

Research

Combined Scar Subcision and Autologous Fat Grafting for Depressed Facial Scar Correction

Ahmed M Abdel Modaber^{1*} Ahmed Hammad¹ and Vusal Aliyev²¹General Surgery Department, Faculty of Medicine, Mansoura University, Egypt²General Surgery Department, Emsey Hospital, Istanbul, Turkey**Abstract****Background**

Scars of the head and neck region can be physically and psychologically disfiguring, excessive scarring can lead to low self-esteem and stigmatization. Scars can be defined by their contour into elevated or depressed scars; the depressed one is characterized by the absence of underlying structure below the epidermis. The goals of scar revision, is to make the scar narrower and flatter, reorient or reposition the scar, fill in the depression, break up the scar, smooth out an irregular scar, improve the color of the scar, and correct facial landmark distortion. Improving both functions and aesthetics related to posttraumatic scarring are important goals in their treatment. Contemporary options for the improvement of depressed scars include scar revision with an elliptical excision, z-plasty, w-plasty, and geometric broken-line closure. Surgical excision for camouflage and/or re-orientation remains the gold standard for treatment of many scars. Subcision is incisionless subcuticular undermining, the principle of this procedure is to break the fibrotic strands which surround the scar to the underlying subcutaneous tissues. Depressed scars require particular attention when planning treatment.

Objectives

The aim of this study was to evaluate the effectiveness of scar subcision and autologous fat grafting in improving the aesthetic appearance and to obtain a uniform surface of facial scars.

Patients and Methods

In our study, 20 patients, suffering from atrophic (depressed) scars traumatic or surgical along more than one year were treated with different scar treatments. Their ages ranged from 18-45 years old. Scar subcision was done to patient in the range of more than 6 months after surgery or trauma in face.

Results

We found non-significant differences among the studied group between preoperative scar and postoperative scar regarding width and suture marks of the scar and high significant differences regarding height, color, overall appearance and total score of the scar.

Conclusion

Core fat grafting technique is simple and effective in augmenting many subcutaneous regions of the face and depressed scars. It is ideal for small defects that couldn't be treated with fillers alone. Because of the technique's simplicity, operative time was short & the cost is cheap.

Key Words: Skin; Adipose Tissue; Wound Healing; Scars**Introduction**

"Scar" is defined as "fibrous tissue that replaces normal tissue destroyed by injury or disease". Cutaneous scarring is a macroscopic disturbance of the normal structure and function of the skin architecture manifesting itself as an elevated or depressed area, with an alteration of skin texture, color, vascularity, nerve supply and biomechanical properties, resulting from the end product of a healed wound. With rare exceptions all wounds leave scars. An estimated 100 million patients acquire scars in the developed world each year following surgery [1].

Depressed scars are dermal depressions with overlying thinned epidermis which results from a loss of dermal collagen following some types of inflammation or traumatic injury such as acne varicella, post-traumatic wounds or post-operative scars [2].

***Corresponding Author:** Ahmed M Abdel Modaber, General Surgery Department, Faculty of Medicine, Mansoura University, Egypt, E-mail: a.abdelmodaber@mans.edu.eg

Sub Date: January 4th 2018, **Acc Date:** January 18th 2018, **Pub Date:** January 19th 2018

Citation: Ahmed M Abdel Modaber, Ahmed Hammad, Vusal Aliyev (2018) Combined Scar Subcision and Autologous Fat Grafting for Depressed Facial Scar Correction. BAOJ Surgery 4: 030.

Copyright: © 2018 Ahmed M Abdel Modaber, et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Depressed scars require particular attention when planning treatment. If there is significant soft tissue loss, scar effacement will be one of the most critical factors in successful management. In this case, soft tissue augmentation will be necessary to fill the depression should be with fat grafts [3].

Subcision (subcutaneous incision less surgery) is a surgical intervention used to treat a variety of skin depressions including atrophic acne scars and other depressed scars, by which a depressed scar is released from deep fibrosis and induce subepidermal thickening. Undermining the lesion allows blood to collect under the lesion surface and balloons the tissue, usually resulting in short-term echymosis. As the clot is reorganized dermal or subdermal fibrosis fills the atrophic and contracted space to efface depressions effectively with autologous tissue [4].

