makeup or the normal shadow of shaved beard hair in men or normal body hair if extrafacial.
3	Moderate	Moderate atrophic or hypertrophic scarring that is obvious at social distances of 50cm or greater and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extrafacial, but is still able to be flattened by manual stretching of the skin (if atrophic).
4	Severe	Severe atrophic or hptrophic scarring that is evident at social distances greater than 50cm and is not covered easily by makeup or the normal shadow of shaved beard hair in men or body hair if extrafacial and is not able to be flattened by manual stretching of the skin.

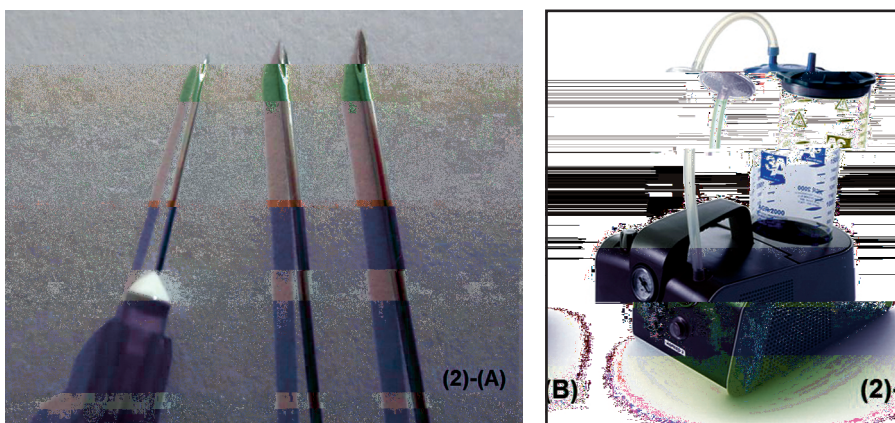
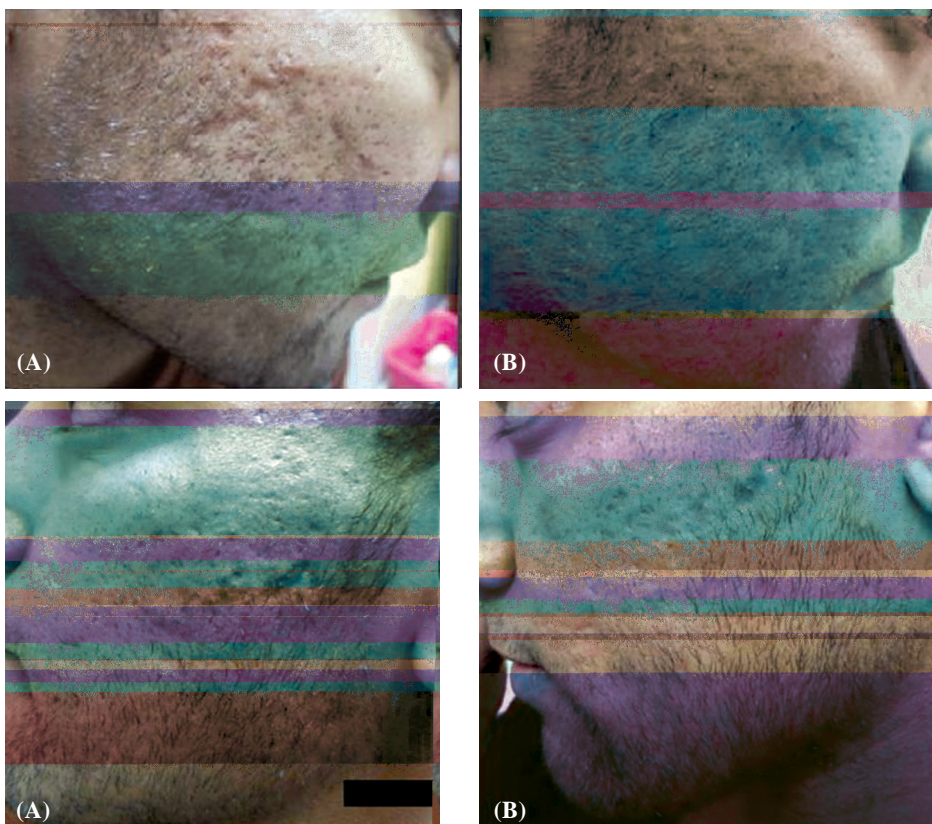


Fig. (2): (A) From 21- to 27-gauge needles were used depend on the size and shape of the scar. (B) 3A Health Care@ aspeed 2 suction device.



