Efficacy of CO2 laser in treating scars

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بسم الله الرحمن الرحيم

"يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ"

صدق الله العلي العظيم

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Introduction

Wound healing is an extremely broad and common topic covering a variety of responses to injury in a variety of different of different organ systems.

Wound healing represents the response of an organism to a physical disruption of a tissue\organ to re-establish homeostasis of that tissue \organ and stabilize the entire organism's physiology .

The first is the substitution of a different cellular matrix as a patch to immediately re-establish both a physical and physiologic continuity to the injured organ this is a process of scar formation.

Type of scars:

1.hypertrophic scars: are thick clusters of scar tissue that develop directly at a wound site ,they are often raised.

2.keloids are larger than hypertrophic scars . they can be painful or itchy , they extend beyond the edges of an original wound or incision.

3.contractures: are scars that restrict movement due to skin and underlying tissue that pull together during healing . they occur when there is of tissue loss , such as after burn.

Until the advent of cutaneous laser resurfacing in the late 1980s, physicians long had used mechanical abrasion and various chemical peeling agents to restore a youthful look to the aged face.
Some authors reported on the use of continuous wave carbon dioxide lasers for resurfacing photoaged skin with good results; however, this technique was not adopted widely because of the significant thermal damage that accompanied the use of continuous wave lasers, which meant a high likelihood of potential scarring.
Advent of short-pulsed high energy and scanned carbon dioxide lasers and other laser systems that limit skin heating has revolutionized laser skin resurfacing.These lasers are capable of removing layers of photodamaged skin in an impressively precise fashion, leaving only a narrow zone of thermal necrosis.

Theory of selective photothermolysis states that selective heating of the target chromophore can be achieved when using laser pulses shorter than the thermal relaxation time (TRT) of the chromophore (time required for chromophore to lose 50% of its heat to surrounding tissue). TRT for 20-30 μm of skin tissue is approximately 1 millisecond.

Using the theory of selective photothermolysis, carbon dioxide lasers with a pulse duration of less than 1 millisecond are capable of selectively vaporizing tissue with only a very thin zone of residual thermal necrosis measuring approximately 100 μm. To have a clinical effect in the skin, laser energy must be absorbed by the target chromophore. Energy fluence (density) necessary to vaporize tissue is approximately 5 J/cm^2 (ablation threshold).

Laser tissue interaction

As with other resurfacing modalities (eg, chemical peeling, dermabrasion), completely removing the epidermis and part of the dermis results in wound remodeling with subsequent new collagen and elastin fiber formation that translates into healthier, firmer, and tighter skin. Although aware of heat-induced collagen shrinkage during laser resurfacing procedure, whether this immediate shrinkage observed clinically persists or results in long-term collagen tightening is not known.

Presentation

- Obagi skin classification: This classification is probably the most comprehensive skin classification system. It analyzes skin using the following criteria:
    - Skin color - Original or deviated(brunette, white, light black, medium black, light Asian, medium Asian) ; carbon dioxide laser resurfacing not recommended for any skin color other than light white, white, or brunette.
    - Skin thickness - Thick, thin, medium (excessively thick or thin skin is a relative contraindication to this procedure)
    - Skin firmness - Firm versus lax
    - Skin fragility - Tough versus fragile
    - Skin oiliness - Oily, normal, dry
- Degree of photoaging: Assess by judging degree of wrinkling, precancerous growths such as actinic keratosis, benign skin growths such as seborrheic keratosis, solar

elastosis, mottled hyperpigmentation, and skin laxity. In general, patients with early photodamage do not require carbon dioxide laser resurfacing. The ideal patient has mild-to-moderate photoaging.

