การศึกษาเปรียบเทียบระหว่าง เลเซอร์ไดโอด 810 นาโนเมตร ชนิดพลังงานต่ำ, พลังงานสูง และ 1,064 นาโนเมตร เลเซอร์ลองเพ้าส์เอ็นดีแย็ก สำหรับการกำจัดขนรักแร้

Comparative Evaluation of Low, High fluence 810 nm diode laser and 1,064 nm Long-pulsed Nd:YAG laser for Axillary Hair Removal.

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นักศึกษาระดับปริญญาโท สาขาวิชาตจวิทยา มหาวิทยาลัยแม่ฟ้าหลวง

บทคัดย่อ

มีการใช้เลเซอร์ไดโอด 810 นาโนเมตร และเลเซอร์เอ็นดีแย็ก 1064 นาโนเมตร เพื่อกำจัดขนกันมาเป็นเวลาหลายปีแล้ว และได้รับการพิจารณาว่าเหมาะสม อย่างยิ่ง สำหรับการกำจัดขนในผู้ป่วยที่มีผิวสีเข้มรวมไปถึงคนเอเชีย

วัตถุประสงค์ เพื่อเปรียบเทียบประสิทธิภาพ, การทนต่อผลข้างเคียงและความพึงพอใจของเลเซอร์ไดโอดในค่าพลังงานที่ต่างกัน และเลเซอร์ลองเพ้าส์เอ็นดีแย็ก สำหรับการกำจัดขนรักแร้ในผู้หญิงไทย

วิธีการศึกษา อาสาสมัครหญิง 30 คน ได้รับการรักษา 3 ครั้ง ห่างกัน 4 สัปดาห์ โดยรักแร้แต่ละคนถูกแบ่งครึ่งบนและล่างได้ 4 บริเวณ โดยแต่ละบริเวณ ได้รับการรักษาด้วยเลเซอร์ ต่างกัน ดังต่อไปนี้: (1) เลเซอร์ไดโอด 810นาโนเมตรชนิดพลังงานสูง 3 ครั้ง (2) เลเซอร์ไดโอด 810นาโนเมตรชนิดพลังงานต่ำ 3 ครั้ง, (3) เลเซอร์ลองเพ้าส์เอ็นดีแย็ก 1,064 นาโนเมตร 3 ครั้ง และ (4) รักษาด้วยเลเซอร์แบบหมุนเวียนคือรักษาด้วยเลเซอร์ทั้งสามแบบ ชนิดละ 1 ครั้ง ประสิทธิภาพในการกำจัดขน ประเมินโดย Folliscope® ผลข้างเคียงและความพึงพอใจจะประเมินหลังการรักษา ที่สัปดาห์ที่ 4, 8, 12 และ 20

ผลการทดลอง อาสาสมัคร 29 ได้รับการรักษาและติดตามครบ ทั้งหมด มีผิว phototypes III และ IVอายุเฉลี่ย 30 ปี เปอร์เซ็นต์ การลดลงของ ขนทั้งสี่บริเวณ ได้เพิ่มขึ้น อย่างมีนัยสำคัญจาก baselineตั้งแต่การติดตามผลครั้งแรก สัปดาห์ที่ 4 หลังการรักษา ครั้งแรก บริเวณที่รักษาด้วยเลเซอร์ไดโอดพลังงานต่ำ , เลเซอร์ไดโอดพลังงานสูง ,เลเซอร์ลองเพ้าส์เอ็นดีแย็กและเลเซอร์หมุนเวียน มีขนลดลง เป็น 58.86%, 64.00%, 63.93% และ 60.21% ตามลำดับ สัปดาห์ที่ 4 หลังการรักษา ที่สอง ขนลดลง 70.23%, 74.28%, 72.38% และ 68.17% ตามลำดับ สัปดาห์ที่ 4 หลังการรักษา ที่สาม ขนลดลง 81.34%, 84.62%, 85.10% และ 81.38% ตามลำดับ และ สุดท้าย สัปดาห์ที่ 12 หลังการรักษา ครั้งสุดท้าย ขนลดลง 76.28%, 78.72%, 79.76% และ 76.34% ตามลำดับ ซึ่งทั้งหมดมีความแตกต่างอย่างมีนัยสำคัญ คะแนนความเจ็บในการรักษาครั้งแรก เป็น 4.62, 5.07, 4.83 และ 4.66 ตามลำดับซึ่งไม่มีนัยสำคัญทางสถิติ ในครั้งที่สองเป็น 5.00, 3.55, 5.79 และ 4.03 ตามลำดับ และครั้งที่สามเป็น 4.72, 3.97, 6.38 และ 6.45 ตามลำดับ ซึ่งสองครั้งหลังแตกต่างอย่าง มีนัยสำคัญทางสถิติ การรักษา ในครั้งหลังๆ ความเจ็บปวดสำหรับการใช้เลเซอร์ไดโอดชนิดพลังงานต่ำลดลงขณะที่การเปลี่ยนแปลงสำหรับ เลเซอร์ลองเพ้าส์เอ็นดีแย็กเห็นได้ไม่ชัด ผลข้างเคียงของทั้งสองระบบเลเซอร์มีเล็กน้อยบริเวณที่รักษาและเป็นแค่ชั่วคราว