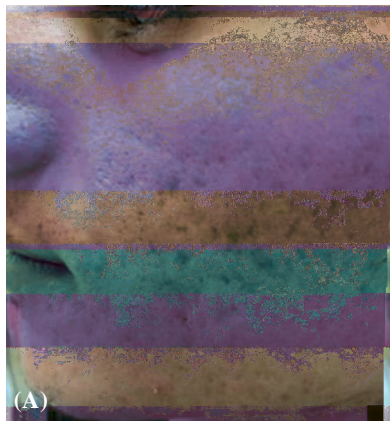
Right side (A) Before treatment. (B) Six months after treatment with Subcision-Suction.

Left side (A) Before treatment. (B) Six months after treatment with Subcision.

Fig. (3): Atrophic acne scars in 24 years old male patient.

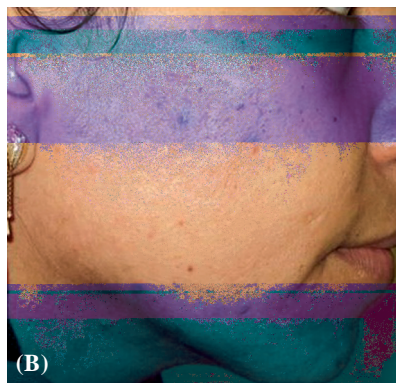


Right side (A) Before treatment. (B) Six months after treatment with Subcision-Suction.



Left side (A) Before treatment. (B) Six months after treatment with Subcision.

Fig. (4): Atrophic acne scars in 20 years old male patient.

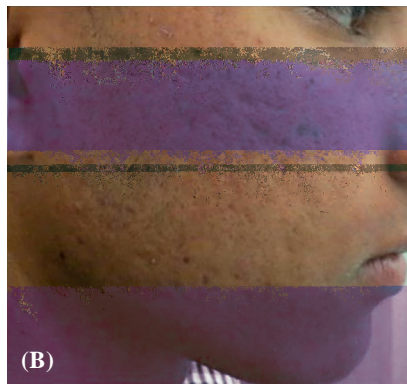
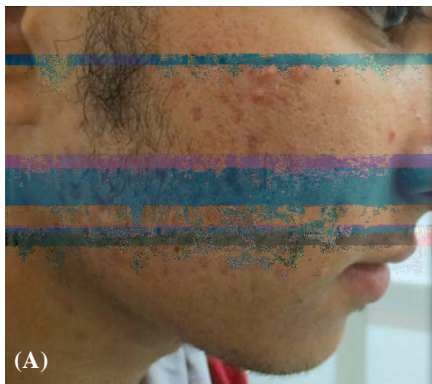


Right side (A) Before treatment. (B) Six months after treatment with Subcision-Suction.

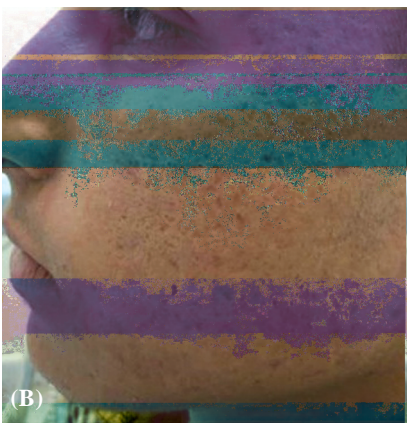


Left side (A) Before treatment. (B) Six months after treatment with Subcision.

Fig. (5): Atrophic acne scars in 35 years old female patient.