The technique of undermining scars has been widely practiced over many years as an adjunct to fibrin foam or animal-based collagen implantation (Fibrel), dermal grafting, and microlipo injection. As a stand-alone corrective technique, it was described for about 15 years ago(5). Technique of subcutaneous incision, or Subcision, was initially described by Orentreich and Orentreich(6), it is used to free the tethering fibrous bands that cause atrophic scars, especially rolling type, and they used a tribeveled hypodermic needle to cut the adherent bands beneath the skin. Later, it was found that better results could be achieved by using an 18-gauge 1 1/2-inch Nokor admix needle . As its triangular tip allows smooth and thorough separation of fibrous cords [4].

The aim of this study is to evaluate the effectiveness of scar subcision and autologous fat grafting in improving the aesthetic appearance and to obtain a uniform surface of facial scars.

Patients and Methods

This interventional study was carried out on 20 patients, of males, suffering from atrophic (depressed) scars traumatic or surgical along more than one year. Patients were enrolled in our study after being asked about different scar treatments, informed by verbal and written explanations about our treatment method, and filling out a consent form.

Scar subcision was done to patient in the range of more than 6 months after surgery or trauma in face.

Inclusion Criteria

1. Patient has old [post-traumatic or post-surgical] singular scars that are discrete, linear depressed scar.
2. Patients age of 16 years old and older.
3. Both sexes.
4. Patients who are able to follow our treatment protocol.

Exclusion Criteria

1. Recent scars.
2. Any other type rather than depressed scars.
3. Patients with history of hematological disorders.
4. Patients Taking drugs that prolong bleeding as aspirin.
5. Mentally or psychologically disordered patients.
6. Prior chemotherapy, radiotherapy.
7. Patients with keloid formation tendency.
8. Those that refuse our treatment protocol.
9. Patients with known chronic diseases.

Methods

For all patients, the following was done

- Thorough history taking
- Physical examination of the patient
- Preoperative laboratory investigations including CBC, liver function test, kidney function test, PT, PTT, and INR
- Preoperative consultation
- Preoperative photography and informed consent from the patient
- Evaluation of the depressed scar; before and after treatment by 2-6 months by qualitative grading system Stoner Brooks scar evaluation [7], as shown in Table (1).

Table (1): Stoner Brooks scar evaluation [7]

Stoner Brooks scar evaluation
(i) Width of the scar: >2 mm- ≤2mm(0–1 points);
(ii) height: elevated - depressed (0–1 points);
(iii) color: darker - same or lighter (0–1 points);
(iv) hatch or suture marks: present - absent (0–1 points);
(v) Overall appearance: poor - good (0–1 points) /total score from 0 to 5 points.
<ul style="list-style-type: none">• Applicable for all scars.• Assessing hatch and suture marks.• An increasing score correlates with an improving scar.

Operational design

1. Wound Subcision



Figure (1): Wound Subcision



2: Fat harvesting (liposuction)

