

A Randomised, Split-Face Comparison of Facial Hair Removal With the Alexandrite Laser and Intense Pulsed Light System

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Introduction: Despite the high incidence of polycystic ovary syndrome (PCOS) in women attending for facial hair removal there are few studies looking specifically at this patient group. We carried out a split-face study directly comparing the efficacy of a 3 milliseconds pulse duration alexandrite laser with the Lumina IPL system in 38 women with PCOS.

Materials and Methods: Each patient underwent six treatments using both systems, with 1, 3 and 6 months follow-up. Hair counts, hair-free intervals and patient satisfaction were recorded for all patients.

Results: After six treatments, alexandrite laser treatment resulted in longer median hair-free intervals when compared to IPL (7 weeks vs. 2 weeks; $P < 0.001$). Decrease in hair counts was significantly larger on the Alexandrite side compared to the IPL side at 1, 3 and 6 months (52%, 43% and 46% vs. 21%, 21% and 27%; $P < 0.001$). Patient satisfaction scores, using linear analogue scales (LAS), at 1, 3 and 6 months were significantly higher for the alexandrite laser than the IPL (8.7, 7.8 and 7.7 vs. 5.7, 5.1 and 5.1; $P \leq 0.002$).

Conclusions: The alexandrite laser resulted in significantly longer hair-free intervals, a larger reduction in hair counts and greater patient satisfaction than the IPL and appeared to be more effective in this patient group. It is clear from the results in this study that the GentleLase alexandrite laser is more effective at reducing facial hirsutism in women with PCOS than the Lumina IPL. It is probable that this is due to the specific wavelength, short pulse duration and single pulse delivery of the GentleLase alexandrite laser, resulting in more follicular destruction than the IPL. *Lasers Surg. Med.* 39:767–772, 2007.

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Key words: polycystic ovary syndrome; hair counts; hair-free intervals; patient satisfaction questionnaire

INTRODUCTION

The presence of excessive facial hair in women is associated with psychological and emotional distress [1,2], and causes significant impairment of their quality of life [3–5]. Polycystic ovary syndrome (PCOS) is estimated to affect between 4% and 6% of the female population, with up to 80% of these women going on to develop hirsutism,

and is therefore one of the most common reasons for women to seek removal of facial hair [6,7]. Despite this, few previous studies have specifically looked at laser treatment of women with PCOS [8,9]. This is important because in a previous study [9], it was demonstrated that alexandrite laser treatment of facial hair in women with PCOS is less effective than would be predicted based upon the results in the laser literature, where non-PCOS patients are usually included.

In this study we carried out a randomised, split-face controlled trial comparing hair removal with a 3 milliseconds alexandrite laser and an intense pulsed light system in women with PCOS. Our primary aim was to establish whether there were any differences between the two systems in terms of outcome and side effects.

MATERIALS AND METHODS

Subjects

The local hospital ethics committee approved the study and written informed consent was obtained from all patients prior to commencement. Patients were recruited from new referrals to our unit seeking removal of facial hair. Due to referral patterns and local health board restrictions, all of the patients had been diagnosed as having PCOS prior to referral, either through gynaecology or endocrinology clinics, and we did not attempt to independently establish the diagnosis. Patients completed a skin sensitivity questionnaire and were assessed by the first author prior to treatment to ensure their suitability for laser hair removal. Past medical history and current drug treatment were recorded at this stage. Inclusion criteria were: a diagnosis of PCOS; facial hirsutism comprising brown or black hair; Fitzpatrick skin types I–V; and patients over the age of 16. Exclusion criteria were:

The Lumina Intense Pulsed Light system used in this study was initially on loan from Lynton Lasers Ltd. (Lynton Laser Ltd., Chapelcross, Cheshire, UK). The Laser suite at Glasgow Royal Infirmary has since purchased this IPL system.

D.J.M. has disclosed a potential financial conflict of interest with this study.

