

# Choosing a Pulsed Light System

A reprint of a presentation on

## **How to Choose a Pulsed Light System**

by Mr Brian Marshall to the  
Appearance Medicine Conference, Napier, NZ March 2005  
& the Australian College of Cosmetic Surgery &  
Cosmetic Physicians Society of Australasia Annual Conference,  
Gold Coast, Australia May 2005



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**1.** When faced with an EQUIPMENT BUYING decision do you feel like the FOX or the CHICKEN?

Most likely you feel like the CHICKEN, CONFUSED about the situation and WORRIED that you might be PLUCKED of all your hard earned DOLLARS by the LASER REP FOX.

Increasingly I am seeing CONFUSION as the number of PRODUCTS PROLIFERATE along with the various competing CLAIMS by the equipment reps. MY AIM is to give you some EVALUATION TOOLS to assist your decision making.



**2.** The Fox will tell you he has a unique new technology called IPL; SIPL; VPL; CPL; Pulse Train; Multiple Sequential Pulsing etc. etc. etc?

Well they are not really different and separate technologies, they are all variations of Intense Pulsed Light (IPL) or, more correctly, they are Pulsed Light Systems (PLS) as distinct from Laser Systems (LS).

They all convert light into heat in the target chromophore to do the required damage.


**HOW DO WE EVALUATE THE OFFERINGS?**

## Six Key Specifications

1. Power
2. Head size
3. Time [pulse width]
4. Repetition rate
5. Wavelength selection
6. Cooling

**EVALUATION ESSENTIAL**

**CHEAP BUY may turn out to be an EXPENSIVE MISTAKE**



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**3.** When choosing a Pulsed Light System (PLS) like any other piece of capital equipment, it is important to compare apples with apples. To do this you need to understand 6 main specifications if you are going to evaluate the equipment on offer and run a profitable business. They are:

1. Power
2. Head size
3. Time [pulse width]
4. Repetition rate
5. Wavelength selection
6. Cooling

Without a proper evaluation of equipment performance an apparently cheap buy may turn out to be an expensive mistake, when it burns patients or doesn't perform as expected and your patients sue or want their money back. It is not without good reason that there is a range of prices for Pulsed Light Systems.

**THE No1 CLAIM by equipment companies is:-**

## 1: My PLS is the most powerful


**A) Average Power: Joules divided by Repetition rate – NOT VERY USEFUL X**

**B) Power Supply: Joules=Watts x time – ENGINE SIZE! ✓**

**C) Peak Power: Watts X**

**D) Power Density: Watts/cmsq X**

**E) Fluence: Watts x Time/cmsq or Joules/cmsq ✓**



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**4. My PLS is the most powerful** This claim may be true depending on the way power is measured.

However, which power measurement is the most significant?

- a) Average Power [Joules divided by Rep rate] Not a very useful measurement.
- b) Power Supply [Joules = Watts x time] This is Engine size! Mac truck or Mini.
- c) Peak Power [Watts]
- d) Power Density [Watts/cmsq]
- e) Fluence [Watts x Time/cmsq OR Joules/cmsq]

**a) Average Power**

This is not a very common measurement so we will pass over it and talk about the POWER SUPPLY.

## 5. SO HOW MUCH POWER IS AVAILABLE TO SOME OF OUR COMMON BRANDS FROM THE POWER SUPPLY?

By the power supply we mean the amount of machine power available from the power supply and the capacitors. You would not put the motor from a Mini Minor in a Mack truck and expect to run an effective trucking business.

These days, neither would you use a PLS that pumped out only 90 Joules through a 2sqcm head and expect to run a competitive Hair Removal business. It is not economically viable to take 21/2 hours to treat a man's back when it can be done in half an hour with a larger head size.

Why do some manufacturers use only a 2sqcm head size when others can use a 7.4sqcm head size to do the job faster?

The MAIN FACTOR is "How much Power is available to the lamp from the Power Supply and the Capacitors".

## 6. We have a FOXEY REP in Sydney who reads competitor's hand-piece outputs with a Watt Meter but neglects to take into account the Pulse Width when making comparisons, so therefore his machine looks very powerful.



Note that we have now defined PEAK POWER in WATTS using 7 milliseconds as a time benchmark for comparison purposes. Many systems can only achieve 7msec pulse width or use a series of small 7msec pulse widths with pauses in-between in order to accumulate the desired POWER DENSITY.