Figure (2): Fat harvest with a syringe through a periumbilical incision

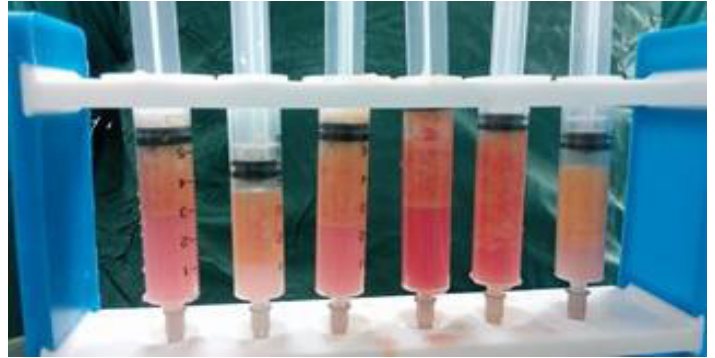


Figure (3): Products of liposuction before centrifugation

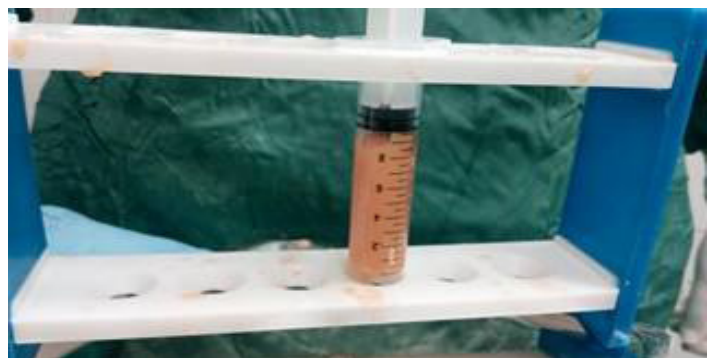
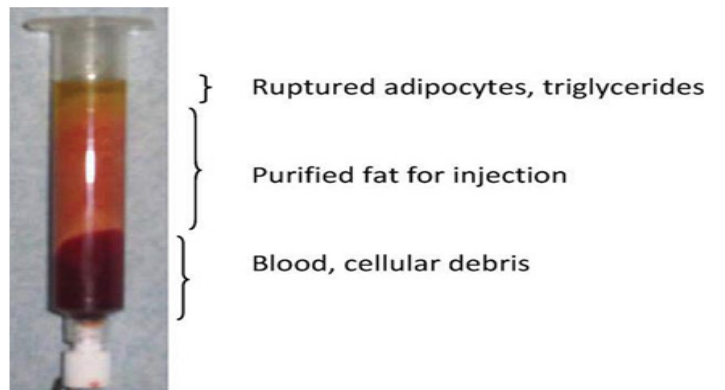
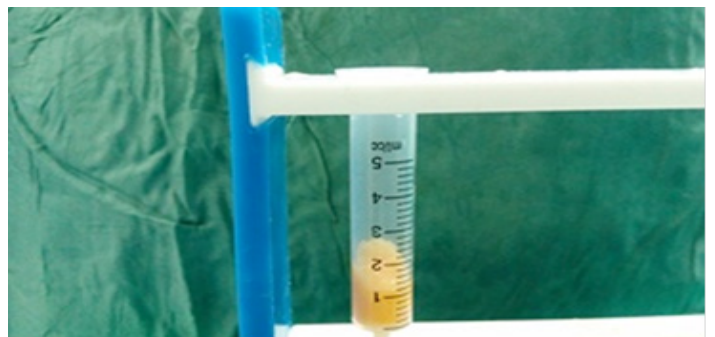


Figure (4): Products of centrifugation before & after oil and fluid was discarded



3- Fat injection:

Figure (5): Coleman-Pattern-Fat-Transfer-Cannulas



Follow up

Data were collected from the patients preoperatively in the form of full medical history and examination. Follow up of patients was for 6 months in the OPD.

Improvement Criteria

We record percentage of improvement for each patient after completion of treatment by comparing before-and-after digital photographs of the face.

1. Size: any measurable decrease in size was considered to be a sign of improvement.
2. Depth: any measurable decrease in depth was considered to be a sign of improvement.
3. Color: any measurable change in color to normal skin color was considered to be a sign of improvement.
4. at the final visit, patients were asked to assess the overall response and their satisfaction of the results as a percentage.

Assessment of Efficacy of the Therapeutic Procedure

Clinical Assessment

The degree of improvement was estimated based on the mean value of the patient (regarding shape, depth, and width of the scars) and percentage of scar improvement was evaluated according Stoner Brooks Scar Evaluation(7) as follows:

- Poor improvement: If there was <25% improvement in the scar
- Good improvement: If there was 25 – 49% improvement in the scar
- Very good improvement: If there was 50 – 74% improvement in the scar
- Excellent improvement: If there was ≥ 75% improvement in the scar

Safety assessment: to detect any complications occurred for the patients as

erythema, edema, itching, ecchymosis, infection, overcorrection, or any allergic manifestations, etc...

Follow up assessment: to detect any improvement or worsening of the scar over a period of six months.

Results

This study was carried out on 20 patients (18 males and 2 females) with atrophic (depressed) scars traumatic or surgical along more than one year. Their ages ranged from 18-45 years old (table 2).

Table (3) showed a non-significant difference among the studied group between preoperative scar and postoperative scar regarding width of the scar ($p > 0.05$).