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idiopathic and non-facial hirsutism; patients with blonde, red, grey or white hair; and patients under the age of 16. The extent of facial hirsutism was not an entry criterion. After assessment and application of inclusion criteria, 38 women were recruited into the trial. Mean age was 34 years (range 16–69); 34 patients were skin types I–II, 4 were types III–IV. From this group, six patients failed to attend for part of their treatment at the correct time and were excluded from the study. In addition, one patient was excluded since she developed skin hypersensitivity to laser treatment resulting in significant blistering even at low fluences. Therefore, 31 patients completed the study and follow-up.

Study Protocol

This study was a randomised split-face controlled trial of facial hair removal comparing the GentleLase alexandrite laser (Candela Corp., Wayland, MA) with the Lumina intense pulsed light system (Lynton Lasers Ltd., Cheshire, UK). The set-up and fluences used for the two systems are described below. In both cases the fluences used were within the recommended range by the manufacturers and those commonly used for the purposes of hair removal. The study aimed to directly compare these two systems by treating one side of the face using the alexandrite laser and the other side with the IPL. Envelopes were made up randomising IPL treatment to either right or left and alexandrite laser treatment to the opposite side. The envelopes were opened immediately prior to the first treatment. Patients initially received test patches using both systems and were reviewed after 2 weeks to examine response at the starting fluence and to assess any side effects. They then underwent a further six full treatments with both the alexandrite laser and IPL with 6 week intervals between treatment. Response to treatment on the two sides of the face was assessed 1, 3 and 6 months after treatment cessation.

Alexandrite Laser

The GentleLase alexandrite laser used in this study has a wavelength of 755 nm and a 3 milliseconds pulse duration. All patients were treated using a 15 mm spot and accompanying Dynamic Cooling Device. Standard starting fluences of 20 J/cm² for skin types I–III were used, with fluences subsequently increased up to 30 J/cm² as tolerated. Twenty-three out of 28 patients (82%) with skin types I–III were treated at a maximum of 30 J/cm², with the remaining 5 patients (18%) treated at 25 J/cm². The three patients with skin type IV were started at 10 J/cm² then increased to between 16 and 18 J/cm² as tolerated.

Intense Pulsed Light System

The Lumina intense pulsed light system employed in the study incorporated a 650–1,100 nm filter on the flashlamp. Treatments were carried out using a 3 cm × 1 cm quartz block. Epidermal cooling was achieved using a thin layer of cooled ECG gel and air-cooling (Cyro 5, Zimmer Medizin-Systems, Irvine, CA). Patients with skin types I–III were

treated using 26–28 J/cm² as a starting fluence increasing up to 42 J/cm² as tolerated, with three pulses and a 20 milliseconds delay between pulses and a pulse duration of 55 milliseconds. Twenty-four out of 28 patients (86%) with skin types I–III were treated at 42 J/cm², with the remaining four patients (14%) treated between 34 and 38 J/cm². Those with skin type IV were started at 16–18 J/cm², increasing to between 24 and 28 J/cm² as tolerated, with the energy divided up into four pulses and 40 milliseconds delay between pulses and a pulse duration of 140 milliseconds.

Outcome Measures

Hair counts and patient satisfaction questionnaires were completed prior to treatment and at 1, 3 and 6 months following treatment. In addition, hair-free intervals (HFI) were recorded following each treatment. HFI were defined as the time to first hair re-growth, as measured by the patient, following each treatment.

Hair counts were measured using a 25× videomicroscope lens, as has been previously described [9,10]. Standard videomicroscopy pictures were taken on the outer margin of the upper lip, the chin and neck from both the right and left side of the face. Three experienced members of the laser suite, blinded to treatment allocation, independently calculated hair counts from the pictures to ensure accuracy. If there was any discrepancy between counts then an average value was taken.

Prior to treatment, and at each follow-up period, patients were asked to complete a patient satisfaction questionnaire. This questionnaire was based upon the one used by Preston and Lanigan [11], with permission from the senior author in that study. The questionnaire used linear analogue scales (LAS) to assess patient satisfaction with both pre-treatment hair removal methods and laser hair removal.