### 1: My PLS is the most powerful

#### B) Power Supply

	STARLUX	MULTILUX	QUANTUM	ELOS	LHE
Power available to the lamp	300J	147J	123J	90J	85J


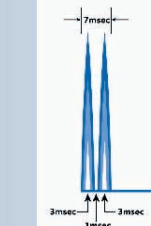
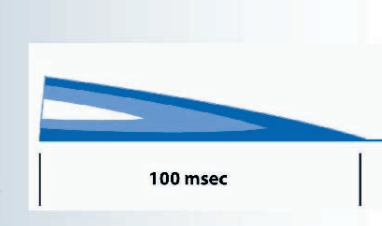
3 Litre
1.5 Litre
1.25 Litre
> 1 Litre
> 1 Litre

### 1: My PLS is the most powerful

#### C) Peak Power

	STARLUX	MULTILUX	QUANTUM	ELOS	LHE
Power available to the lamp	300J	147J	123J	90J	85J
Available Pulse Width (Time)	1 – 500msec	10 – 100msec	7msec multiples	35msec	35msec
Peak Power					
If all machines fired for 7msec	42,857 watts	21,000 watts	17,570 watts	12,857 watts	12,143 watts



- 7.** We can now relate the power in Watts to the size of the head to get the POWER DENSITY. While this may reveal why someone was burnt due to high wattages it is not a useful day to day measurement. What we need to take into account is the PULSE WIDTH: that is HOW LONG THE FLASH PROVIDES THE WATTAGE TO THE SKIN. This is FLUENCE.

**1: My PLS is the most powerful**

**D) Power Density**

	STARLUX	MULTILUX	QUANTUM	ELOS	LHE
Power available to the lamp	300J	147J	123J	90J	85J
Available Pulse Width (Time)	1 – 500msec	10 – 100msec	7msec multiples	35msec	35msec
Peak Power					
If all machines fired for 7msec	42,857 watts	21,000 watts	17,570 watts	12,857 watts	12,143 watts
Head Sizes Available	1.44sqcm 3.6sqcm 7.4sqcm	1.44sqcm 3.6sqcm 7.4sqcm	2.7sqcm	2sqcm + RF	12sqcm
Power Density					
If all machines fired for 7msec	29,761 W/sqcm 11,904 W/sqcm 5,791 W/sqcm	14,583 W/sqcm 5,833 W/sqcm 2,838 W/sqcm	6,507 W/sqcm	6,428 W/sqcm	1012 W/sqcm

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- 8.** Here we have quite a range of Fluences depending on POWER available, HEAD Size, and PULSE WIDTH. YES SIZE does matter

**1: My PLS is the most powerful**

**E) Fluence**

	STARLUX	MULTILUX	QUANTUM	ELOS	LHE
Power available to the lamp	300J	147J	123J	90J	85J
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Fluence					
If all machines fired for 7msec	208J/sqcm 83J/sqcm 40.5J/sqcm	102J/sqcm 40J/sqcm 20J/sqcm	45.5J/sqcm	45J/sqcm	8.5J/sqcm

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**CLAIM 2: Size does matter**

**POWER FROM LIGHT SOURCE**

**OUTPUTS**

LHE	8.5 J/Sqcm
Palomar (StarLux Main Head)	41 J/Sqcm
Quantum	45 J/Sqcm
ELOS	45 J/Sqcm
Palomar (StarLux Second Head)	69 J/Sqcm

**FLUENCE is the amount of joules (watts x pulse width) available per square cm of head size**  
**Using a 2.0sqcm head compared to a 7.4sqcm head creates a running expense factor of 3.7.**

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9. Some PLS have only enough power to drive a small head, whilst others try to drive too large a head and the power densities are dismal.

Here is our same group of products and their relevant head sizes.

The trick is to have enough power to drive the head that is the correct size for the job and perform the job properly and economically.

We will now introduce the concept of a **RUNNING EXPENSE FACTOR** to allow us to make comparisons between two theoretical systems. Using a 2.0sqcm head compared to a 7.4sqcm head creates a running expense factor of 3.7X just to get enough flashes to cover the whole area.