Table (4) showed statistically a high significant difference among the studied group between preoperative scar and postoperative scar regarding height of the scar ($p < 0.001$).

Table (5) showed statistically a high significant difference among the studied group between preoperative scar and postoperative scar regarding color of the scar ($p < 0.001$).

Table (6) showed a non-significant difference among the studied group between preoperative scar and postoperative scar regarding suture marks of the scar ($p > 0.05$).

Table (7) showed statistically a high significant difference among the studied group between preoperative scar and postoperative scar regarding overall appearance of the scar ($p < 0.001$).

Table (8) showed statistically a high significant difference among the studied group between preoperative scar and postoperative scar regarding total score of the scar ($p < 0.001$).

Table (2): Demographic data of the studied group:

Variable	Cases (n=20)	
Age : (year)		
Mean ± SD	33.2 ± 9.98	
Range	18 - 45	
Variable	No	%
Sex:		
Female	2	10
Male	18	90

Table (3): Width of the scare pre & post-operative among the studied group:

Variable	Pre (n=20)		Post (n=20)		MC	P
	No	%	No	%		
Width:						
< 2	10	50	10	50	0	1
≥ 2	10	50	10	50		NS

Table (4): Height of the scare pre and post-operative among the studied group:

Variable	Pre (n=20)		Post (n=20)		MC	P
	No	%	No	%		
Elevated or depressed:						
Present	20	100	4	20	14.06	<0.001**
Absent	0	0	16	80		

Table (5): Color of the scare pre & post-operative among the studied group:

Variable	Pre (n=20)		Post (n=20)		MC	P
	No	%	No	%		
Color:						
Same	14	70	4	20	8.01	0.001**
Lighter	6	30	16	80		

Table (6): Suture marks of the scare pre & post-operative among the studied group:

Variable	Pre (n=20)		Post (n=20)		MC	P
	No	%	No	%		
Marks:						
Present	3	15	0	0	1.33	0.25
Absent	17	85	20	100		NS

Table (7): Overall appearance of the scare pre & post-operative among the studied group:

Variable	Pre (n=20)		Post (n=20)		MC	P
	No	%	No	%		
	Appearance:					
Poor	20	100	4	20	14.06	<0.001**
Good	0	0	16	80		

Table (8): Total score of the scare pre & post-operative among the studied group:

Variable	Pre (n=20)		Post (n=20)		MC	P
	No	%	No	%		
	Score:					
0	3	15	0	0	18.9	<0.001**
1	7	35	4	20		
2	4	20	0	0		
3	6	30	0	0		
4	0	0	6	30		
5	0	0	10	50		
Score:					Paired W	
Mean ± Sd	1.65 ± 1.09		3.9 ± 1.55		3.57	<0.001**
Range	0 - 3		1 - 5			

Discussion

Scars of the head and neck region can be physically and psychologically disfiguring, excessive scarring can lead to low self-esteem and stigmatization. Scars may be the end product of elective or urgent surgery, burns, and trauma [8].

The goals of scar revision, is to make the scar narrower and flatter, reorient or reposition the scar, fill in the depression, break up the scar, smooth out an irregular scar, improve the color of the scar, and correct facial landmark distortion [3].

Improving both functions and aesthetics related to posttraumatic scarring

are important goals in their treatment. Patients should be reminded that total elimination of a scar is not feasible. Moreover, recurrence of the same scarring pattern after repair can be an unfortunate possibility [9].

Surgical excision for camouflage and/or reorientation remains the gold standard for treatment of many scars. However, less invasive treatments can frequently offer improvement or serve as an adjunct following surgical treatment [10].

In the preoperative setting it is important to delineate the goals and expectations of scar revision. Patients often present with considerable misperceptions about what is feasible in scar revision. While decreasing the visibility of scarring is a reasonable objective [9].

Subcision, which is incisionless subcuticular under-mining, was first introduced by Orentreich and Orentreich. The authors reported that subcision with tribeveled hypodermic needles was effective in correcting various types of skin depressions. They postulated that a depression could be lifted by the releasing action of the procedure and the formation of fibrotic tissue in the normal course of wound healing. The individual propensity for fibroplasia in the subcised area depends upon skin tension, which may cause internal hypertrophic scarring [11].