- History of herpes labialis infection: Start suppressive therapy with oral antiviral medications 1-2 days before procedure and continue until complete reepithelialization takes place.
- History of frequent vaginal candidal infections: Administer prophylactic course of oral antifungal medications.
- Paucity of adnexal structures (skin poor in pores, hair follicles, oily glands): This can occur in some skin types or can be related to a previous deep resurfacing procedure or radiation therapy.
- History of hypertrophic scars or keloids: Avoid resurfacing deeper than papillary dermis.
- Significant lower eyelid laxity: Avoid aggressive carbon dioxide laser resurfacing on the lid to avoid postresurfacing scleral show and ectropion.
- Allergies: Investigate allergies to local and systemic anesthetics properly.

Select patients with realistic expectations. Avoid patients with psychological instability, since they may not be able to withstand posttreatment course and potential complications.

Indications:

Recognition of suitable candidates for carbon dioxide laser resurfacing is of paramount importance to avoid undesired outcomes. Generally, middle-aged patients (40-65 y) with fair skin and fine-to-moderate static (nondynamic) wrinkles are ideal candidates. Select patients with realistic expectations, such as those who seek improvement rather than complete eradication of wrinkles or scars.

Complication:

Primarily Epidermal Complications

1.Hyperpigmentation:

Postoperative hyperpigmentation can be observed after virtually any cutaneous or endovenous laser procedure and after intense pulsed light procedures. This problem is more common in patients with darker skin types. Patients with fresh tans are also more at risk. Hyperpigmentation is almost always a temporary effect that responds to

topical bleaching therapy and resolves over time. Hyperpigmentation is relatively common after ablative (especially carbon dioxide laser) resurfacing, lasting an average of 3-4 months. The risk of hyperpigmentation with laser-assisted hair removal is related to seasonal variations, the presence of a tan, and the intrinsic pigment defining the patient's skin type. Linear hyperpigmentation may occur corresponding to underlying venous structures following endovenous laser ablation. Idiosyncratic hyperpigmentation may occur, and patients should always be warned of this risk. Interesting to note is that although cryogen spray cooling systems limit hyperpigmentation due to epidermal heating, excessive application of cooling in itself can cause epidermal damage and hyperpigmentation.

2.Hypopigmentation:

Postoperative hypopigmentation is also possible, particularly after the use of lasers that target melanin as a chromophore, or pigment-specific laser irradiation. Thus, it is quite common in tattoos, pigmented lesions, or hair removal treated with Q-switched ruby, alexandrite, and Nd:YAG lasers. In these situations, hypopigmentation is more commonly observed after multiple treatments and is more common in patients with darker skin types. As with hyperpigmentation, this complication is often temporary, although permanent hypopigmentation has been noted. Delayed permanent hypopigmentation has been recognized as a complication particular to ablative laser resurfacing especially carbon dioxide laser skin resurfacing.

3.Postoperative blistering:

Blister formation (or vesiculation) is due to epidermal thermal damage and, while uncommon, can be produced by virtually all laser systems. It is most often observed with Q-switched laser irradiation for tattoo removal. Explanations for its development include use of excessive laser fluence or inadvertent absorption of laser energy attributable to the increased presence of an epidermal chromophore (eg, melanin in a tan). The concomitant use of tissue cooling (through a contact chill tip or cryogen spray) serves to protect the epidermis from excessive thermal damage during laser irradiation, and improperly applied or improperly functioning cooling may also account for epidermal damage.

4.Postoperative crusting:

This undesirable effect is also caused by laser-induced epidermal damage. Crusting is common with Q-switched lasers used for tattoo removal but can be observed after treatment with other lasers as well. Without appropriate postoperative care, crusting is inevitable after cutaneous laser resurfacing procedures.

5.Milia:

Milia often occur as a normal event in the postoperative course of patients who have undergone carbon dioxide or erbium laser skin resurfacing. Their development may be reduced by application of topical tretinoin or glycolic acid. When just a few lesions are present, milia are easily treated by manual extraction.