**CLAIM 2: Size does matter**

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10. One other factor about head size that is not well understood is the need to have sufficient width to effectively use scatter and reduce the need for excessive overlap. **THAT WIDTH is at least 12mm.**

**CLAIM 2: Size does matter**

**8mm head x 28 flashes  
10 flashes x 12mm head**

**Running expense factor x 2.8**

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**11.** Not only is an 8mm head covering only 2/3 the area of the 12mm head, the need for greater overlap means the 8mm head takes 28 flashes to provide the same coverage as 10 flashes on the 12mm wide head. In the case of overlap the 8mm wide head machine would cost 2.8X more to run than the 12mm wide head, if the lengths are the same (running expense factor x 2.8).

**CLAIM 2: Size does matter**

**Total running expense factor is now**

- 1. Head Size [2 or 7.4sqcm] = X3.7**
- 2. Overlap [8mm or 12mm] = X2.8**
- 3. Flashes [50 or 100,000] = X2.0**

**Total = X20.6**

**20 times more costly to maintain PLUS Huge labour costs due to small coverage**

**One machine can cost \$60,000 vs \$12,000 per year for same area of flashes.**

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**12.** As you are running a business, the on-going overheads are important. If in our comparison the larger head machine also guarantees twice the number of flashes as the narrow head machine then add another x 2 running costs factor.


1. Head Size [2 or 7.4sqcm] = X3.7
2. Overlap [8mm or 12mm] = X2.8
3. Flashes [50 or 100,000] = X2.0

Total running expense factor is now  $3.7 \times 2.8 \times 2 = 20.6$ . These are MULTIPLIED together not added.

If head replacement costs were the same, one system would be 20 times more costly to maintain, plus huge labor cost increases due to small effective coverage.

Number 3 refers to the manufacturers GUARANTEED number of Flashes, not the number the FOX claims. It is SO CRITICAL that one machine on the market can Cost \$60,000 and another a whopping \$108,000 instead of \$12,000 per year for the same flash coverage.

The usual mistake is to simply look at the lamp cost replacement and not do the rest of the calculations.



**CLAIM 3: Time  
(You Need a Wide Pulse Width)**

**PULSE WIDTHS**  
TIME measured in **MILLESECONDS (msec. or thousands of second)** in the case of PLS.

**Early systems EPILIGHT & PHOTODERM had a tendency to burn, particularly on darker skins.**

**WHAT DID THEY HAVE IN COMMON?**  
**Incapable of sustaining wide pulse widths and could generally not get beyond 7 msec. using high peak power and narrow pulse widths.**


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**13.** The third key specification is PULSE WIDTHS. When discussing PULSE WIDTHS we need to appreciate that they are merely TIME measured in MILLISECONDS (msec. or thousands of a second) in the case of PLS.

Older design systems such as EPILIGHT, or PHOTODERM, and many modern copies, had a tendency to burn, particularly on darker skins.

**WHAT DID THEY HAVE IN COMMON?**

They all were incapable of sustaining Wide Pulse Widths and could generally not get beyond 7 msec. They used High Peak Power and Narrow Pulse Widths.



**CLAIM 3: Time  
(You Need a Wide Pulse Width)**

**EPIDERMIS Thermal Relaxation Time = 10msec**

**Pulse widths less than that supposed to prevent thermal damage**

**However, basal membrane has TRT of only 100 microseconds. Any millisecond pulse is an order of magnitude too long for protection.**

**For Pulsed Light Systems, TRT is a MYTH.  
(Extended Theory of Selective Photothermolysis: GB Altshuler, Rox Anderson et al)**

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**14.** **WHY WERE THEY NARROW PULSED?** Because the conventional wisdom was that the THERMAL RELAXATION TIME of the EPIDERMIS is 10msec, so therefore the Pulse Width should be kept less than this to prevent thermal damage.

However, the basal membrane (the thin delicate membrane that lies at the base of the epithelium) has a thermal relaxation time of only 100 microseconds so any millisecond pulse is an order of magnitude too long to protect this layer.

When discussing PLSs it's time that the "Thermal Relaxation Time" arguments were consigned to the MYTHS and Legends department.

Please refer to The EXTENDED THEORY OF SELECTIVE PHOTOTHERMOLYSIS by Altshuler and Rox Anderson et al

There are just two ways to protect the Epidermis. The 1st is CONTACT COOLING and the 2nd is WIDE PULSE TECHNOLOGY.



