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PDL and keloids

Treatments for keloids

- Surgical excision
- Intralesional
- Compression
- Cryotherapy
- Radiation
- Light-based therapies

PDL

LASER

- 1983: 1060-nm Nd:YAG laser decreased collagen production
- One year later argon and CO2 lasers: Showed a high recurrence rate
- PDLs : Improvement of scar texture,redness, size, and pliability

A. Ablative lasers

B. Non-ablative lasers

C. Light sources

CO2 ,Er-YAG

PDL

IPL

- Ablative lasers come with a prolonged recovery time
- Complications, such as scarring, depigmentation infection
- Non ablative lasers have been developed

LASER have been shown to be effective,in thetreatment, and the prevention of hypertrophic scars

Treatment of keloid sternotomy scars with 585 nm flashlamp-pumped pulsed-dye laser

Tina S Alster, Carmen M Williams

Summary

Despite increasing knowledge of wound healing and collagen metabolism, hypertrophic scars and keloid scars are difficult to eradicate. Median sternotomy scars are often hypertrophic or keloidal. We treated them with a 585 nm flashlamp-pumped pulsed-dye laser, which selectively injures cutaneous microvessels without inducing scars.

16 adult patients with hypertrophic or keloidal median sternotomy scars after heart surgery received two treatments to one half of their previously untreated scars every 6–8 weeks and were reviewed at 6 months. Symptoms and clinical, histological, photographic, and surface texture assessments were obtained for treated and untreated areas of scar and evaluated independently by two observers blind to the treatment and by digital image analysis of skin surface casts.

There was a significant improvement in erythema, scar height, skin surface texture, and pruritis in laser-treated scar areas; this improvement persisted for at least 6 months.

Lancet 1995; **345:** 1198–200

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Introduction

Hypertrophic scars and keloids are notoriously difficult to treat. A hypertrophic scar is a scar that has become raised, red, and nodular but which remains within the confines of the original skin damage; a keloid grows beyond the confines of the previous wound. Various treatments have been tried in the past, including intralesional steroids, cryosurgery, radiotherapy, pressure therapy, silicone gel sheeting, excisional surgery, and ablative laser surgery. After these treatments, however, hypertrophic scars and keloids often recur or may become worse.

The 585 nm flashlamp-pumped pulsed-dye laser has been shown effectively to remove microvascular lesions, such as telangiectasis and port-wine stains.[1,2] This laser has also been shown to improve the appearance and surface texture of hypertrophic scars.[3] We studied the effectiveness of the 585 nm laser in improving the appearance, texture, and symptoms arising from hypertrophic and keloidal median sternotomy scars.

Patients and methods

The study protocol was approved by the institutional review board of Georgetown University Medical Center. Between Sept 1, 1993, and Oct 31, 1993, patients at least 18 years of age with keloid or hypertrophic median sternotomy scars of at least 6 months' duration were enrolled in the study.

16 patients (10 men, 6 women, mean age 49 years, mean scar duration 17 months) were identifed through the division of cardiovascular-thoracic surgery at Georgetown University Medical Center as meeting the eligiblity criteria: a uniformly hypertrophic scar, no prior treatment, and skin types I, II, or III (melanin in darker skins acts as a competing chromophore for

