Treatment of Freckles and Solar Lentigines Using
A Long-Pulsed Alexandrite Laser in Asian Skin:
A Pilot Study

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Background

Solar lentigines and freckles are benign hyperpigmented spots occurring on sun-damaged skin. Various modalities such as laser surgery, cryotherapy, topical and chemical peeling preparations, have been reported to treat these lesions.

Because all pigmented lesions contain the light-absorbing pigment, melanin, to a greater or lesser extent, lasers are often used for treating these pigmented lesions. The traditional approach is to use a surgical laser or some other destructive or ablative method to burn, destroy, or excise the pigmented lesions. But these approaches usually leave a frank wound and a visible scar or mark.

A more elegant approach is to exploit the absorption of melanin and the unique properties of lasers to selectively treat the discoloration while sparing normal tissue.

For these reasons, we chose the alexandrite laser, which is approved by U.S. Food and Drug Administration (FDA) for hair removal therapy and has been previously used for treating small melanocytic nevi without scarring. The concept of selective photothermolysis, we believed that the 755 nm wavelength of the alexandrite laser would effectively target the melanin pigment in solar lentigines and freckle, leading to the destruction of melanin-containing keratinocytes and melanocytes. The added benefits of the alexandrite laser include the excellent depth of penetration and the ability to produce a high fluence. The ability to achieve selective destruction of a lesion with preservation of surrounding tissue, the minimal side effects associated with laser use, and the ability to
treat many lesions in a short period of time were all factors in the decision to attempt to cosmetically treat these solar lentigines or freckle with this kind of laser.

However, there is no reports for treatment freckles and/or solar lentigines in Asian skin. To the best of our knowledge this is the first study about treatment freckles and/or solar lentigines in Asian skin with long-pulsed alexandrite laser.

**Objective**

To evaluate the safety and the efficacy of long-pulsed alexandrite laser for treating freckles and/or solar lentigines in Asian skin.

**Patients and Methods**

9 Thai women ranging in age from 14 to 70 years with solar lentigines or freckles on the face were involved in this study. The patients had Fitzpatrick skin type III-V. Patients who had previously received laser treatment for these conditions, or with a history of medical diseases that rendered them unfit for laser treatment (such as epilepsy or photosensitive skin disease) were excluded.

**Laser parameters and Treatment Protocol**

All 9 patients were treated with long-pulsed alexandrite laser with a spot size of 5 mm, pulse width of 0.5 ms, and a fluence of 15 J/cm². The clinical endpoint was defined as immediate whitening of the lesions without purpura. The number of treatment sessions range 1-5 sessions and the mean treatment interval was 7 days. Treatment was continued at regular 1-week interval until a clearance of more than 90% was clinically obtained or the alexandrite laser device had been unavailable. All the patients were advised to avoid excessive sun exposure and to apply a broad-spectrum sunscreen with a sun protection factor of 15 or greater during and after the course of treatment. Depigmentation agents including 4% hydroquinone and 0.1% tretinoin cream were given to some cases those who developed post-laser hyperpigmentation, start from 1 week after the last treatment session.
**Assessment of Responses and Complications**

The responses to laser treatment were objectively assessed by 3 blinded independent clinicians using side-by-side comparisons of clinical photographs taken before the first treatment and after the last treatment, these photographs taken by in the same quality and camera parameters.

A visual analog scale consisting of five levels according to the percentage of pigmentary lightening:

- No improvement
- < 25% improvement = mild
- 25% - < 50% improvement = moderate
- 50% - < 75% improvement = good
- 75% - 100% improvement = excellent

Any possible complications (e.g. edema, erythema, hypopigmentation, hyperpigmentation, infection, scarring) were also recorded.

**Result**

A total of 9 Thai female between the ages of 14-70 years (mean, 39.67 years) were enrolled. Of the 9 subject, 3 subjects had freckles and 6 subjects had solar lentigines on the face. Fitzpatrick skin type ranged from III-V (III 1/IV5/V3). The characteristic of the subjects and the detail of the results were summarized in table 1.
Table 1. The characteristic of the subjects enrolled in this study

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Age (Years)</th>
<th>Fitzpatrick Skin type</th>
<th>Type of lesions</th>
<th>Number of treatment session</th>
<th>Physician evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>14</td>
<td>V</td>
<td>FK</td>
<td>1</td>
<td>excellent</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>42</td>
<td>IV</td>
<td>FK</td>
<td>3</td>
<td>good</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>48</td>
<td>V</td>
<td>SL</td>
<td>2</td>
<td>good</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>17</td>
<td>IV</td>
<td>FK</td>
<td>3</td>
<td>moderate</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>51</td>
<td>III</td>
<td>SL</td>
<td>3</td>
<td>excellent</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>52</td>
<td>IV</td>
<td>SL</td>
<td>3</td>
<td>no improvement</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>28</td>
<td>V</td>
<td>SL</td>
<td>3</td>
<td>good</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>35</td>
<td>IV</td>
<td>SL</td>
<td>5</td>
<td>excellent</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>70</td>
<td>IV</td>
<td>SL</td>
<td>1</td>
<td>moderate</td>
</tr>
</tbody>
</table>

FK = freckle ; SL = lentigine

Three blinded independent physicians evaluated the pretratment and the last available post treatment photographs for all 9 subjects. Overall, 8 subjects (88.89%) had improvement in pigmentary lightening. One subject had no improvement. Of 8 subjects with improvement, 6 subjects (75%) revealed good or excellent improvement.