**CLAIM 3: Time  
(You Need a Wide Pulse Width)**

**Single smooth wide pulse  
Much safer than series of spikes**

**PLS is "WIDE PULSE" if it can achieve  
continuous pulse over 100msec**

**Not as a train or by inserting pauses.**

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**15.** In PLSs the delivery of a single smooth pulse to achieve the desired fluence will be much safer than a series of spikes, which can never get down to nanoseconds (billionths of a second).

**CLAIM 3: Time  
(You Need a Wide Pulse Width)**

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**16.** You understand that receiving the energy from the sun will tan your skin over a period of time. Imagine how badly your skin will burn if you received all that energy in a second.

**CLAIM 3: Time (You Need a Wide Pulse Width)**

**The impact of increasing pulse widths**

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## 17. And this is how significant PULSE WIDTH really is.

Here is a comparison between a narrow pulse 810nm diode laser and a wide pulse 810nm diode laser.

The illustration shows the difference in administering 45J/Sqcm to the same patient with 3 different pulse-widths i.e.

65m/sec = SEVERE HYPO-PIGMENTATION

100m/sec = MODERATE HYPO-PIGMENTATION

200m/sec = NO HYPO-PIGMENTATION

**CLAIM 3: Time (You Need a Wide Pulse Width)**

**PULSE TRAINS Offer no protection against hypo-pigmentation**

**Short duration combined with high wattage output or very low power with too long a pause in between**

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## 18. Some manufacturers suggest that they have "variable pulse" or "pulse trains" in order to achieve a wide pulse. These systems are still the early generation of Pulsed Light Systems that use a series of narrow under 7msec pulse widths with high wattage and with pauses in between each short pulse.

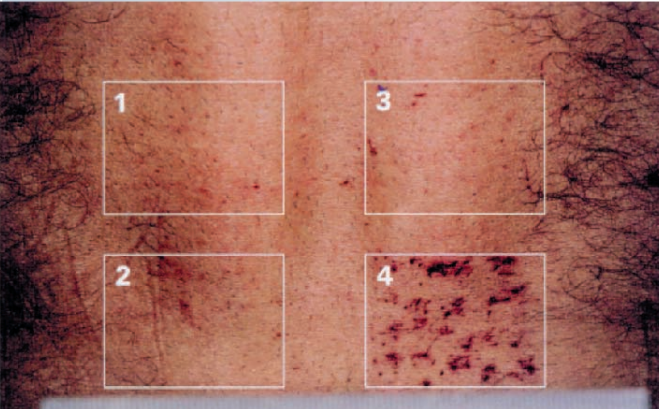
This offers no protection against hypo-pigmentation as each pulse is of short duration combined with a high wattage output. Or each pulse is of very low power with too long a pause in between to sustain correct heating. Pulse Trains also reduce lamp life.

Pulse Trains DO offend the Thermal Relaxation Time theory, which states that the TRT is the time it takes a body to lose half its heat. This means that the long pauses in between the spike are wasting the effect of the energy applied.

With no pulse width in the nanosecond range, protecting the skin from thermal damage, vitally important factors are contact cooling and SINGLE wide smooth pulse widths.

**CLAIM 3: Time  
(You Need a Wide Pulse Width)**

**LIGHTSHEER/SLP1000 COMPARISON**  
Here is a comparison of the lasers (810nm)



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**19.** Palomar learnt this lesson. They introduced hair removal to the world with the Ruby Laser and then went on to produce the LIGHTSHEER 810nm Diode Laser, which it later sold to COHERENT (now called LUMINUS). Palomar then produced a long pulse 810nm Diode Laser called the SLP1000.

Here is a comparison of the 2 lasers. The lesson learned from this study is that by reducing the high wattage and dramatically increasing pulse width, (Fig.3) hair elimination is better because 2 1/2 times the FLUENCE can be administered to dark skin safely. At 2 1/2 months, hair re-growth reduces from 49% to 32%.

Has this lesson been learned by the majority of the PLS manufacturers? – NO! They are mainly cheap copies of the ORIGINAL EPILIGHT and PHOTODERM products.

**CLAIM 4: Repetition Rate:  
My machine is faster**

**The machine's ability to recovery and quickly deliver the next flash. This measurement is usually shown as hertz (Hz)**

**If PLS flashes every second it is rated at 1 Hz;  
2 seconds is 0.5 Hz;  
4 seconds = 0.25Hz  
8 seconds = 0.125 Hz.**

**To wait 4 or 8 seconds between flashes is unacceptable and uneconomic.**

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**20.** REPETITION RATE is the machine's ability to recovery and quickly deliver the next flash. This measurement is usually shown as hertz (Hz).