- Down-regulation of TGF-β1 expression

- Up-regulation of MMP-13 activity

- Reduction in the lesional vessel volume

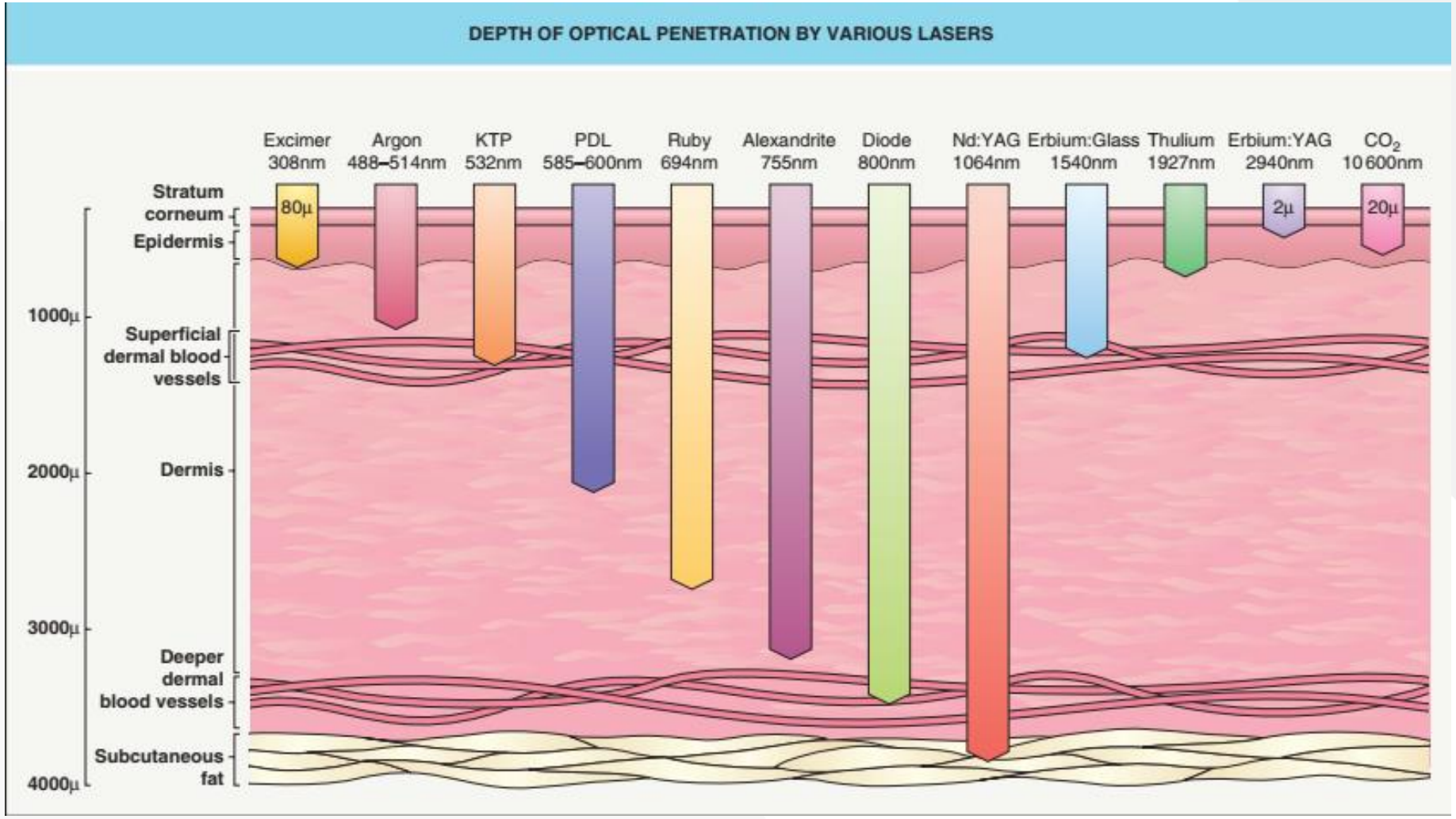
- Ischaemia, which may induce collagen turnover

- Scar Height
- *Scar Erythema*
- *Scar Volume*
- *Scar Pliability/Elasticity*
- *Scar Pigmentation*

Scar Height

- PDL significantly reduced scar height
- PDL not demonstrate significant reduction compared with TAC
- PDL in combination with TAC plus 5-FU showed greater percent height reduction
- CO2 fractional laser showing the greatest reduction

- PDL has an approximate 1.2 mm depth
- Penetration and efficacy in thicker keloids may be limited
- Targets hemoglobin in the papillary and reticular dermis