สรุปผล ทั้งเลเซอร์ไดโอดแล ะเลเซอร์ลองเพ้าส์เอ็นดีแย็ก มีประสิทธิภาพในการกำจัดขนรักแร้ โดยเลเซอร์ไดโอดชนิดพลังงานต่ำเลเซอร์ลองเพ้าส์เอ็นดีแย็ก มีประสิทธิภาพในการกำจัดขนสูงกว่าเลเซอร์ไดโอดชนิดพลังงานสูงและการรักษาด้วยเลเซอร์แบบหมุนเวียนอย่างมีนัยสำคัญทางสถิติ การรักษาด้วยเลเซอร์แบบ หมุนเวียน ไม่ได้มีประสิทธิภาพไปกว่าการรักษาด้วยเลเซอร์ไดโอดหรือเลเซอร์ลองเพ้าส์เอ็นดีแย็กเพียงอย่างเดียว และเลเซอร์ไดโอดชนิดพลังงานต่ำเจ็บน้อยที่สุด
คำสำคัญ เลเซอร์ไดโอด, เลเซอร์ลองเพ้าส์เอ็นดีแย้ก, เลเซอร์กำจัดขน

ABSTRACT

Background: The 800 nm diode laser and the 1064 nm Nd:YAG laser have been used successfully for hair removal for several years and are considered to be particularly suitable for hair removal in dark-skinned patients.

***Objective*:** To compare the efficacy, the tolerability, side effects and satisfaction of a diode laser with a long-pulsed Nd:YAG laser of different fluences for axillary hair removal in Thai woman.

***Methods*:** Thirty female patients received three treatments sessions performed at 4 week intervals. Each axilla was divided in half to yield four distinct areas that were treated by the following lasers: (1) three sessions with a high fluence 810 nm diode laser, (2) three sessions with a low fluence 810 nm diode laser, (3) three sessions with a long-pulse 1,064 nm neodymium:yttrium-aluminum-garnet (Nd:YAG) laser, and (4) rotational treatment consisting of a single session by each of the three laser systems. Percent hair reduction, tolerability, satisfaction and side effects were evaluated after treatment.

Results: Of all 30 volunteers, 29 subjects received three treatments and attended 1-month and 3-month follow-up visits. A total of patients have skin phototypes III and IV. The mean age was 30 years. The percent hair reduction of high fluence diode laser, low fluence diode laser, long-pulsed Nd:YAG laser and rotational treatments on follow-up 1, 2,3 and 4 has increased significantly from baseline. At 4 week after the first treatment, hair reduction has increasingly on the high fluence diode, low fluence diode, Nd:YAG and rotational lasers area was 58.86%, 64.00%, 63.93% and 60.21%, respectively. At 4 week after the second treatment, hair reduction was 70.23%, 74.28%, 72.38% and 68.17%, respectively. At 4 week after the third treatment, hair reduction was 81.34%, 84.62%, 85.10% and 81.38%, respectively. And the last follow-up at 12 week after the last treatment, hair reduction was 76.28%, 78.72%, 79.76% and 76.34%, respectively, which were all statistically significant. Immediate pain scores at the first session were 4.62, 5.07, 4.83 and 4.66 respectively, which were not statistically significant. The second session were 5.00, 3.55, 5.79 and 4.03, respectively. And the third session were 4.72, 3.97, 6.38 and 6.45, respectively, which both were statistically significant. With increasing numbers of treatments, the pain score for the diode laser decreased, while changes in pain for the Nd:YAG laser were not obvious. Side effects of both laser systems were local, mild and transient.

Conclusion: Both diode laser and long-pulsed Nd:YAG laser systems are effective in the axillary hair removal treatment. Low fluence diode laser and long-pulsed Nd:YAG laser showed a statistically significant in hair reduction compared to high fluence diode laser and rotational laser treatment. Rotational laser treatment is not as effective as treatment with the diode laser or long-pulsed Nd:YAG laser alone. Low fluence diode was less painfull.