All results were analysed using SPSS version 10 (SPSS, SPSS, Inc., Chicago, IL). The data for hair counts, HFI and patient satisfaction all failed tests of normality and therefore the Wilcoxon Signed Ranks non-parametric test was used in each case.

RESULTS

Hair Counts

The hair count results are displayed in Figure 1. There was no difference in pre-treatment hair counts between sides: 37 ± 3 (mean ± SEM) on the IPL side versus 37 ± 3 on the alexandrite side ($P = 0.904$). At 1 month follow-up, hair counts had decreased to 30 ± 3 on the IPL side (21% decrease, $P = 0.002$) and 18 ± 2 on the alexandrite side (52% decrease, $P < 0.001$). After 3 months, the decrease in hair counts on the IPL side had remained static at 30 ± 2 (21% decrease, $P = 0.015$ vs. pre-treatment and $P = 0.516$ vs. 1 month follow-up) whilst on the alexandrite side there was a slight increase in hair counts to 22 ± 2 compared with the results at 1 month (43% decrease, $P < 0.001$ vs. pre-treatment and $P = 0.091$ vs. 1 month follow-up). At 6 months, there was slight further decrease in hair counts

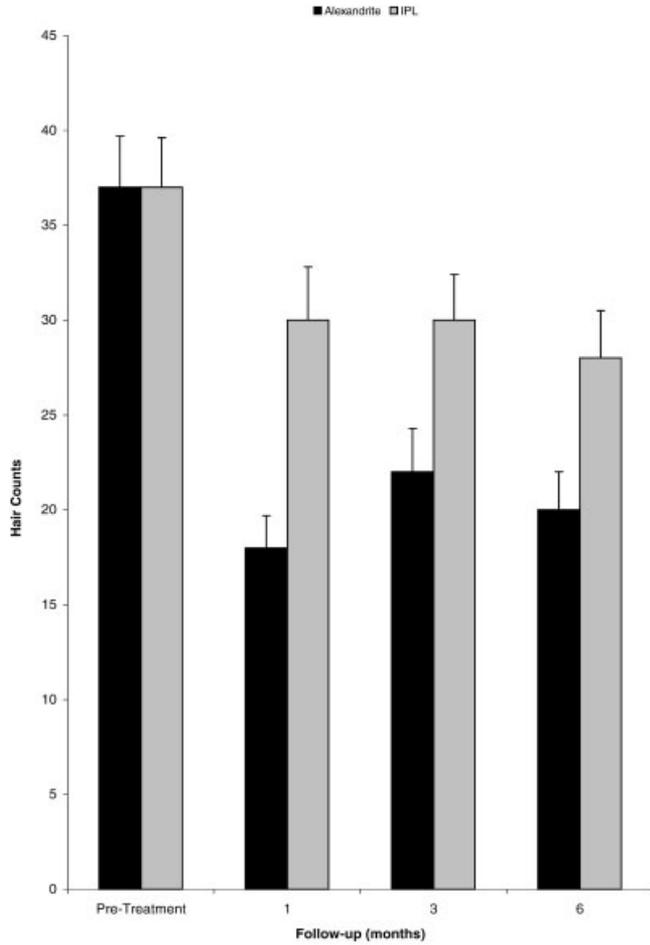


Fig. 1. Mean hair counts (with SEM error bars) are displayed for the alexandrite laser and Lumina IPL.