DEPTH OF OPTICAL PENETRATION BY VARIOUS LASERS
Excimer 308nm
Argon 488–514nm
KTP 532nm
PDL 585–600nm
Ruby 694nm
Alexandrite 755nm
Diode 800nm
Nd:YAG 1064nm
Erbium:Glass 1540nm
Thulium 1927nm
Erbium:YAG 2940nm
CO2 10 600nm
80µ
2µ
20µ
Stratum corneum
Epidermis
Superficial dermal blood vessels
Dermis
Deeper dermal blood vessels
Subcutaneous fat
1000µ
2000µ
3000µ
4000µ

Scar Erythema

- PDL alone significantly reduced scar erythema (lower skin phototypes)
- PDL alone did not produce significant reduction of erythema when compared with silicone gel sheeting and TAC
- PDL in combination with TAC plus 5-FU similarly demonstrated significant reduction in erythema compared with TAC plus 5-FU alone

- Ablative systems :Reduced by 50 %
- PDL: Reduced by 26%
- The PDL 585nm theoretical for the treatment of erythematous scars
- This is not supported by our results

Scar Pliability

- PDL alone also showed significant improvement in scar pliability/elasticity
- No significant difference between PDL alone and PDL plus TAC
- PDL did not show significant improvement in scar pliability/elasticity compared with TAC plus 5-FU alone

Pruritus

- PDL decrease pruritus in hypertrophicscars and keloids
- Exact mechanism is unknown
- Changes in neuropeptide Y,vasoactive polypeptide,substance P ,CGRP

PDL v/s CO2

	PDL	CO2
Erythema	26%	56%
Height	37%	46%
Pliability	40%	47%
Pigmentation	12% ↑	36% ↓

CO2 LASER

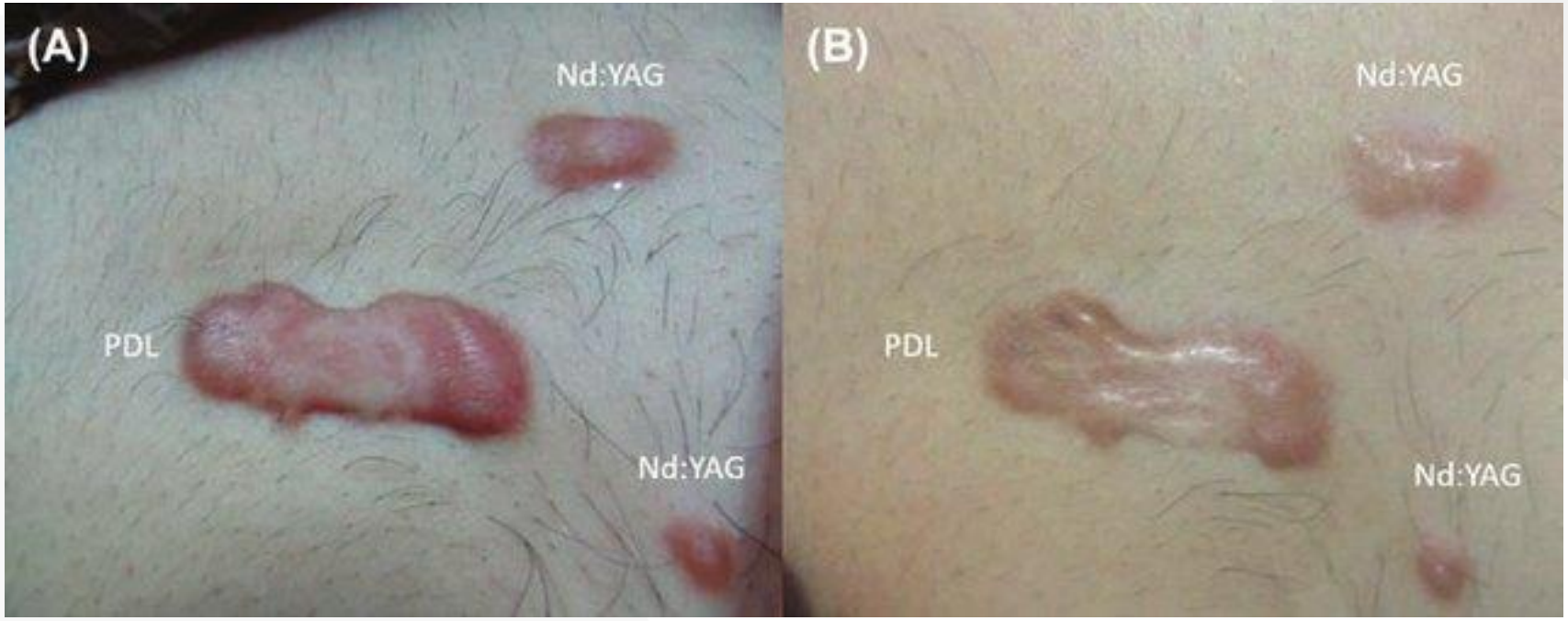
- Recurrence rates of CO2 LASER:

70-88% Within 2 years

- In combination therapy : Recurrence is lower
- Hypothesize that CO2 monotherapy may in fact worsen keloids

Nd-YAG vs PDL

- Trial compared 595-nm PDL with long-pulsed 1064-nm Nd:YAG laser :
- Significantly reduced in both treatment
- With a higher (but non-significant) improvement in the Nd:YAG
- Narrow therapeutic window and higher risk of bulk heating causing subsequent worsening of the scar


(A)
Nd:YAG
PDL
Nd:YAG
(B)
Nd:YAG
PDL
Nd:YAG

PDL was superior to conventional : scar appearance

Adverse Effects

- Blisters
- Pain
- Mild purpura
- Transient hyperpigmentation

More adverse events were noted with trials that utilized higher fluence

- The most common side-effect :
  - Post operative purpura
  - Persist for 7-10 days
- Hyper pigmentation:
  - 1-24%
  - Related to thermal injury of the epidermis
  - Darker skinned individuals

Optimal parameters for PDL

Selective Photothermolysis

Selective Photo Thermolysis

Selective photo Thermolysis

⇩

Selective Heat

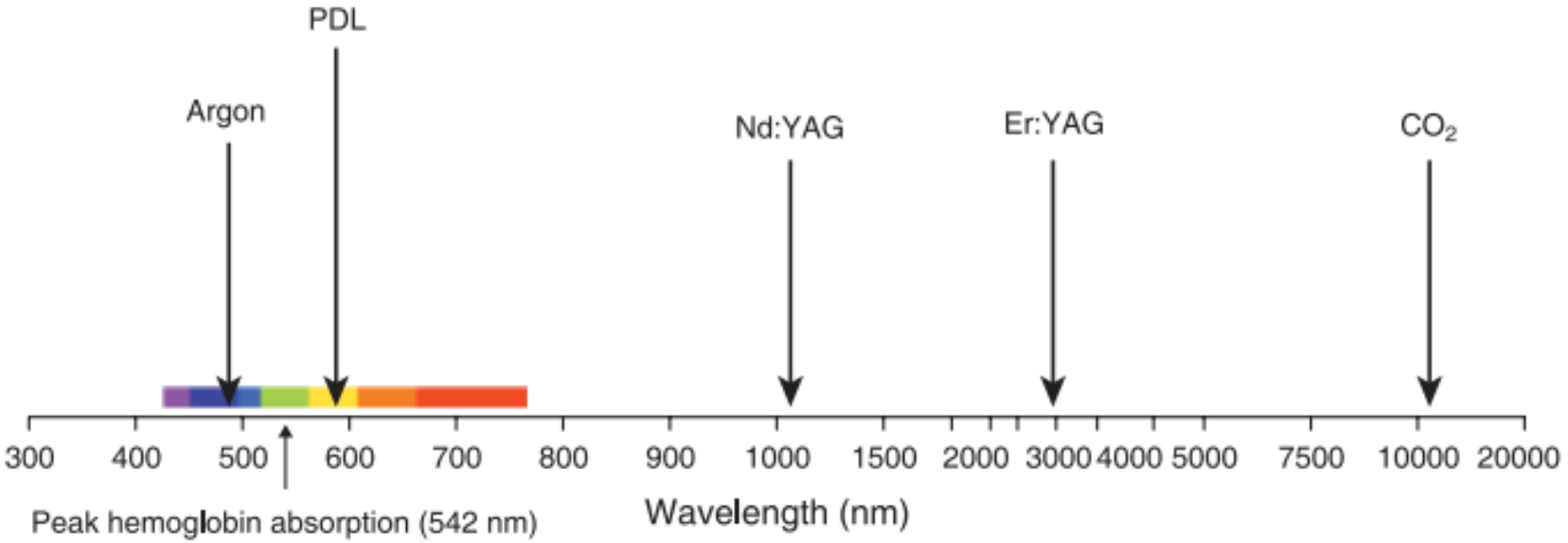
⇩

Selective Target

Wavelength

- Nm
- unique absorption
- Depth of penetration
  - short : superficial penetration
  - long : deeper penetration(355 to 1200 nm)

Wavelength


PDL
Argon
Nd:YAG
Er:YAG
CO_2
300
400
500
600
700
800
900
1000
1500
2000
3000
4000
5000
7500
10000
20000
Peak hemoglobin absorption (542 nm)
Wavelength (nm)

Energy Density

- Fluence
- J/CM^2
- Energy per unit area
- Very high: undesirable thermal injury
- Very low: not be effective

Fluence

- Low-fluence PDL:

  May lead to an increase in the procollagen production rate

- High-fluence PDL :