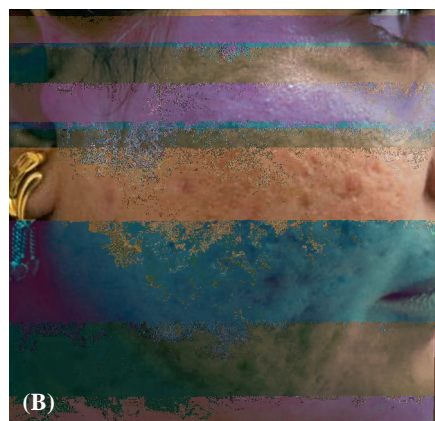
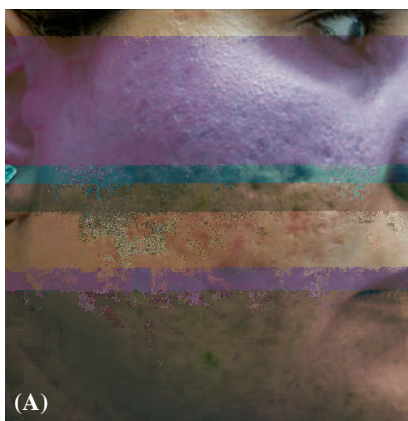


Right side (A) Before treatment. (B) Six months after treatment with Subcision-Suction.

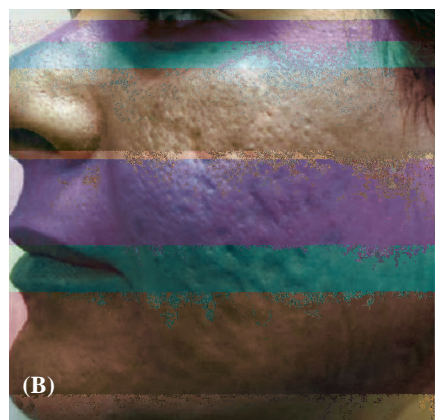
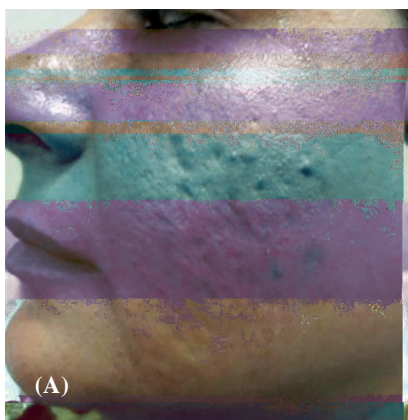


Left side (A) Before treatment. (B) Six months after treatment with Subcision.

Fig. (6): Atrophic acne scars in 19 years old male patient.



Right side (A) Before treatment. (B) Six months after treatment with Subcision-Suction.



Left side (A) Before treatment. (B) Six months after treatment with Subcision.

Fig. (7): Atrophic acne scars in 39 years old female patient.

DISCUSSION

Various therapeutic options have been described with variable clinical outcomes and complications [20]. Improvement of acne scarring, rather than total cure, must be the target for the patients and physicians [21].

Subcision is a simple procedure for improvement of acne scars. Scars can be subcised repeatedly [22]. Suction is a complementary treatment to subcision that can be done after subcision in depressed and flat scars. It was hypothesized that, repeated suctioning of the subcised scars might prevent re-depression by induction of repeated haemorrhage in the dermal pocket, delay in healing and more new connective tissue formation at the scar area [18].

This study demonstrates that both physicians and patients found that "subcision only" improves acne scars, with significant close agreement regarding the degree of improvement ($p=0.004$). The degree of severity showed a statistically significant reduction in grade of acne scars on subcision side ($p=0.030$, McNemar-Bowker Test) according to qualitative global scarring grading scale.

In all our patients the overall mean physician estimation of improvement in subcision side was 1.73 ± 1.10 while the mean patient satisfaction was 1.86 ± 1.12 . Twelve patients (80%) showed improvement in their scars. 26.7% patients have over 50% improvement in physician assessment after six months.

According to patient satisfaction in subcision side, 33.3% patients graded their response to treatment as marked with 51-75% improvement in their acne scars after treatment, 40% patients graded their response to treatment as moderate with 26-50% improvement in their acne scars after treatment.