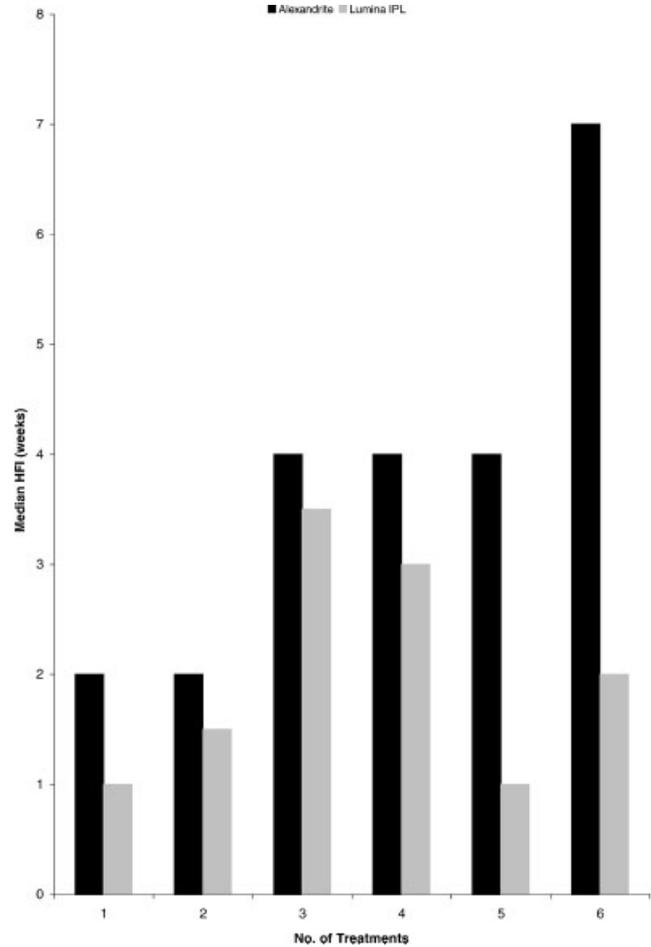


Fig. 2. Median hair-free intervals are shown for both systems after each treatment.

on the IPL side to 28 ± 3 (27% decrease, $P = 0.004$ vs. pre-treatment), however this finding was not statistically significant when compared to the 1 and 3 months follow-up results ($P = 0.94$ and 0.307 , respectively). On the alexandrite side, there was also a slight further decrease in hair counts, to 20 ± 2 (46% decrease, $P < 0.001$ vs. pre-treatment). Again this difference was not significant compared to the 1 and 3 months follow-up results.

At all follow-up points the decrease in hair counts on the alexandrite side was greater than that seen on the IPL side ($P < 0.001$).

Hair-Free Intervals

The HFI recorded for both the alexandrite laser and IPL system after each treatment are displayed in Figure 2 and Table 1. HFIs were self-reported by the patient. Since these recordings are to an extent subjective, HFI results are presented as medians with accompanying ranges. On the side treated with the alexandrite laser, there was a marked increase in median HFI with treatment, with the longest HFI recorded after the sixth treatment (7 weeks, range

0–15), which was significantly longer than those recorded after treatments 1–5 ($P \leq 0.002$). In contrast, the median HFIs on the IPL side peaked after the third treatment at 3.5 weeks (0–6) before decreasing again to 2 weeks (0–10) after the sixth treatment. The HFI after the third treatment was significantly longer than those after 1, 2 and 5 treatments ($P \leq 0.02$), whilst the difference between the

TABLE 1. HFIs (Median and Range) are Displayed for Both the Alexandrite Laser and IPL System After Each Treatment

Treatment	Hair-free interval (weeks)	
	Alexandrite laser	Lumina IPL
1	2 (0–5)	1 (0–5)
2	2 (0–6)	1.5 (0–5)
3	4 (0–6)	3.5 (0–6)
4	4 (0–6)	3 (0–6)
5	4 (0–6)	1 (0–5)
6	7 (0–15)	2 (0–10)

HFI after the third and sixth treatments failed to reach statistical significance ($P = 0.076$).

The median HFIs were longer on the alexandrite laser side, when compared to the IPL, after all six treatments. This finding reached statistical significance from the second treatment result onwards ($P < 0.005$).