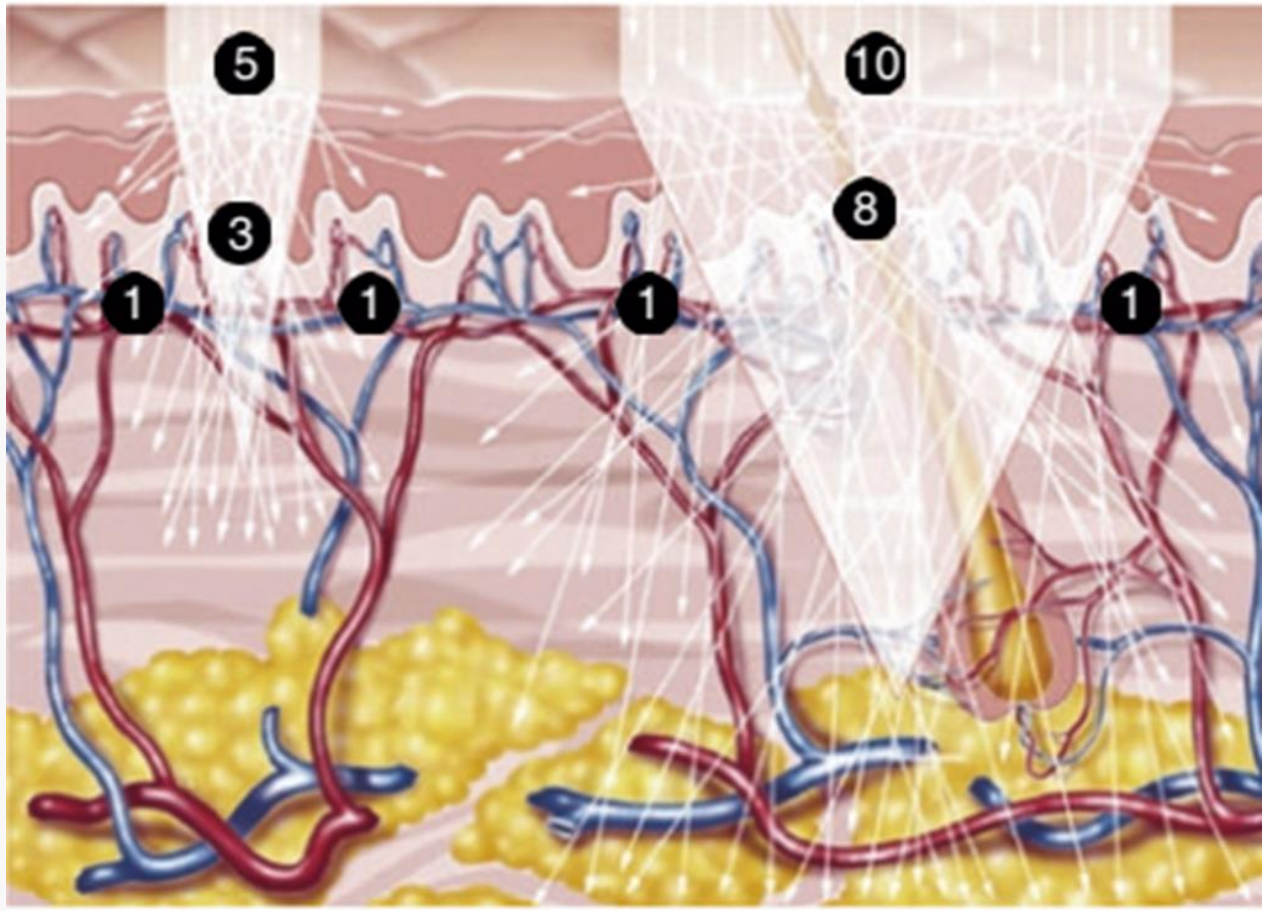
  Greater risk of side-effects

- Especially in darker skinned individuals

Fluence

- Range: **3.5–7.5 J/cm**
- Some authors: higher laser fluence is associated with a better tissue response
- Many of these studies did not detect any significant differences in treatment outcome with different fluences of the laser in the above range

- Fluences of 4-5 J/cm2 without skin cooling and 5-6 J/cm2 with skin cooling (Robinson)
- Lower fluence: for higher skin types
- Higher fluence: for smaller spot size


5
10
3
8
1
1
1
1

Spot Size

- Darker skinned population: a larger spot size (10mm) can enhance the degree of penetration and therefore may be more effective.

- Optimal parameters for PDL are: 10-mm spot size (Robinson)

Pulse Duration

- Pulse duration

  Length of time the beam is in contact with the skin

- Seconds, milliseconds, microseconds, nanoseconds

- PD
  - Short: superficial penetration
  - long : deeper penetration

- Small lesion :short PD

Pulse Durations

- Pulse width has an important effect on outcome
- The previous PDL used a fixed pulse width of 0.45 ms
- Current PDL :pulse widths ranging between 0.45 and 40ms

- 0.45-ms width being found to be superior to 40-ms width in reducing scar size and scar pliability

- The short duration of the 0.45-ms:

  More selectively eliminate the vascular supply of the scar

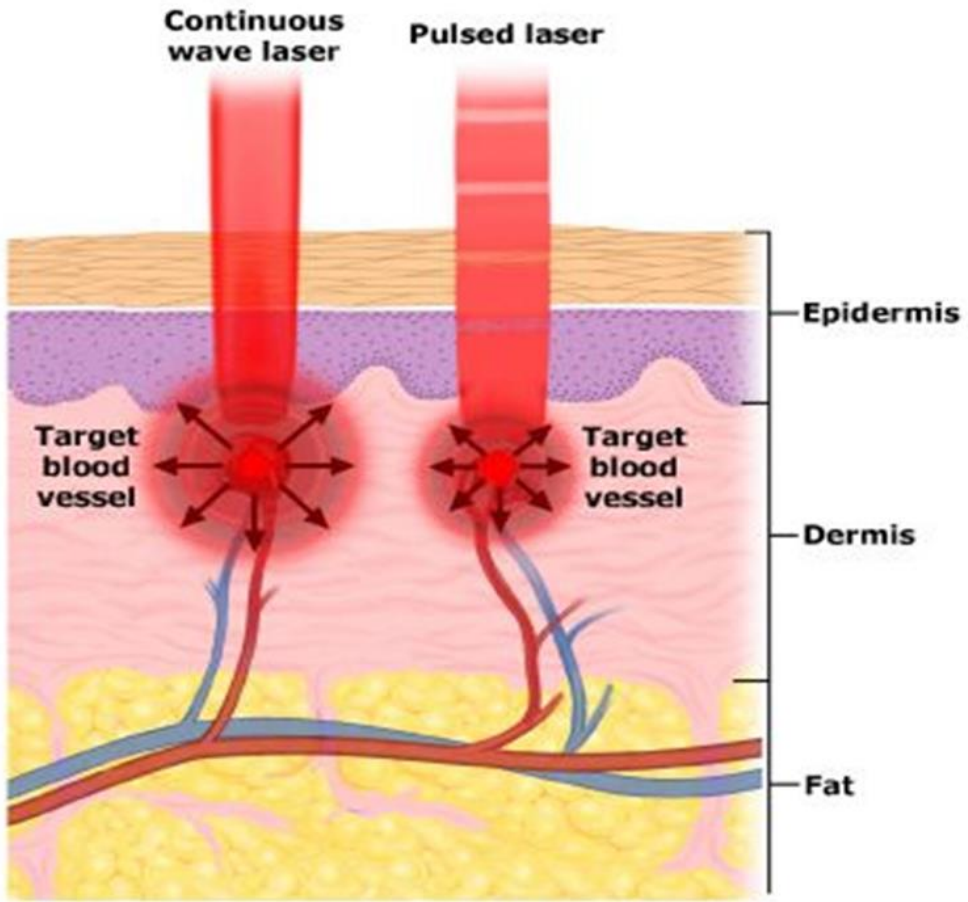
  Greater success in therapeutic outcome

Long duration of the 40-ms:

Generates heat more slowly

Nonspecific thermal injury to the scar tissue

Melanin epidermal absorption


Continuous wave laser
Pulsed laser
Target blood vessel
Target blood vessel
Epidermis
Dermis
Fat

Nouri:

- Short- versus long-pulse therapy in scars

- Short pulse to also be **more beneficial**

- Hypothesis : in keloids, the vessels are of small diameter with short pulse width will confine heat within the vessels and thus produce a better outcome.

CONCLUSION

- PDL was superior to conventional : scar appearance

- PDLs more efficacious in relieving scar symptoms when used in combination treatment

At least **three treatment** sessions with PDL may lead to significant improvement in VSS

Factional ablative lasers CO2 10600nm and Er:YAG 2940nm were found to produce the best results regarding erythema, height and pliability, while the flashlamp-pumped pulsed dye laser (PDL) 585nm scored slightly below that

- PDL :Improve pruritus, pain and burning
- Better treatment : lower skin phototypes and with the use of higher fluence
- More adverse effects were noted with higher fluence

Scar Location And Duration

Facial, shoulder, and arm scars responded better than anterior chest