The wire scalpel instrument consisting of a braided wire attached to a straight needle that was introduced by Sulamanidze et al. has been used for subcision in the clinical field. The authors concluded that subcutaneous dissection using a wire scalpel is a simple, safe, and effective method for improving the appearance of scars or age-related contour defects. Subcision with a wire scalpel is effective for depressed scars, wrinkles, or folds. Furthermore, they reported that better results were obtained by simultaneous filling with fat or other autogenous tissues after subcision [11].

Although subcision is safe, valuable and practical, depression recurrence is a very common side-effect. Aalami et al. (12) observed such common re-depression in their patients in the first 2–3 weeks after subcision as follows: start of re-depression from 2 to 5 days after subcision, rapid progress of re-depression up to about the 10th day of subcision and gradual progression for about 1 week more. This is concurrent with absorption of oedema and haemorrhage in dermal pocket and completion of healing process of dermal wound.

Core fat graft is en bloc fat graft harvesting which is less traumatic to the graft and theoretically reduces tissue loss and improves fat graft survival. However, en bloc fat graft augmentation requires donor and recipient incisions and has the potential for visibility of the scar [13].

In our study, 20 patients, suffering from atrophic (depressed) scars traumatic or surgical along more than one year were treated with different scar treatments. Their ages ranged from 18-45 years old. Scar subcision was done to patient in the range of more than 6 months after surgery or trauma in face.

Fontdevila et al. [13] and Cervelli et al. [14] showed mean age 45 and 40 respectively as they were concerned with fat injection for rejuvenations and in chronic Lower-Extremity Ulcers which mostly occurs in old age. Hendi [15] worked on facial re-contouring using fat transfer; the mean age was 35 years. Adly et al. [16] assess the success of core fat graft in management of depressed scars in forty patients presented with subcutaneous defects due to depressed scars, the mean age was 21.8 ± 5.1 years, ranging between 12 and 31 years in half of cases, the injection site was forehead. Face was the injection site among 40% of patients.

Gadkari and Nayak [17] compare the efficacy of combined subcision and dermaroller vs combined subcision and cryoroller in acne depressed scar treatment on thirty patients (19 males and 11 females) with grade 2, 3,

and 4 postacne scarring with a mean age of 27.17 years 83% of the patients were in the 20–29 years age group, the minimum age being 20 years and maximum age being 40 years.

Patients were (90%) males and (10%) females; this may be explained by high frequency of male's exposure to trauma than females. Also, most of females were afraid about the technique i.e. the syringe used in subcision.

Hendi [15] showed 100% female sex in the studied population which confirms the idea that females are psychologically affected with skin problems more males. It was found that in another study that males counting about 70% of the studied population [13].

Adly et al. [16] show study sample consisted of 12 (30.0%) males and 28 (70.0%) females.

Gadkari and Nayak [17] show 37 patients included in the study, seven patients dropped out. Of the remaining 30 patients who completed the study, 19 were males and 11 were females.

We found non-significant differences among the studied group between preoperative scar and postoperative scar regarding width and suture marks of the scar and high significant differences regarding height (degree of depression), color, overall appearance and total score of the scar.

Vaishnani [18] studied the efficacy of subcision in depressed scars and stated that results after subcision differ at 2 months and 6 months, with greater improvement observed over time, because scar remodeling is a continuous process, and it cannot be considered to be in a steady state until at least 2 years after wounding. Improvement in patients was about 30%.

Aalami et al. [12] stated that superficial dermal undermining was the key point of successful undermining for various types of atrophic and depressed scars in their patients. And by using this method most of atrophic scars of a patient in any type, number, shape and size could be treated in one session. Also they said that, deeper undermining was not as effective as superficial dermal undermining in management of various types of atrophic scars. Improvement in subcision-suction method compared with subcision alone was quite remarkable and showed that repeated suctioning at the recurrence period increases the efficacy of subcision.

Atrophy and fibrous tissue formation following wound healing or improvement of acne is the cause of depression that occur in post-traumatic or in acne scars. In subcision, due to release of fibrotic tissue, scar surfaces separate from underlying attachment and blood dermal pocket is formed beneath the scar. Blood not only acts as a short-term spacer to keep the tissue from early attachment, but also the subsequent organization of blood is thought to induce connective tissue formation and correction of the defect, because the blood clot is made up of cross-linked fibrin, fibronectin, and platelets that trap plasma proteins and blood cells.