Patient Questionnaires

The results for patient satisfaction are displayed in Figure 3. Happiness with pre-laser treatment hair removal methods (e.g., depilation, waxing, shaving) scored a median of 1.2 (0–5.3) on a LAS scoring 0 for very unhappy up to 10 for very happy, with 30 out of 31 patients (97%) rating their satisfaction less than 5. In contrast, 1 month after laser treatment, median satisfaction had increased to 8.7 (0.2–10) on the side treated with the alexandrite laser and 5.7 (0.2–10) on the IPL side ($P < 0.001$ vs. pre-treatment score). Twenty-eight out of 31 patients (93%) rated themselves satisfied with alexandrite laser treatment, compared to 18 out of 31 (60%) on the IPL side, by scoring more than 5 on the LAS. At 3 months patient satisfaction dropped slightly on both sides with 77% (23 out of 31) of patients scoring over 5 on the LAS (median 7.8, range 0–10) on the alexandrite

side ($P = 0.02$ vs. 1 month) and 57% (17 out of 31, median 5.1, range 0–10) on the IPL side ($P = 0.005$ vs. 1 month), although this was still significantly higher than pre-treatment on both sides ($P < 0.001$). At 6 months follow-up, patient satisfaction was maintained relatively unchanged compared to the 3 months results on both sides: median 7.7 (1.3–9.8) on the alexandrite side and 5.1 (0.4–9.6) on the IPL side, which was still a marked improvement upon pre-treatment scores ($P < 0.001$).

At all stages of follow-up, patient satisfaction with the alexandrite-laser treated side was statistically significantly higher than that on the IPL side ($P \leq 0.002$).

Side-Effects of Treatment

Both systems were well tolerated by the majority of patients in the study. One patient did decline treatment to the upper lip as she found it too painful, even with the use of topical local anaesthetic. For the alexandrite laser, the main complication was purpura at higher fluences. Typically this occurred at 30 J/cm^2 and was seen in four patients (13%). In three of these patients, all of the subsequent treatments were carried out at 25 J/cm^2 . In the fourth patient it was possible to increase the fluence again to 30 J/cm^2 without further purpura after one further treatment at 25 J/cm^2 . Three patients (10%) sustained small areas of blistering on the IPL-treated side. In two cases this settled within 14 days without scarring. The third patient also healed without scarring but a small area did become temporarily hyperpigmented. A further two patients (6%) developed notable areas of leukotrichia on the side treated with IPL.

DISCUSSION

Hair Counts

In this study, the patients were found on the alexandrite treated side to have, on average, a 52% reduction in hair counts at 1 month, dropping slightly to 43% and 46% at 3 and 6 months follow-up respectively. This improvement, when compared to the 31% average decrease for patients undergoing alexandrite laser facial hair removal in a previous study [9], is most likely to be due to the higher fluences used in this study (average fluence of 30 J/cm^2 compared to 20 J/cm^2). However, these findings are still generally poorer than has been published previously for the alexandrite laser, where reductions in hair growth of up to 86% have been reported after up to 6 months follow-up [12–18]. This is likely to be due to the androgenic drive for facial hair growth in women with PCOS, which appears to result in these patients responding in a similar fashion to males undergoing facial hair removal [9].

In contrast, the reduction in hair counts on the IPL treated side was lower than on the alexandrite side at all follow-up points. This is despite using higher fluences on the IPL side than on the alexandrite side: mean fluences of 42 and 30 J/cm^2 were used respectively. Previous studies have found hair reductions using IPL systems to vary between 33% and 80.2%, with the improvement lasting up to 30 months following treatment [19–24]. The Lumina IPL