Primarily Dermal Complications

1.Purpura:

Purpura (or bruising) is often noted in patients after pulsed-dye laser treatment. It was virtually inevitable with the first-generation 585-nm pulsed dye lasers and was typically used as a clinical measure of effective fluence selection. Purpura is a transient phenomenon that usually lasts 7-14 days. Its incidence has been reduced with the development of pulsed dye lasers with longer pulse durations, which permit slower heating of cutaneous vessels.

2.Scarring:

This permanent complication is perhaps the most feared of laser complications and was relatively common with continuous-wave lasers. The risk of scarring with more recently developed pulsed and Q-switched lasers that use the principles of selective photothermolysis is far less, but scarring is still possible with almost any device. Whether atrophic or hypertrophic in type, scarring is always due to excess damage to the collagen comprising the dermis. This may arise from direct laser-induced thermal damage or from complications such as postoperative infection.
In general, the risk of scarring is low with pigment-specific lasers, pulsed vascular lasers, nonablative laser systems, and pulsed hair-removal laser systems. Cutaneous laser resurfacing (both carbon dioxide and erbium) has the highest risk of scarring because of the intended destruction of dermal tissue as well as the increased risk of infection in the deepithelialized skin. Factors such as the number of passes delivered and the energy used may affect the risk of scarring, while technology that uses a

cooling system works to minimize this risk. Owing to the unique attributes of the individual's skin receiving treatment, this complication may occur even at the hands of the most experienced surgeon and may occur in only a portion of the treatment field.

Scars:

Acne scars can be classified into 3 basic types:
 (1) shallow depressed scars.
 (2) wide-base atrophic scars.
 (3) ice-pick scars.

 The first 2 types of acne scars generally are amenable to carbon dioxide laser resurfacing; however, fibrotic or ice-pick scars often require punch excision, punch grafts, or punch elevation. Scar base lifting and injection of filling substances for atrophic acne scars (performed as a separate procedure at a different time) also can be combined with laser resurfacing for optimal results.
Varicella and smallpox scars also may be improved with carbon dioxide laser resurfacing.

Contraindications:

Absolute contraindications

- Active bacterial, viral, or fungal infections
- Unrealistic expectations
- Uncooperative patient

Relative contraindications

- Poor general health
- Oral isotretinoin (Accutane) use within previous 6 months
- Fitzpatrick skin phototypes 5-6
- Reticular dermis-level resurfacing procedure within preceding 2-3 months
- Unwillingness to accept possibility of postoperative erythema or hypopigmentation
- Significant eyelid laxity
- Excessively thick or thin skin
- Collagen vascular disease
- Human immunodeficiency virus (HIV) or hepatitis C infections
- Tendency for keloid or hypertrophic scar formation

Method

Study design

Cross sectional study with analytic elements.

Place and timing of data collection:

the study was conducted at Dr. Jaafar privet clinic, data collection period were from 10th of November 2018 to 16th of February 2019.

Target population and sampling technique:

A convenience sample of 40 patient were included in this study gathered from patients seeking co2 laser resurfacing at privet clinic.

Data collection:

The data was collected retrospectively by taking patients registry from the recorded data in the clinic

The data was collected according to the following topics

- Patient age
- Patient gender
- Cause of complaint
- Number of sessions

Statistical analysis:

The analysis of data was carried out using Microsoft Office Access 2010 Database.The data was presented in tables and charts of frequency and percentage.

Aim:

To know the most common indication for co2 laser resurfasing procedure ,the age distribution of patients, and the number of session each required.

Result

It seems that young adults (77.5%) are significantly the most common age group that seek co2 laser resurfacing procedure, followed by adult patients (15%), while adolescent patient occupy only (7.5%).

Female patient (55%) were slightly higher than male patient (45%).

Acne scar (65%) was remarkably the indication for co2 laser resurfacing comparable with trauma (25%) and to less extend surgical scar (10%).

In this study most of the patient required 1 and 2 session in which it account (40%) for each, the remaining need 3 sessions (15%) of patients and to less extend few patient came for 4-6 sessions (2.5%) for each.