Key Words: diode laser / long-pulsed Nd:YAG laser / laser hair removal

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Introduction

Unwanted facial and body hair is a common problem, generating a high level of interest for treatment innovations. (Wanitphakdeedecha & Alster, 2009) Several traditional

treatments are offered for hair removal including shaving, plucking, waxing, chemical depilatories and electrolysis. (Liew, 1999; Olsen, 1999) None of these treatments are ideal as the efficacy is limited, painful and tedious, and there may be a risk of side-effects such as skin irritation, infection, allergic and irritant dermatitis as well as scarring. (Liew, 1999) Lasers and light sources have been used to address this problem with improved success rates in properly selected patients and emerged as the gold standard to remove unwanted hair. The original lasers designed for hair removal concentrated on removing unwanted hair in light skinned individuals, whereas more recent investigations, especially in regard to the longer wavelength systems such as the diode laser systems and the Nd:YAG laser, have shown efficacy in darker-skinned individuals. The long-pulsed 800 nm diode laser and the 1064 nm Nd:YAG laser have been reported to be safe and effective in the Asian population as well (Feng, Wang & Zhou, 2007).

Objective

The purpose of this clinical study was to comparing the efficacy, tolerability, and satisfaction of two popular lasers of different wavelengths and fluences for axillary hair removal in Thai woman. Furthermore, the utility of combining these lasers in a novel, rotational regimen is examined.

Methods

Twenty-nine Thai women were enrolled in this clinical evaluation for laser hair removal. The mean age of the patients was 30 years (range 20 – 40) and the skin types ranged from Fitzpatrick III to IV. Exclusion criteria included: pregnant patients; infection or tattoo in the treatment areas; the use of any topically or oral photosensitizing drugs within 1 year prior to entry into the study; a history of keloid formation; a history of photoallergy; hypertension or any other serious cardiac disease; and a history of plucking of the hair, waxing, or electrolysis treatments in the treatment areas within 6 weeks of the beginning of this trial.

Laser device and parameter

The parameters of the 810 nm diode laser (MeDioStar Next; Aesclepion, Germany) and the 1064 nm Nd:YAG (Gentle YAG; Candela, USA) are presented in Table I.

Table I Laser system specifications.

	Diode laser		Nd:YAG laser
	High Fluence	Low Fluence	
Wavelength	810 nm	810 nm	1064 nm
Mode	Epilation Basic	Smooth pulse	-
Speed	1 Hz	6 Hz	1 Hz
Spot size	10x14 mm	10x14 mm	18 mm (spot)
Fluence	30 – 35 J/cm^2	10-12 J/cm^2	24 – 26 J/cm^2
Cooling	Contact skin cooling	Contact skin cooling	Cryogen spray
Pulse duration	70 ms	-	20 ms
Repetition rate	1 pass	8 pass	1 pass

Treatment protocol

After patients signed an informed consent for treatment, the axillary fossae were randomly treated by both the 800 nm diode laser and the 1064 nm by Random Allocation Software. Each subject's axilla was divided in half to yield four distinct treatment areas: the (1) right upper axilla, (2) right lower axilla, (3) left upper axilla, and (4) left lower axilla. Prior to the first laser hair removal treatment session, digital photographs of treatment sites at each patient visit were obtained using identical lighting, patient positioning, and camera settings using a digital camera (Canon IXUS110 IS, Canon Inc., Tokyo, Japan). Standardized view with fixed distance at 30 cm was used. A 3 cm^2 round-shaped magnifying lens (Folliscope) was placed well within the confines of each treatment area, and hair counts were accurately performed on each of the four 3 cm2 axillary regions.

Each treatment area was then assigned the following treatment regimen:

1. Right upper axilla: High fluence 810 nm diode laser for each of the 3 treatment sessions
2. Right lower axilla: Low fluence 810 nm diode laser for each of the 3 treatment sessions

3. Left upper axilla: Long-pulse 1,064 nm Nd:YAG laser for each of the 3 treatment sessions
4. Left lower axilla: : High fluence 810 nm diode laser for the first treatment session, Low fluence 810 nm diode laser for the second treatment session, and long-pulse 1,064 nm Nd:YAG laser for the third treatment session

Immediately after each laser treatment, subjects were evaluated for immediate pain score and side effects (such as burned hair, erythema, edema, and pain) and were asked to keep a log of the duration of these events. After treatment, patients were advised to cleanse the laser treated area with mild soap and water twice a day. Each patient received a total of three laser treatments at monthly intervals using the same laser parameters for each area at every visit.