Similar results have been reported in a study by Balighi et al., where they found 33.3% and 62% improvement after subcision according to investigators and patients, respectively [23]. In another study by Balighi et al., that had assessed Subcision in acne scar with and without subdermal implant in 22 patients, 10% of patients had no improvement, 70% of patients had mild improvement and 20% had moderate improvement 6 months after subcision. The mean patient assessment in this study was 53% (± 1.57) for subcision side after 6 months. Also in a study conducted by Alam et al. [15], where they assessed the efficacy of subcision in 40 patients with acne scars and found a mean

improvement of 50% by investigators at six months post-procedure [16].

In our study, both physician and patients found that subcision with suction improves acne scars, with a significant close agreement regarding the degree of improvement ($p=0.009$). The degree of severity showed statistically significant reduction in grade of acne scars ($p=0.029$, McNemar-Bowker Test) in subcision suction side according to qualitative global scarring grading scale. The overall mean physician estimation of improvement was 2.13 ± 1.55 while the mean patient satisfaction was 2.33 ± 1.29 . Twelve patients (80%) showed improvement in their scars in subcision suction side. 46.7% of patients have over 50% (marked to excellent) improvement in blinded physician assessment after six months.

These results are nearly coinciding with a study done by Balighi et al., where the mean improvement was 65% of physician estimation of improvement after 3 month follow-up [23]. In another study by Harandi et al., where 87.9% was skin type III, the overall improvement on the group that had continuous suction daily or every other day was 70% of improvement. However, in our study 20% was skin type III, 53.3% skin type IV and 26.7% skin type V [18].

On comparing both sides of the face, physician assessment of improvement showed no statistically significant difference between these two sides (subcision side and subcision plus suction side) 6 months after the procedure ($p>0.05$, Fisher's exact test), but there was statistically significant difference regarding patient satisfaction of two sides ($p=0.029$, Paired *t*-test). There was a significant correlation between investigator and patient assessment of improvement ($p<0.05$ Correlation Coefficient) on both sides.

In our study we found that patients with rolling scars had better improvement than boxcar or mixed scars regarding physician assessment on both sides, however this relation was statistically insignificant. Also, we found a negative relation between Fitzpatrick skin type and improvement of both sides regarding physician assessment, which was statistically significant ($p=0.011$ & 0.016), (where, 67.0% of patients with Fitzpatrick skin type III, 62.0% of patient with Fitzpatrick skin type IV and 0.0% of patients with Fitzpatrick skin type V had more than 50% improvement in subcision suction side). While in subcision side 67.0% of patients with Fitzpatrick skin type III, 25.0% of patients with Fitzpatrick skin type IV and 0.0% of patients

with Fitzpatrick skin type V had more than 50% improvement. We did not find similar data in other studies on reviewing literature regarding these relations.

The incidence of adverse effects such as swelling, bruising, was similar in both sides and transient lasting for several days. This is in agreement with previous studies where similar side effects were minimal to negligible [15,16].

Conclusion:

Subcision procedure with or without suction is safe, effective, simple, with minimal complications for the improvement of atrophic acne scars in patients with Fitzpatrick skin types III to V. We found that combination of the two procedures is better than subcision alone. However, we believe that these effects can be maximized when it is combined with recent lasers and/or injection techniques.