Table 1: age distribution of patient

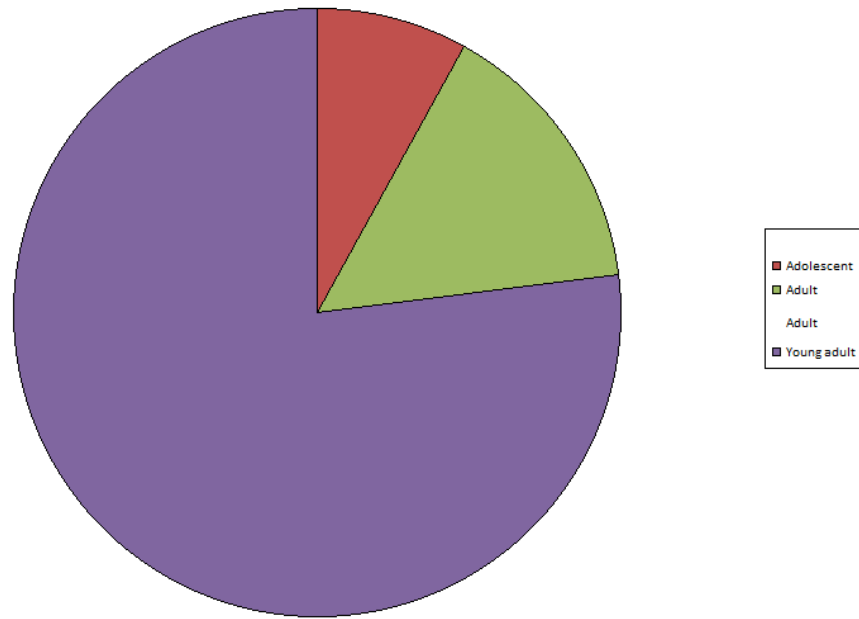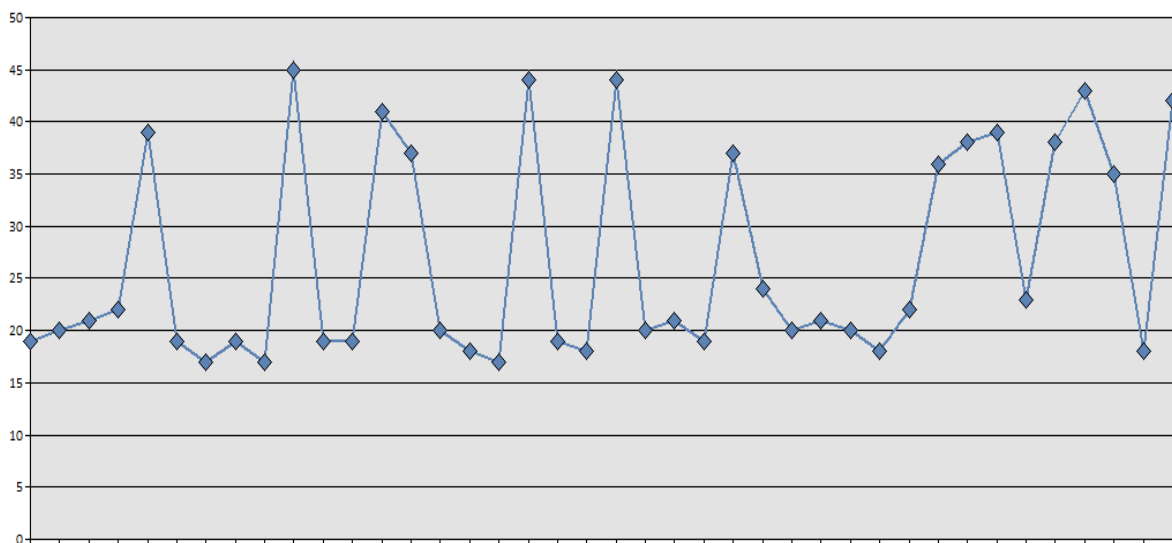| Patients age	Frequency	Percent
Adolescent (11-17 years)	3	7.5
Young adult (18-40 years)	31	77.5
Adult (41-65 years)	6	15
Total	40	100