Also, endogenous growth factors help for new connective tissue formation beneath the subcised scars [19].

The greater the grade the patients had, the more severe their atrophic scars. So, the more the severity of atrophic scars the more they are resistant to treatment. On the other hand, patients with scar grades II and less indicate that they have mild and shallow scars, so they will get more benefit from the new connective tissue formed in the dermal wound following subcision and show better results. Moreover, it was reported that; a large, deep, ill-defined defect is not predominantly a dermal event but is deeper and needs subcutaneous augmentation [20].

Balighi et al. [21] mentioned that the complication between their cases were few, only swelling and bruising following subcision in 60% of their patients. Also it was reported by Aalami et al. [12] that subcision is a safe, easy to perform, well-tolerated, and effective surgical technique for treating atrophic scar.

Aalami et al. [12] mentioned that during 4th to 8th day after subcision, haemorrhagic papule and pustule can be formed followed by formation of hypertrophic scar, they stated that performing subcision too superficial (subepidermal like undermining) was the main aetiology for this complication in some of their cases, they explain the mechanism by which this technical error causes a hypertrophic scar is formation of a prominent subepidermal blood pocket, which consequently induces an elevated fibrous scar tissue immediately under the epidermis, also skin susceptibility can play a role in the aetiology for hypertrophic scar following subcision. So, taking a detailed and careful history from the patients was very important.

In our study, we take care of many important precautions regarding subcision procedure to avoid a lot of complications such as: sufficient anesthesia, selection of the needle, Placement of the needle was meticulously planned, always in the superficial dermis, prescribing local and systemic antibiotic following subcision.

Doctor's satisfaction on evaluation of scar post-injection in comparison to pre-injection state showed significant improvement, when comparing those results with personal satisfaction post-injection in comparison to pre-injection state, we found that doctors had more strictly objective evaluation of the injected area than did the patients. So, subcision followed by fat grafting technique is simple cost effective, simple to be performed in an outpatient clinic.

Ayeni et al. [22] do subcision using the 20-G cataract blade which is extremely sharp, which allows more controlled depth and precision of incision; it is sharp along the length of its bevel, giving it a longer cutting distance than a Nokor needle; and it has a handle, making it easier to grasp in the hand and allowing the operator to visualize the depth and angle of penetration. As they see that the Nokor needle is that it is not exceedingly sharp. In addition, it is a short needle without a handle, which may make

it ergonomically challenging to use.

Lee and Sung [23] use a modified subcision technique using a 20-gauge spinal needle cannula and a 4-0 Vicryl suture as, an alternative to the wire scalpel method for nasolabial fold correction.

Balighi et al. [21] assessed subcision in rolling acne scars and evaluation the use of a novel dermal short-lived filler 'absorbable plain catgut suture' in conjunction with subcision. They stated that subcision seems to be a safe, simple, well-tolerated and valuable surgical procedure for some types of acne scars and for patient unwilling to undergo more complex procedure. In this regard, it is a useful tool for dermatologists who perform scar revision with considerable rate of improvement and patients' satisfaction. The subcision has been performed with use of an 18-gauge hypodermic needle (Nokor Admix, Becton Dickinson Co.).

Bloemen et al. [24] investigated the reliability and validity of the PRIMOS for objective and quantitative measurement of surface roughness of skin and scars. They concluded that The Phase shift Rapid in Vivo Measurement of the Skin (PRIMOS) is a reliable and valid objective tool for evaluating surface roughness in normal appearing skin and burn scars. By means of the PRIMOS, scar maturation and final outcome can be measured and documented. This instrument could become a valuable tool to clinicians and researchers in the field of (plastic) surgery and dermatology.

Adly et al. [16] assessed the success of core fat graft in management of depressed scars after creating a space in the recipient site by either a pair of baby metzenbaum scissors or the same syringe containing the fat. Forty patients presented with subcutaneous defects due to depressed scars were managed with core fat graft injection. The results were good with significant improvement of personal satisfaction post injection in comparison to pre-injection state. The overall mean percentage increase in personal satisfaction (64% out of total score). Recipient site bruising and pigmentation were the only complication in six out of forty patients. They concluded that core fat grafting technique is simple and effective in augmenting depressed scars. The technique is simple, with short operative time and the cost is cheap.