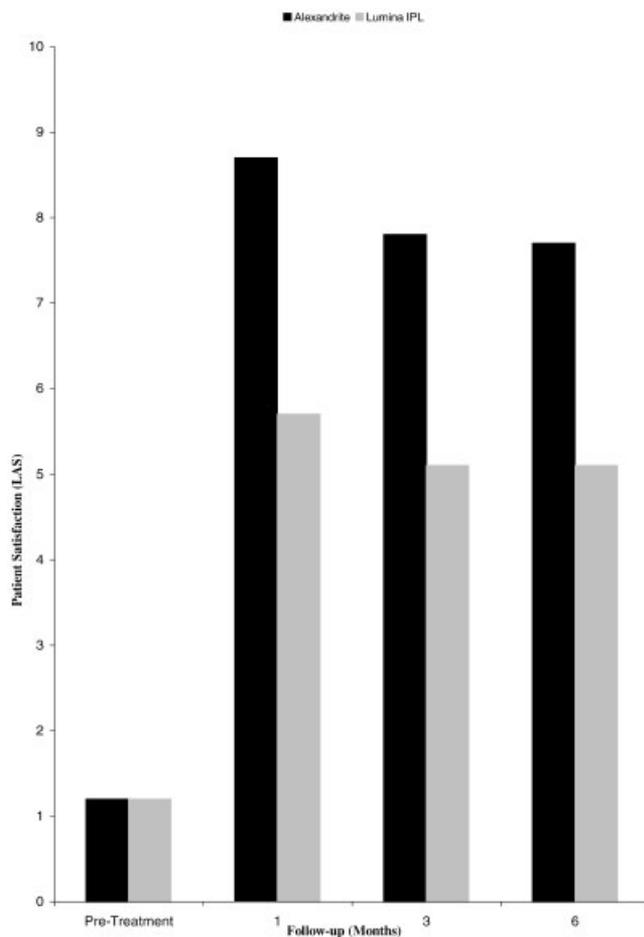


Fig. 3. Median patient satisfaction scores on the linear analogue scales (LAS) are shown for both systems.

resulted in mean hair count reductions of 21% at 1 and 3 months follow-up and 27% at 6 months follow-up. A possible reason for the difference in response between the two systems is that the GentleLase alexandrite laser delivers all of its fluence in one 3 milliseconds pulse and at a potentially optimum wavelength for follicular destruction. In contrast, the IPL delivers broadband light, some of which is likely to be less effectively absorbed by the melanosomes in the follicle. Additionally, the IPL delivers its fluence split into 2–4 pulses with a 20–40 milliseconds delay between pulses, which results in a slower energy build-up in the follicle and may cause less thermal transfer to the germinative elements of the follicle such as the bulge and hair bulb. Therefore, less follicular destruction and more hair re-growth would be the end result. Previous work by Lin et al. [25] supports this, finding that shorter pulses with the ruby laser resulted in more follicular disruption.

Overall, whilst there was some return of hair growth on the alexandrite-treated side at 3 and 6 months follow-up, the hair count reductions were maintained on the IPL treated side at 3 and 6 months follow-up. Both systems therefore demonstrated that they are capable of maintaining a significant reduction in hair counts up to 6 months after the last treatment.

Hair-Free Intervals

The hair-free interval results for the side treated with the alexandrite laser demonstrated a consistent increase after each treatment. In addition, in contrast with previous results [9], there was a distinct improvement in HFIs after six treatments: a median of 7 weeks compared to 1 week, which is likely to be due to the higher fluences used in this study. Despite this improvement, the HFI results are still shorter than has been previously reported after four treatments with the ruby laser [26]. A ruby laser was previously used for hair removal in our unit, and has been superseded by the GentleLase alexandrite laser because the latter produces better results in our patients. This is again indicative of the androgenic drive for hair growth in these women since the patients in the study by Chana and Grobbelaar were not selected for PCOS or for site of depilation, but included all patients attending for laser hair removal [26].

The HFI response to the Lumina IPL was different to that of the alexandrite laser. Rather than increasing consistently with the number of treatments, the HFIs on the side treated with the IPL peaked after the third treatment then stabilised between 1 and 2 weeks and were statistically significantly shorter than on the alexandrite side from the second treatment onwards. The hair count results demonstrated that there was a smaller reduction in hair growth on the IPL side, while the HFI results also suggest that there is faster hair re-growth after each treatment on this side. This again suggests that, when compared with the alexandrite laser, there is less follicular destruction occurring with IPL treatment, allowing quicker recovery of the follicle after treatment.

