Non-ablative melanin depigmentation of gingiva

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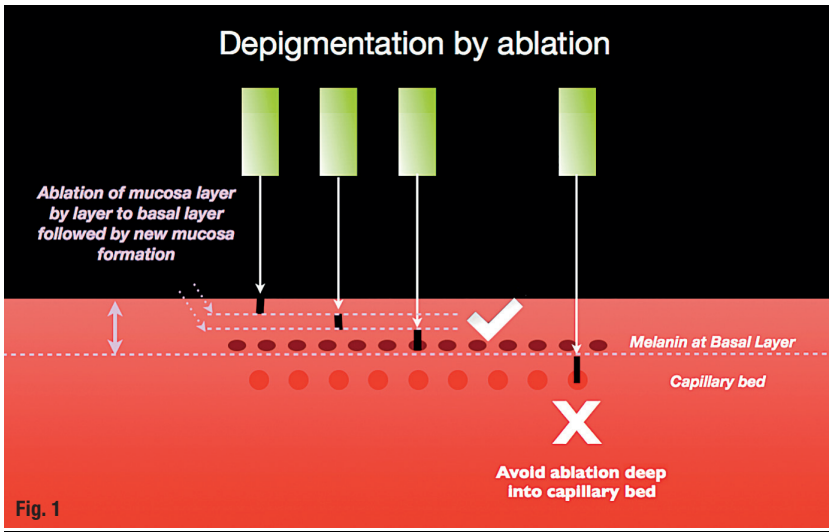
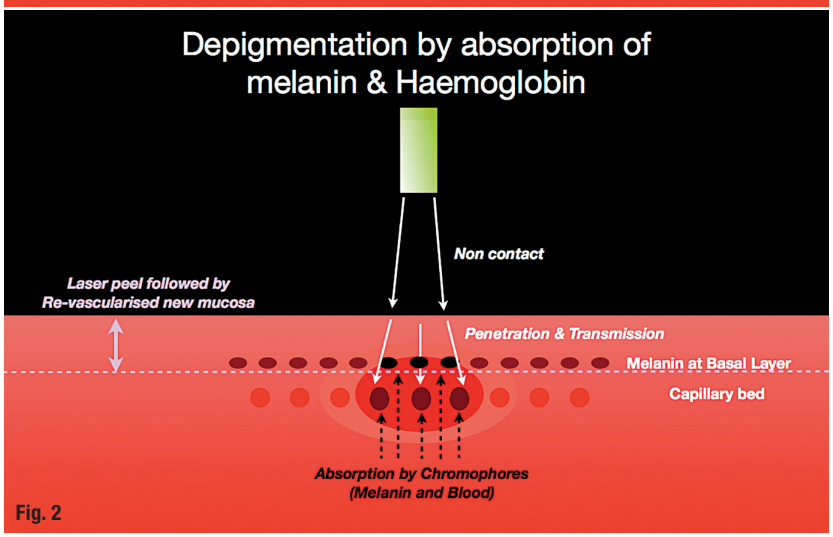
Introduction

Melanin depigmentation of gingiva using various laser wavelengths have been reported for over ten years.[1–5] Layer by layer, the mucosa is ablated to the basal layer of the epithelium where the melanocytes are located. The use of lasers have been compared with the use of scalpel and diamond bur (Fig. 1).[6–9] By incorporating the optical properties and absorption characteristics of 810 nm together with specific power parameters, a non ablative technique was developed (Fig. 2).[10,11]

Fig. 1: Depigmentation by ablation.
Fig. 2: Depigmentation by absorption of melanin and haemoglobin.





Another similar non-ablative technique described as microcoagulation was also reported using a 20 W 980 nm diode laser.[12] The 445 nm blue wavelength was introduced in the dental market in 2015. By using 320 µm uninitiated fiber delivering 1 W continuous wave of 445 nm, the same non-ablative procedure and result can also be realized.

Background with non-ablative technique

Diode laser at 810 nm is poorly absorbed in water, but it is well absorbed by pigment such as haemoglobin and melanin. The use of high power, short pulse duration concentrated the thermal energy on the surface over deep tissue thermal conduction with lower power and long pulse.[13,14]

The author has used the 810 nm wavelength (elexxion Claros 810 nm diode laser, elexxion AG, Singen, Germany) with the power parameters of 30 W, 20 kHz, 16 µsec giving an average power of 10 W. Under local anaesthesia, a non-initiated 600 µm fiber was used. The fiber was placed at a distance of 2 mm to 5 mm from the pigmented mucosa. Coagulation can be observed with immediate effect upon irradiation.

A constant movement must be performed in order to avoid thermal damage deep into the tissue. Water irrigation can be used as coolant

Figs. 3–6: Depigmentation on upper arch using 810 nm at 30 W, 20 kHz, 16 µsec, pre-op (Fig. 3), immediate coagulation (Fig. 4), three weeks post-op (Fig. 5), eight years post-op (Fig. 6).

during the treatment. There is no surface ablation of the pigmented mucosa but rather the haemoglobin and melanin absorbing the laser energy (Fig. 2). This technique (Figs. 3–6) showed a treatment time of two minutes compared to the ablative technique time up to 30 minutes in an area of first premolar to first premolar of one dental arch.