REFERENCES

- 1- Thiboutot D.M. and Strauss J.S.: Diseases of the sebaceous glands. In: Freedberg I.M., Eisen A.Z., Wolff K., Austen K.F., Goldsmith L.A., Katz S.I., editors. Fitzpatrick's dermatology in general medicine. 6th ed, New York: McGraw-Hill, 672-687, 2003.
- 2- Ghodsi S.Z., Orawa H. and Zouboulis C.C.: Prevalence, severity, and risk factors of acne in high school pupils: A community-based study. *J. Invest Dermatol.*, 129 (9): 2136-2141, 2009.
- 3- Williams C. and Layton A.M.: Persistent acne in women: Implications for the patient and for therapy. *Am. J. Clin. Dermatol.*, 7 (5): 281-290, 2006.
- 4- Holland D.B. and Jeremy A.H.: The Role of Inflammation in the Pathogenesis of Acne and Acne Scarring. *Semin Cutan Med. Surg.*, 24: 79-83, 2005.
- 5- Fabbrocini G., Annunziata M.C., D'Arco V., De Vita V., Lodi G., Mauriello M.C., Pastore F. and Monfrecola G.: Acne Scars: Pathogenesis, Classification and Treatment. *Dermatol Res Pract*, 893080, 2010.
- 6- Fabbrocini G., Vita V.D., Cozzolino A., Marasca C., Mazzella C. and Monfrecola A.: The Management of Atrophic Acne Scars: Overview and New Tools. *J. Clin. Exp. Dermatol. Res.*, S5: 001, 2012.
- 7- Layton A.M., Henderson C.A. and Cunliffe W.J.: A clinical evaluation of acne scarring and its incidence. *Clin. Exp. Dermatol.*, 19 (4): 303-308, 1994.
- 8- Goulden V., Stables G.I. and Cunliffe W.J.: Prevalence of facial acne in adults. *J. Am. Acad. Dermatol.*, 41: 577-580, 1999.
- 9- Poli F., Dréno B. and Verschoore M.: An epidemiological study of acne in female adults: Results of a survey conducted in France. *J. Eur. Acad. Dermatol. Venereol.*, 15: 541-545, 2001.
- 10- Holland D.B., Jeremy A.H., Roberts S.G., Seukeran D.C., Layton A.M. and Cunliffe W.J.: Inflammation in acne scarring: A comparison of the responses in lesions from patients prone and not prone to scar. *Br. J. Dermatol.*, 150: 72-81, 2004.
- 11- Fife D.: Practical Evaluation and Management of Atrophic Acne Scars, Tips for the General Dermatologist. *J. Clin. Aesthet. Dermatol.*, 4 (8): 50-57, 2011.
- 12- Lee J.W., Kim B.J., Kim M.N. and Lee C.K.: Treatment of Acne Scars Using Subdermal Minimal Surgery Technology. *Dermatol. Surg.*, 36: 1281-1287, 2010.
- 13- Orentreich D.S. and Orentreich N.: Subcutaneous incisionless (subcision) surgery for the correction of depressed scars and wrinkles. *Dermatol. Surg.*, 21: 543-549, 1995.
- 14- Goodman G.J.: Therapeutic undermining of scars (Subcision). *Australas J. Dermatol.*, 42: 114-117, 2001.
- 15- Alam M., Omura N. and Kaminer M.S.: Subcision for acne scarring: Technique and outcomes in 40 patients. *Dermatol. Surg.*, 31: 310-317, 2005.
- 16- Balighi K., Robati R., Moslehi H. and Robati A.: Subcision in acne scar with and without subdermal implant: A clinical trial. *J. Eur. Acad. Dermatol. Venereol.*, 22: 707-711, 2008.
- 17- Vaishnani J.B.: Subcision in rolling acne scars with 24G needle. *Indian J. Dermatol. Venereol. Leprol.*, 74: 677-679, 2008.
- 18- Harandi S., Balighi K., Lajevardi V. and Akbari E.: Subcision-suction method: A new successful combination therapy in treatment of atrophic acne scars and other depressed scars. *J. Eur. Acad. Dermatol. Venereol.*, 25: 92-99, 2011.
- 19- Goodman G.J. and Baron J.A.: Post acne scarring: A qualitative global scarring grading system. *Dermatol. Surg.*, 32 (12): 1458-1466, 2006.
- 20- Kim H.J., Kim T.G., Kwon Y.S., Park J.M. and Lee J.H.: Comparison of a 1,550nm Erbium: Glass fractional laser and a chemical reconstruction of skin scars (CROSS) method in the treatment of acne scars: A simultaneous split-face trial. *Lasers Surg. Med.*, 41 (8): 545-554, 2009.
- 21- Rivera A.E.: Acne scarring: A review and current treatment modalities. *J. Am. Acad. Dermatol.*, 59 (4): 659-676, 2008.
- 22- Branson D.F.: Dermal undermining (scarification) of active rhytids and scars: Enhancing the results of CO₂ laser skin resurfacing. *Aesthet. Surg.*, 18: 36-7, 1998.
- 23- Balighi K., Jamshidi S., Daneshpajoo M., Lajevardi V., Aalami Harandi S. and Ghassemi H.: Subcision for acne scarring with and without suctioning: A clinical trial. *Iran J. Dermatol.*, 14: 95-99, 2011.