Assessments

Hair reduction: for hair removal, a round area 3 cm^2 was chosen from the treatment site, and marked and photographed by Folliscope®. The same site was utilized during each treatment session to determine the hair-removal rate in this study. Follow-up clinical evaluations, photographs, and hair counts were also made 1, 2, 3 and 5 months after the first laser treatment. Hair reduction was quantified utilizing the following formula:

Hair reduction = (quantity before treatment - the quantity after treatment) / the quantity before treatment x 100

Immediate pain: patients were asked to score the degree of immediate pain using a visual analog scale (VAS), where a score of 1=no pain, while a score of 10=maximum pain possible. The patients were asked to mark the score accordingly on the VAS form.

Participants´ satisfaction: Patient satisfaction rating was subjectively measured at 1 and 3 month follow-up visits after last treatment on a visual analog scale (VAS) ranging from 1 to 5

1 = slightly improvement (0-20%)
2 = mild improvement (20-40%)
3 = moderate improvement (40-60%)
4 = good improvement (60-80%)
5 = very good improvement (80-100%)

Statistical Analysis

A paired *t* -test was applied to each result as a statistical analysis tool.

Results

Hair Reduction: The results of the hair reduction is shown in Table II.

Table II Comparison the mean of percent hair reduction between groups of four lasers treatments on each follow-up. (n = 29)

(%) Hair reduction	HF diode (Mean ± SD)	LF diode (Mean ± SD)	LP Nd:YAG (Mean ± SD)	Rotational (Mean ± SD)	P value
Follow-up 1	58.86 ± 5.74^{A}	$64.00 \pm 6.33^{A,B}$	$63.93 \pm 4.29^{A,B}$	60.21 ± 4.97^{B}	<0.05
Follow-up 2	70.03 ± 5.26^{A}	$74.28 \pm 5.36^{A,B}$	72.38 ± 4.23^{B}	68.17 ± 4.67^{B}	<0.05
Follow-up 3	81.34 ± 5.09^{A}	$84.62 \pm 4.46^{A,B}$	$85.10 \pm 3.64^{A,B}$	81.38 ± 3.77^{B}	<0.05
Follow-up 4	76.28 ± 5.39^{A}	78.72 ± 4.35^{B}	$79.76 \pm 4.25^{A,B}$	76.34 ± 4.26^{B}	<0.05

p-value from paired t test, Same characters mean difference significant

All the four areas showed that the percent hair reduction on follow-up 1, 2,3 and 4 has increased significantly from baseline, with a $p < 0.05$.

At 4 week after the first treatment, hair reduction on the high fluence diode, low fluence diode, Nd:YAG and rotational lasers area was 58.86%, 64.00%, 63.93% and 60.21%, respectively. At 4 week after the second treatment, hair reduction was 70.23%, 74.28%, 72.38% and 68.17%, respectively. At 4 week after the third treatment, hair reduction was 81.34%, 84.62%, 85.10% and 81.38%, respectively. And the last follow-up at 12 week after the last treatment, hair reduction was 76.28%, 78.72%, 79.76% and 76.34%, respectively, which were all statistically significant ($p<0.05$).

Figure 1 Comparison the mean of percent hair reduction

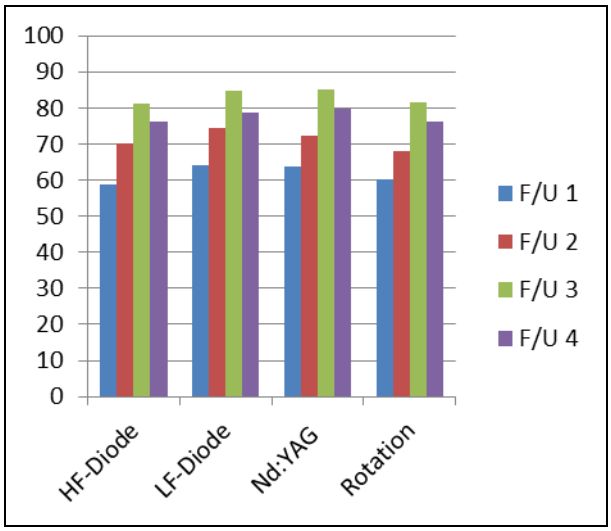
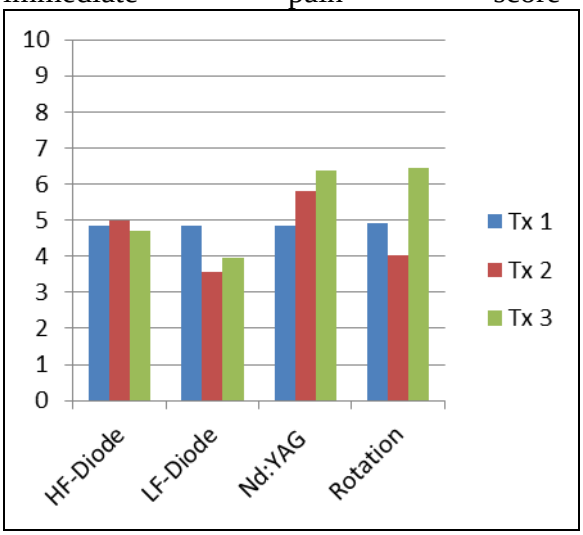