Alster :Found no relation between scar location and response to treatment

Scars less than 1 year old respond better than older scars

- Monotherapy with PDL required 12-14 sessions for moderate to excellent outcomes versus only 4-5 sessions with combination treatmen (TCA)

- Botulinum toxin in conjunction with PDL for traumatic scarring on the face also demonstrated improvements

Optimal Parameters

- 10-mm spot size
- Fluences of 4-5 J/cm2 (Without Cooling)
- 5-6 J/cm2 with skin coolin
- Intervals are typically 4-8 weeks

- PDL: Treatment of vascular disorders and malformations

- Expanded to wrinkles and pigmented lesions

- PDL well absorbed by oxyhemoglobin, but also by melanin
- Solar lentigines treatment
- Photodamage
- Without surrounding tissues injury

PDL and lentigo

- Group I: One stacked/ PDL session
- Group II: Two stacked /one-month interval
- The two techniques of PDL are efficient for solar lentigines
- Two stacked PDL with one month apart is a successful and safe

Two treatments
F: 9 J/cm2,
12 mm spot
10 ms

- 585-nm pulsed dye laser to increase dermal collagen
- Collagen was increased after only a single treatment with the laser
- Improvement in rhytids
- Increased extracellular matrix protein after periorbital

KERMAN UNIVERSITY OF MEDICAL SCIENCES

THANK YOU FOR YOUR ATTENTION