Ramadan et al. [25] compared the efficacy of a high-concentration TCA CROSS method with subcision with 1.5-inch NoKor Admix needle in the treatment of atrophic rolling acne scars. Subcision shows better results and fewer side effects than 100% TCA CROSS, although 100% TCA CROSS can be a useful alternative in patients with contraindications to subcision.

Al-Dhalimi and Arnoos [26] evaluated the effectiveness and safety of subcision using an 18G needle in Iraqi patients with rolling acne scars. They concluded that subcision appears to be simple, safe, well tolerated surgical tool to improve selected people with acne scars. It is useful mainly for rolling depressed scars and has no much effect in those with icepick or boxcar scars. It can be part of multiple types of treatments used for patients with acne scars. It can lead to overall improvement in those

unwilling to undergo other types of sophisticated treatments like laser, dermabrasion or dermal fillers.

Gadkari and Nayak [17] compared the efficacy of combined subcision and dermaroller against combined subcision and cryoroller in the treatment of acne scars. Subcision was performed using a 20-gauge needle. They concluded that combined subcision and cryoroller is a better technique than combined subcision and dermaroller in treatment of acne scars.

In our study, we do subcision with an 18-gauge 1.5 inch Nokor Admix needle which causes sharp cutting to fibrous tissue beneath the depressed scar leading to release the adherent scar. Then, fat harvesting and collection are accomplished by using the syringe method with a cannula of 3 mm diameter tubes and centrifuged at 3000 rpm for 1 min. Fat is then gently injected through a 2mm cannula.

Undoubtedly, development of combined scar subcision and autologous fat grafting for depressed facial scar correction requires further studies with larger numbers of patients and longer follow-up duration- by interested colleagues to solve such a prevalent cosmetic problem from which many people suffer.

Conclusion

Combined scar subcision and autologous fat grafting technique is simple and effective in augmenting many subcutaneous regions of the face and depressed scars. It is ideal for small defects that couldn't be treated with fillers alone. Because of the technique's simplicity, operative time was short & the cost is cheap.

- Therefore, from the results of this study, we can conclude that:
- The advantages of combined scar subcision and autologous fat grafting were:
- Easy to apply,
- Not too expensive tools,
- Applicable for various skin types (II-IV),
- Applicable for different types of atrophic scars with no significant complications.
- Remarkable and persistent improvement in short time without injury to the skin surface.
- The disadvantages, mostly unremarkable, were:
- Bruising, transient discoloration,
- Haemorrhagic papule and pustule (because of nearly subepidermal undermining),
- Some precautions should be taken for effective subcision with no or mild complications, such as;

- Sufficient anaesthesia,
- Good selection of the needle used in subcision,
- Meticulously planned needle position with care to avoid injury to the deeper structures.
- Autologous fat grafting increases subcision efficacy remarkably and causes significant and persistent improvement in short time, without considerable complication as, fat act as a spacer to keep the tissue from early attachment, but also as a filler which causes augmentation and correction of the defect in depressed scars of the face.
- Considering the points discussed, we can consider method of combined scar subcision and autologous fat grafting as a safe, well-tolerated and highly effective method for the treatment of various types of depressed scars.
- Method of combined scar subcision and autologous fat grafting can be used as the first and important step for cutaneous atrophic scars management.