The wavelength of 445 nm is much better absorbed by melanin and haemoglobin than 810 nm (Fig. 7). Hence, a much lower power density may be used to produce the same effect.

Case outline

A 26-year-old female patient of Chinese ancestry presented with melanin pigmentation in 2007. Congenital melanin pigmentation of the labial gingiva was diagnosed. Depigmentation on the upper arch using 810 nm at 30 W, 20 kHz, 16 µsec was carried out. Eight years post-op showed mild relapse of pigmentation, but the patient was satisfied with the cosmetic appearance (Figs. 3–6). She now wanted the melanin pigment on her lower anterior segment to be removed (Fig. 8).

Purpose

Pigment removal in the requested sites was discussed using 445 nm diode laser. The same technique would be used and the patient consented to the treatment.

Material and method

SIROLaser Blue (Dentsply Sirona) with an emission wavelength of 445 nm was used at 1 W, CW delivered through a 320 µm fiber.

Procedure

Depigmentation technique is the same as described with the 810 nm wavelength (above). Under local anaesthesia, a non-initiated 320 µm fiber delivers the energy at a distance of 2 mm to the pigmented area with constant movement.

Figs. 7: Absorption Spectra of biological materials. (Courtesy of J. Meister)

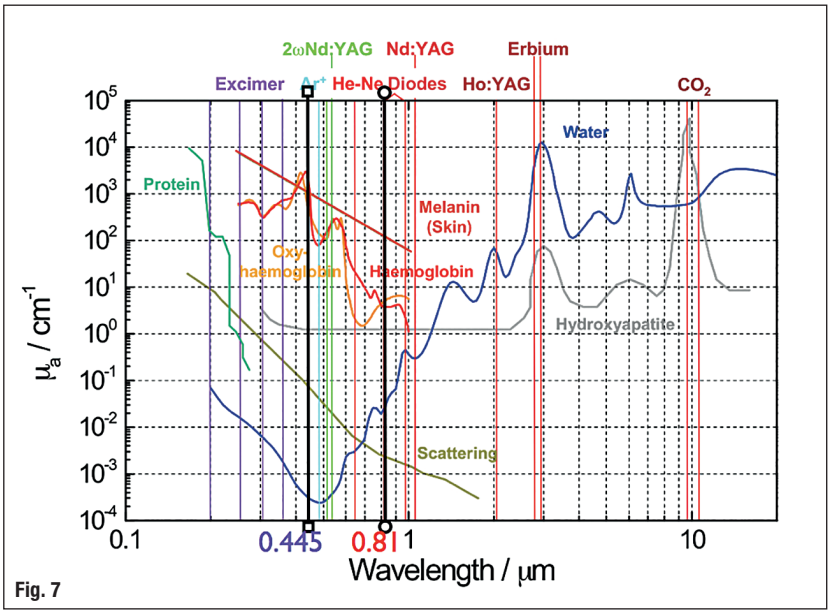


Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Figs. 8–11: Depigmentation of lower arch using 445 nm at 1 W CW, pre-op (Fig. 8), immediate post-op (Fig. 9), one day post-op (Fig. 10), one day post-op laser peel between 31, 41 (Fig. 11).

Immediate change to pink colour without surface ablation of the pigmented mucosa was observed. The procedure took approximately 40 seconds to complete between lower left and right canine region.

Results

In this case, the mucosa turns pink without any signs of surface mucosal ablation except one spot between teeth 41, 42 (Fig. 9). Sub-surface coagulation of blood vessels gave a pink coloured appearance. There was very mild post-op discomfort for about one hour after loss of the anaesthetic effect. No analgesics were required as the discomfort feeling disappeared fast.

Laser peeling of mucosa between 31 and 41 was noted during photograph taking at one day post-op review (Figs. 10 and 11). The three day post-op photo taken by the patient showed that the laser peel disappeared with new gingival mucosa formation (Fig. 12). Two weeks post-op showed complete recovery of the gingival mucosa without melanin pigmentation (Fig. 13).

Discussion

There has not been much information on this new wavelength. From Fig. 7, the absorption coefficient for haemoglobin is estimated at $7x10^2/cm^{-1}$ and $10^3/cm^{-1}$ for melanin. Penetration depth for haemoglobin is calculated at 140 µm and 10 µm for melanin. The penetration depth of haemoglobin and melanin with 810 nm are 2 mm and 0.1 mm respectively. Furthermore, scattering curve showed less tissue scattering effect with 445 nm than 810 nm.

Fig. 12: Three days post-op (photo taken by patient on holiday).
Fig. 13: Two weeks post-op.