figure 1:age distribution of patients

figure 2:total age representation for each patient

table 2:gender of patients with co2 laser resurfacing

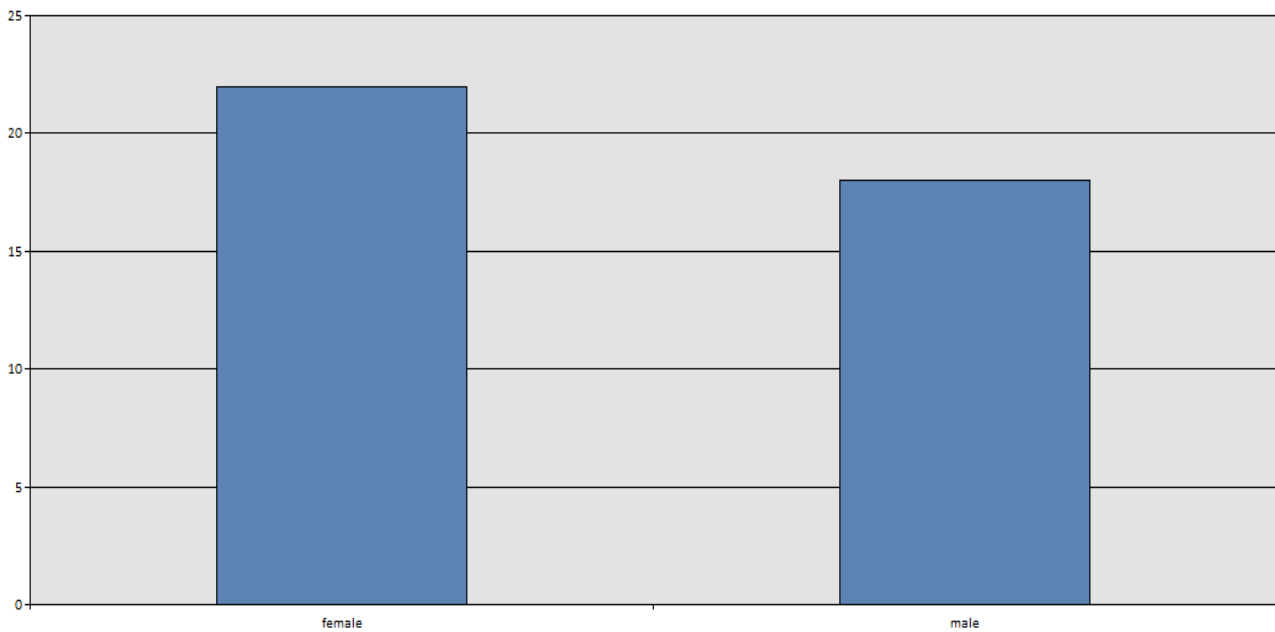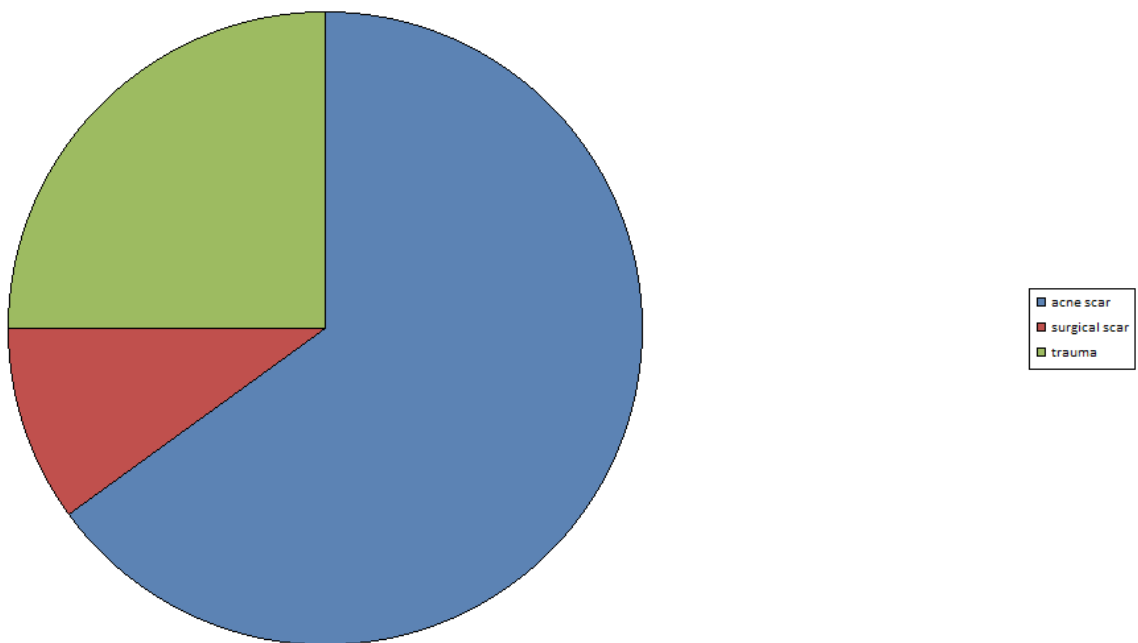| Patients gender	Frequency	Percent
Male	18	45
female	22	55
Total	40	100