It is difficult to explain why the HFIs peak after three treatments on the IPL side. Since HFIs were self-reported,

one possibility is that as the patient's began to perceive a noticeable difference between the hair re-growth on the two sides, which occurred after the second to fourth treatment in most cases, they would become more dissatisfied with the side where re-growth was fastest. This would then tend to make them more aware of hair growth on that side and increase the chances of them recording a shorter HFI, whereas on the opposite side the perception of a better result would increase the likelihood of recording a longer HFI. It is also likely that the presence of leukotrichia, which was particularly notable in two of the patients on the IPL-treated side and tends to take several treatments to develop, will tend to reduce the HFI. Leukotrichia has been reported as a side effect of IPL treatment [27], and is felt to be due to thermal damage to the melanocytes that is insufficient to damage the germinative cells in the hair follicle, therefore allowing ongoing de-pigmented hair growth. This change of dark terminal hairs into white hairs would result in both a lower subsequent reduction in hair counts with treatment and also in patients noticing hair re-growth more quickly after each treatment since the white hairs are less likely to be removed with further treatment. It should be noted that we have also seen leukotrichia in patients following alexandrite laser treatment, although it does not appear to be as prevalent as after IPL treatment.

Patient Satisfaction Questionnaires

Patient satisfaction with laser treatment mirrored the other measures of outcome, in that satisfaction with both sides of the face improved significantly at 1 month follow-up, then deteriorated at 3 months before remaining relatively unchanged at 6 months follow-up. In addition, there was a marked difference in satisfaction levels for the alexandrite laser and Lumina IPL, reflecting the patients' higher levels of satisfaction for the alexandrite laser when compared to the IPL. The level of satisfaction with the alexandrite laser at 1 month (93%) and 6 months (90%) was similar to that found in our previous study [9], where satisfaction levels of 95% were found, although satisfaction with treatment in the current study did dip at 3 months to 77%. This drop at 3 months is most likely to be due to an element of dissatisfaction with the gradual recurrence of hair growth since the previous review, whilst the relative increase in satisfaction again at 6 months is probably due to the fact that the level of hirsutism had stabilised. The level of satisfaction with the alexandrite laser is higher than the 71% reported by Preston and Lanigan [11] using a similar LAS. In contrast, satisfaction with the IPL was lower than both of the alexandrite laser and the results from the study by Preston and Lanigan [11]. However, despite the poorer results on the IPL-treated side, more than 50% of patients still registered themselves satisfied with the IPL treatment at all follow-up points.

CONCLUSIONS

In this study, there was a marked difference between the two systems used. The alexandrite laser outperformed the

IPL system in terms of larger hair count reductions, longer HFIs and higher levels of patient satisfaction. This is in contrast to previous studies, which have shown broadly similar levels of efficacy for hair removal with both alexandrite lasers and intense pulsed light systems. In one of the few reported direct comparisons, Amin and Goldberg [24] compared hair removal from the back or thigh using a GentleLase alexandrite laser, a Palomar Starlux IPL (incorporating two different filter settings) and a Lumenis Lightsheer diode laser and found that there were no significant differences between hair count reduction between the systems. It is possible that the increased rate of facial hair growth, especially in women with PCOS, may amplify differences between the two systems in our patients.

It is clear from the results in this study that the GentleLase alexandrite laser is more effective at reducing facial hirsutism in women with PCOS than the Lumina IPL. It is probable that this is due to the specific wavelength, short pulse duration and single pulse delivery of the GentleLase alexandrite laser, resulting in more follicular destruction than the IPL where the energy delivered is split into between 2 and 4 pulses with a 20–40 milliseconds delay in between. In terms of hair removal alone therefore, the GentleLase alexandrite laser does appear to be the more cost-effective. However, despite the poorer results, the Lumina IPL did still result in a significant reduction in hair growth and more than 50% of patients were satisfied with treatment. Since the IPL can be used to treat a wide variety of other conditions simply by changing the filter used, and is significantly cheaper to purchase than the alexandrite laser, it still has a role to play in the treatment of facial hair, particularly where one system is wanted to treat a variety of different conditions.

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