Figure 2 Comparison the mean of immediate pain score



Immediate pain score: Immediate pain scores on the high fluence diode, low fluence diode, Nd:YAG and rotational laser treatments at the first session were 4.62, 5.07, 4.83 and 4.66 respectively, which were not statistically significant ($p>0.05$). The second session were 5.00, 3.55, 5.79 and 4.03, respectively. And the third session were 4.72, 3.97, 6.38 and 6.45, respectively, which both were statistically significant ($p<0.05$). With increasing numbers of treatments, the pain score for the diode laser decreased, while changes in pain for the Nd:YAG laser were not obvious.

Side effects: The study did not show any serious side effects and the number of side effects was minimal. After the diode and Nd:YAG lasers treatment, there was perifollicular erythema and edema, which were the clinical end-point of the treatment and were reported as having disappeared within 12-24 hours. No other adverse effects such as crusting, burn or dyspigmentation, were demonstrated.

Patient satisfaction: At 1 month and 3 month follow-up visits after the last treatment, all of patients have a good improvement and a very good improvement.

Discussion

The present study demonstrates that both diode laser and long-pulsed Nd:YAG laser systems are effective in the axillary hair removal treatment and created a high patient satisfaction. Low fluence high repetition rate 810 nm diode laser and high fluence low repetition rate 1064 nm long-pulsed Nd:YAG laser showed a statistically significant in hair reduction compared to high fluence low repetition rate 810 nm diode laser and rotational laser treatment. In previous split axillary hair removal studied by Wanitphakdeedecha et al., (2012) high fluence low repetition rate Nd:YAG laser was superior in hair reduction than low fluence high repetition rate 810 nm diode laser that percentage of axillary hair reduction at 1-month and 6-month follow-up visit were 82.3% VS. 71.0% and 54.2% VS. 35.7%, respectively, likely as in our study. Compare to our study, larger spot size of long-pulsed Nd:YAG laser (18 mm VS. 12 mm) show greater reduction in hair counts. Li, Zhou and Gold (2010) studied, the diode laser system was more efficacious than the Nd:YAG laser (60 vs. 41% and 79 vs. 65% after one and two sessions respectively) In contrast, the efficacy of diode laser found in our study was lower. This may result from the different treatment settings. We used the greater spot size of diode laser and Nd:YAG laser so the percentage of hair reduction after one treatment in our study was higher than their study. Chan et al. (2001) studied found that there were similar and substantial regrowth rate for both laser systems after 36 weeks of single treatment (91% for both systems). In our study did not follow-up as long as 36 week but the percentage of hair reduction quite be greater than their study after one treatment, it

may due to the different of parameters(spot size and fluence). For the study of Goldberg and Silapunt (2001), they concluded that a 5 mm, 50-msec long-pulsed Nd:YAG laser hair removal with fluences of either 50, 80 or 100 j/cm^2 leads to similar efficacy with no significant adverse effects. Cause their choice of a 50-msec pulse duration is consistent with the combined goal of thermal damage to the hair and epidermal protection. Thus the least effective delivered fluence and the proper other parameters setting (spot size and pulse duration) should be utilized.

Conclusion

Both diode laser and long-pulsed Nd:YAG laser systems are effective in the axillary hair removal treatment. Low fluence diode laser and long-pulsed Nd:YAG laser showed a statistically significant in hair reduction compared to high fluence diode laser and rotational laser treatment. Rotational laser treatment is not as effective as treatment with the diode laser or long-pulsed Nd:YAG laser alone. Low fluence diode was less painfull.

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