Figure 3: gender of patients with co2 laser resurfacing

Table 3:most common indication for co2 laser resurfacing

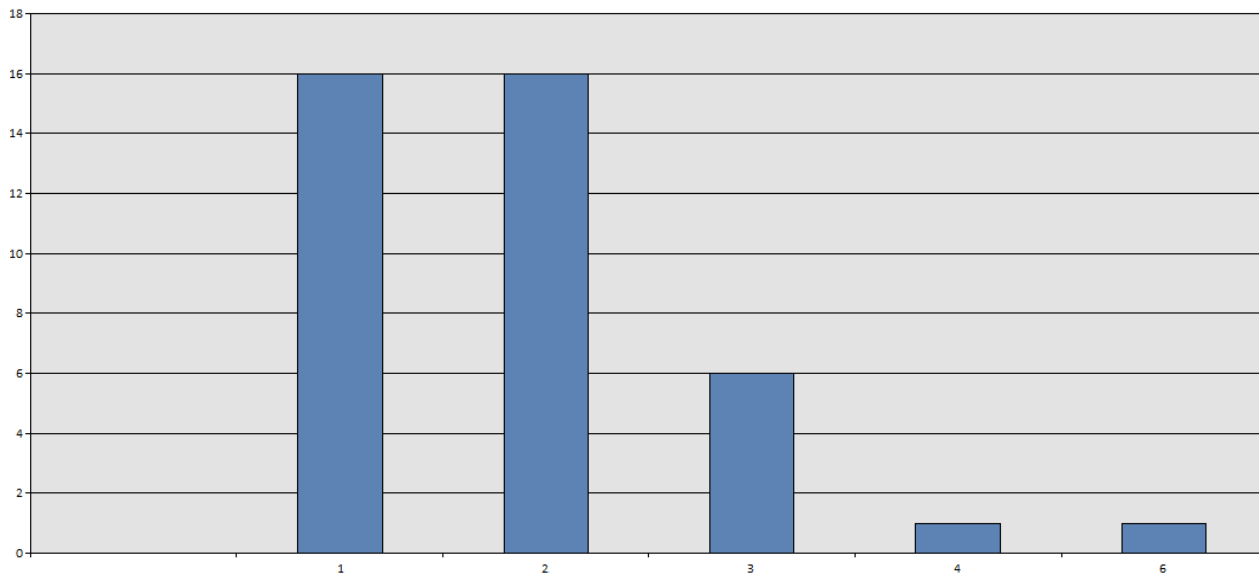| cause of procedure	Frequency	Percent
Acne scar	26	65
Trauma	10	25
Surgical scar	4	10
total	40	100