The number of treatments per subject ranged from 1-5 (mean, 2.67) sessions.

All of subjects completed at least one post-treatment evaluation. The follow-up period ranged from 8 weeks to 60 weeks after the last treatment depended on the subject’s availability.

Side effects were generally mild and transient including transient erythema, localized swelling, immediate hypopigmentation, and hyperpigmentation. The subjects who had hyperpigmentation had been treated with topical 4% hydroquinone and 0.1% tretinoin cream and the pigmentary change gradually resolved. The other side effects can resolved within 24 hours after laser treatment. No scarring, infection or other serious side effects was observed.
Discussion

Freckle or ephelides is a common, small, tan-brown macule typically found on sun exposed skin, usually on the face or dorsal forearms and hands of children or young adults with a fair-skinned phenotype.

Solar lentigines (liver spots, age spots, senile lentigines) is an acquired lentigo resulting from sun exposure, more common in middle-aged or older patients, and tend to persist even the absence of sunlight.

Histologically, freckle shows normal epidermis without elongation or branching of the rete ridges, the only differences that can be detected in lesional skin as compared to normal surrounding skin are larger-sized melanocytes (which are normal in number) with more prominent dendrites and an increased transfer of larger, darker melanosomes to surrounding keratinocytes. While solar lentigines typically have a normal number of melanocyte plus increased melanin in the basal layer of the epidermis.

Long-pulsed alexandrite laser is a laser device that delivers energy in the near infrared (755 nm.), which is approved by U.S. Food and Drug Administration (FDA) for hair removal therapy and has been previously used to treat small melanocytic nevi without serious complications. The biological effect of normal mode laser is thermal damage of the pigment-containing cells whereas the effect of Q-switch lasers is based on a photo-acoustical effect. Pulse duration from as low as 10-50 ns in Q-switch laser systems and up to 200-300 ms have all been reported efficacious. Goldburg reported that new long-pulsed pigmented-specific lasers might prove to further enhance the clinical results in resistant pigmented lesions. In general, treatment of superficially located pigmented lesions such as solar lentigines is highly successful, and clearances of up to 60-70% have been reported. The final cosmetic outcome of treatments with lasers is highly dependent on light source, the number of treatments and the intervals between these, as well as biological variables for example type and depth of lesion, and anatomical location.
In our study, 8 in 9 patients (88.89%) had improvement. The earliest visible result appeared after 1 treatment session while most cases needed around 3 sessions. The mechanism of action of long-pulsed alexandrite laser with 755-nm wavelength and 0.5-millisecond pulse duration (which is longer than the thermal relaxation time of melanosomes, but shorter than that of epidermis) caused a gradual and diffuse epidermal necrosis while preserving the dermis. In addition, without the photomechanical effect associated with the use of Q-switched laser, the risk of postinflammatory pigmentary alteration associated with long pulsed laser is lower.

Unfortunately, one patient had no improvement. It was possible that inflammation after laser treatment stimulated active melanocytes to produce more pigments or the energy exposure may be subthreshold and directly stimulated melanocytes.

From the Clinical Reference Manual of Apogee Elite prepared by clinical service department, Cynosure, Inc. May 2004 recommend fluence of 18-25 J/cm² for treating pigmented lesion in skin type III. In this pilot study, because we studied in Asian skin type (most cases were skin type IV or higher) so we decided to choose a fluence at 15 J/cm² for avoiding possible complications.

The number of treatment session ranged from 1-5 sessions. Some cases show marked improvement at 1 or 2 sessions, while some needed more treatment sessions. But we had to stop the study eventhough some cases not reveal the expected result yet, because of the laser device’s unavailability.

In addition to treating hyperpigmented lesions, the previous study shown that long-pulsed alexandrite laser is also an effective treatment for wrinkles due to aging or photodamage.

Finally, there are several advantages associated with the use of long-pulsed mode alexandrite laser for treatment of freckles or solar lentigines. Treatment time is minimized since the larger spot size than Q-switched laser produce a more evenly distributed beam and allows for only 1 pulse placed on each pigmented lesion. There is no immediate pinpoint bleeding or exudation with this technique. Recent innovations in cooling at the skin surface allow the use of high fluence delivery in the selected patients.
And using such a laser for treatment of freckles and solar lentigines offers the additional advantage of a second use of an expensive device.

Apogee Elite (Cynosure, INC.) can emit both long-pulsed 1064-nm Nd:YAG laser and long-pulsed 755-nm alexandrite laser. Their indications are overlapped including hair removal therapy, rejuvenation, vein treatment, but long-pulsed 755-nm alexandrite laser may be superior than long-pulsed 1064-nm Nd:YAG laser in treatment pigmented lesions.

The limitations of this study were the fixed fluence for all patients and the duration of the study that is too short because the company can support the device for about 2 months from the beginning of this study, and resulted in a small sample size. In the further study the fluence should be adjusted depend on the skin type of the patient, type and depth of the lesions. And from previous study that reported the efficacy in treatment for wrinkles, the investigator should also record the result of rhytides and the quality of treated skin.

**Conclusion**

Long-pulsed alexandrite laser is safe, and could be an alternative way for treatment freckles and solar lentigines in Asian skin.
References