References

1. Sund B (2000) New developments in wound care. London: PJB Publications Clin Reprt CBS 836: 1255.
2. Alster T, Zauilyanov L (2007) Laser Scar Revision. *Dermatol Surg* 33(2): 131-140.
3. Shockley WW (2011) Scar revision techniques. *Operative Techniques in Otolaryngology* 22(1): 84-93.
4. Jacob CI, Dover JS, Kaminer MS (2001) Acne scarring: a classification system and review of treatment options. *J Am Acad Dermatol* 45(1):109-117.
5. Branson DF (1998) Dermal undermining (scarification) of active rhytids and scars. Enhancing the results of CO2 laser skin resurfacing. *Aesthetic Surg* 18(1): 36-37.
6. Orentreich DS, Orentreich N (1995) Subcutaneous incisionless (subcision) surgery for the correction of depressed scars and wrinkles. *Dermatol Surg* 21(6): 543-549.
7. Nele B, Ali P, Henk H (2010) A Systematic Review of Different Scar Scales. *J Surg Res* 164(1): 115-123.
8. Mobley SR, Sjogren PP (2014) Pediatric Facial Plastic and Reconstructive Surgery: Soft Tissue Trauma and Scar Revision. *Facial Plastic Surgery Clinics of North America* 22(4): 639-651.
9. Ardeshirpour F, Shaye DA, Hilger PA (2013) Surgical Management of Facial Trauma, Improving Posttraumatic Facial Scars. *Otolaryngologic Clinics of North America* 46(5): 867-881.

10. Humphrey CD, Thomas JR (2011) Improving scars with minimally invasive and topical treatment. *Operative Techniques in Otolaryngology* 22(1): 94-100.
11. Sasaki GH (2008) Comparison of results of wire subcision performed alone, with fills, and/or with adjacent surgical procedures. *Aesthet Surg J* 28(6): 619-626.
12. Aalami H, Balighi K, Lajevardi V (2011) Subcision-suction method: a new successful combination therapy in treatment of atrophic acne scars and other depressed scars. *J Eur Acad Dermatol Venereol* 25(1): 92-99.
13. Fontdevila J, Serra-Renom JM, Raigosa M (2008) Assessing the Long-Term Viability of Facial Fat Grafts: An Objective Measure Using Computed Tomography. *Aesthetic Surgery Journal* 28(4): 380-386.
14. Cervelli V, Gentile P, Grimaldi M (2009) Regenerative surgery: use of fat grafting combined with platelet-rich plasma for chronic lower-extremity ulcers. *Aesthet Plast Surg* 33(3): 340-345.
15. Hendi A (2010) Facial Re-Contouring using Autologous Fat Transfer, Egypt. *J Plast Reconstr Surg* 34(1): 65-69.
16. Adly OA, Elbadawy MA, Abbas AA, Mohamedy IM, Maati TA (2011) Core Fat Graft Injection in Depressed Scar Augmentation, Egypt. *J Plast Reconstr Surg* 35(2): 221-226.
17. Gadkari R, Nayak C (2014) A split-face comparative study to evaluate efficacy of combined subcision and dermaroller against combined subcision and cryoroller in treatment of acne scars. *Journal of Cosmetic Dermatology* 13(1): 38-43.
18. Vaishnani JB (2008) Subcision in rolling acne scars with 24G needle. *Indian J Dermatol Venereol Leprol* 74(6): 677-679.
19. Bayat A, McGrouther DA (2006) Spectrum of abnormal skin scars and their clinical management. *Br J Hosp Med* 67(10): 634-639.
20. Goodman GJ, Baron JA (2006) Postacne scarring: a quantitative global scarring grading system. *J Cosmet Dermatol* 5(1): 48-52.
21. Balighi K, Robati RM, Moslehi H, Robati AM (2008) Subcision in acne scar with and without subdermal implant: A clinical trial. *JEADV* 22(6): 707-711.
22. Ayeni O, Carey W, Muhn C (2011) Acne Scar Treatment with Subcision Using a 20-G Cataract Blade. *Dermatol Surg* 37(6): 846-847.
23. Lee SY, Sung KY (2013) Subcision using a spinal needle cannula and a thread for prominent nasolabial fold correction. *Archive of Plastic Surgery May* 40(3): 256-258.
24. Bloemen MCT, van Gerven MS, van der Wal (2011) An objective device for measuring surface roughness of skin and scars. *J Am Acad Dermatol* 564: 706-15.
25. Ramadan SA, El-Komy MH, Bassiouny DA, El-Tobshy ASA (2011) Subcision Versus 100% Trichloroacetic Acid in the Treatment of Rolling Acne Scars. *Dermatol Surg* 37(5): 626-633.
26. Al-Dhalimi MA, Arnoss AA (2012) Subcision for treatment of rolling acne scars in Iraqi patients: A clinical study. *Journal of Cosmetic Dermatology* 11(2): 144-150.