Fig. 12

Fig. 13

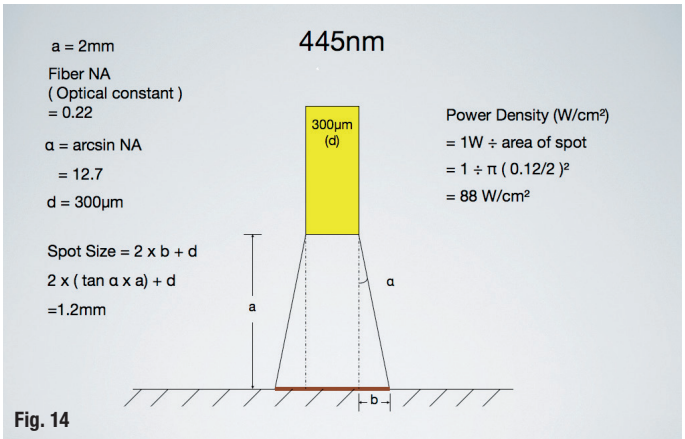


Fig. 14

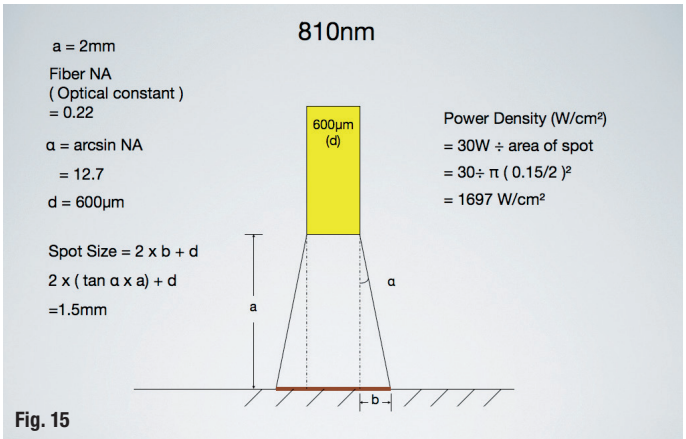


Fig. 15

In view of the low scattering effect together with high absorption of haemoglobin and melanin to 445 nm, 1 W CW was used. Power density of 88 W/cm² (Fig. 14) delivering at 88 J/cm² fluence at 2 mm distance was calculated. Although the power density of 1,697 W/cm² (Fig. 15) delivering 543 J/cm² fluence used by 810 nm is higher than 445 nm delivered, the eight years post-op showed stable gingival contour with no recession (Fig. 6). The understanding of the optical properties of the wavelength, power parameters and laser tissue interaction are important information for the clinician to achieve the desired treatment outcome.

Conclusion

The use of 1 W CW 445 nm blue diode laser is effective in non-ablative depigmentation of oral mucosa. This non ablative technique provide immediate aesthetic result with very short procedure time. To the author's knowledge, this is the first case presented using 445 nm for melanin depigmentation._

Editorial note: A list of references is available from the publisher.

Dr Luk reports no potential conflicts of interest.

Fig. 14: Diagram 3.
Fig. 15: Diagram 4.

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Kurz & bündig

Seit mehr als zehn Jahren wurde bereits über eine Melanin-Depigmentierung durch Laser verschiedener Wellenlängen berichtet.[1–5] Schicht für Schicht wird die Mukosa bis hin zur Basalschicht des Epitheliums abgetragen, wo sich die Melanozyten befinden. Für diesen Prozess liegen Vergleiche zwischen Laser, Skalpell und Diamantbohrer vor (Abb. 1).[6–9] Durch die Nutzung der optischen Eigenschaften und Absorptionscharakteristiken der Wellenlänge 810 nm gemeinsam mit spezifischen Parametern wurde eine nicht-ablative Technik entwickelt, die als Mikrokoagulation beschrieben wurde.[12] Im Jahr 2015 wurde die Wellenlänge 445 nm auf dem Dentalmarkt vorgestellt. Durch Anwendung einer nicht initiierten 320 µm-Faser wird kontinuierlich eine Wellenlänge von 445 nm und 1 W abgegeben, sodass bei gleichem Vorgehen wie bei den konventionellen Methoden dieselben Ergebnisse erzielt werden können. Der SIROLaser Blue (Dentsply Sirona) mit einer Wellenlänge von 445 nm wurde im vorliegenden Fall mit 1 W CW und einer 320 µm-Faser verwendet. Die Depigmentationstechnik ist die gleiche, wie sie für eine Wellenlänge von 810 nm beschrieben wird. Unter Lokalbetäubung wurde die Bestrahlung, wie beschrieben, aus einer Entfernung von 2 mm zur pigmentierten Fläche mit konstanter Bewegung ausgeführt. Dabei wurde ein sofortiger Koagulationseffekt beobachtet. Die pigmentierte Mukosa wurde nicht direkt bestrahlt, und die gesamte Prozedur dauerte etwa 40 Sekunden, bis sie bei 1 W CW in der unteren linken und rechten Eckzahnregion beendet wurde (Abb. 8–11). Die Anwendung des blauen 445 nm-Diodenlasers bei 1 W CW ist eine effektive, nicht-ablative Depigmentationstechnik für die orale Mukosa. Sie ermöglicht sofortige ästhetische Ergebnisse bei einer kurzen Behandlungsdauer. Nach aktuellem Kenntnisstand des Autors handelt es sich beim vorgestellten Fall um den ersten Bericht zur Melanin-Depigmentation bei 445 nm.