Figure 4: most common indication for co2 laser resurfacing

Table 4:number of sessions required for the patients

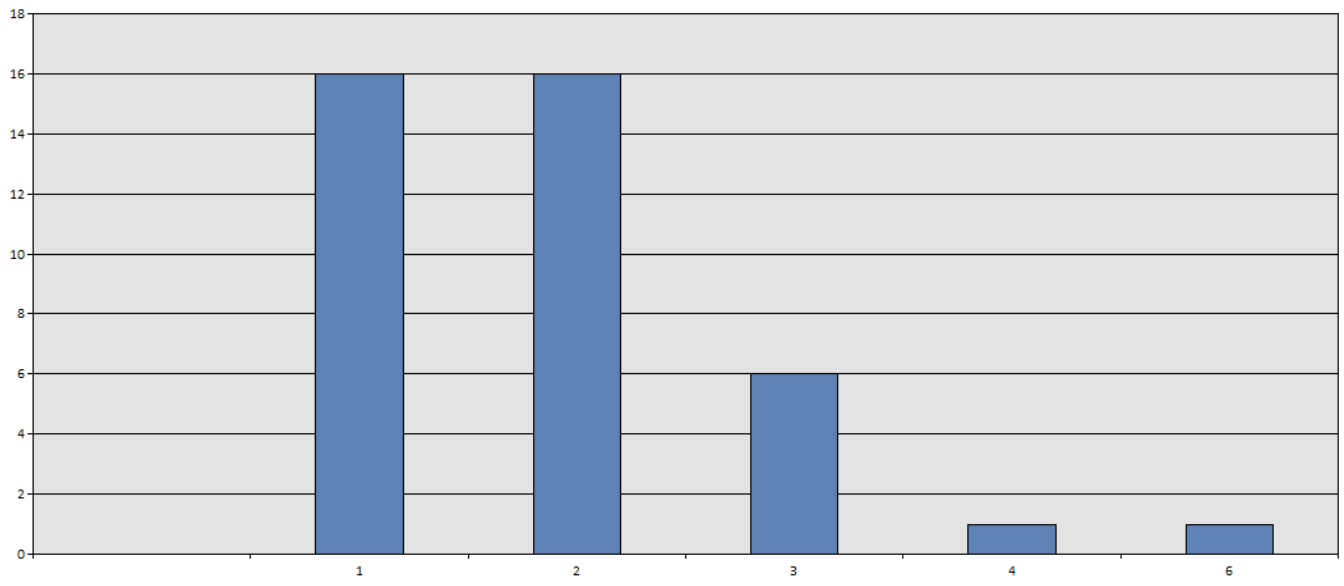| Number of sessions	Frequency	Percent
1	16	40
2	16	40
3	6	15
4	1	2.5
6	1	2.5
Total	40	100

Figure 5: number of sessions required for the patients

Discussion

Conclusion:

Acne scar was the most common indication for our patients affecting young adult persons with slight higher in female than male.

Most patient required no more than 1 to 2 sessions but it sometimes extend to involve 6 sessions in small percentage of them.

Recommendations:

More extensive research should be done over a longer period of time, more than one years to record it as prevalence over wider sample of people.

Data is preferred to be collected prospectively for more accurate results.

Since acne scar is the most indication for co2 laser resurfacing it is important to prevent this form of complication through the use of medical treatment such as tretinoin and educational programs.

Trauma should be reduced; as it account of over (15%) of indication, by providing more advanced mean of safety and education of the population.

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