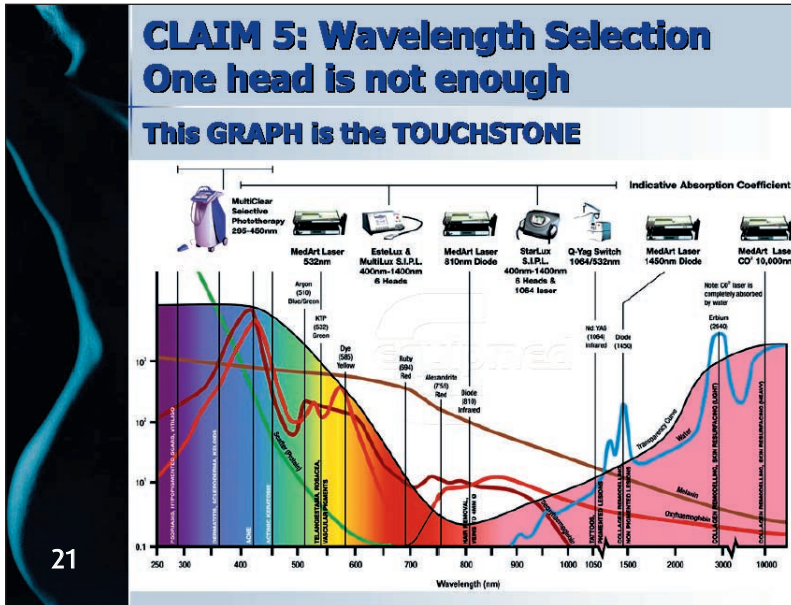
If a Pulsed Light System flashes every second it is rated at 1 Hz.

[Every 2 seconds is 0.5 Hz;  
4 seconds = 0.25Hz and  
8 seconds = 0.125 Hz.]

To wait 4 or 8 seconds between flashes is unacceptable and uneconomic.

This is just "standing around doing nothing" labor costs due to waiting for the machine to flash again.

Imagine the cost and frustration of taking 4 times longer than your competitor to perform a hair removal procedure at today's labor costs.



**21.** This GRAPH is the TOUCHSTONE when examining wavelength claims. One of the greatest advantages of PLS is their ability to utilize a band of wavelengths instead of just a single wavelength in the case of lasers. If the wavelengths are carefully selected the one machine can perform many different tasks. Thus it's a crying shame when the FOX claims his single head machine can do everything. **It's fraud really.**

For example, when attraction to melanin is required a Yag (1064nm) laser requires 50% more power (read pain) into the skin than an 810nm diode laser. Also water is starting to attract the 1064nm wavelength, which is undesirable.

In a PLS power is not delivered evenly across the range and changes as small as 25nm in the filtering system of heads can have a significant impact on the efficacy of treatments, particularly at the lower end of the nanometer scale.

### CLAIM 5: Wavelength Selection One head is not enough

**Rule of thumb wavelengths**

- 400nm+ – Acne treatments
- 470nm+ – Pigmented lesions & telangiectasias
- 650nm+ – Hair removal on darker skins
- 1100-2000nm – Collagen stimulation

**Changes as small as 25nm in the filtering system of heads can have a significant impact on efficacy of treatments, particularly at the lower end of the nanometer scale.**

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**22.** As a rule of thumb the following wavelengths are used to accomplish the required tasks:

- 400nm+ – Acne treatments
- 470nm+ – Pigmented lesions and telangiectasias.
- 650nm+ – Hair removal on darker skins.
- 1,100 – 2,000NM – Collagen stimulation.

### CLAIM 6: Contact Cooling

**Not enough can be said about cooling**

**If you want comfortable patients and good protection of the epidermis CONTACT COOLING is vital**

**Good cooling of the lamp makes a significant difference to lamp life and good skin cooling makes a significant difference to pain levels, healing time and customer relations**

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**23.** Not enough can be said about cooling. If you want comfortable patients and good protection of the epidermis CONTACT COOLING is vital. Contact cooling for the patient should not be confused with the cooling of the lamp; both are necessary. Good cooling of the lamp makes a significant difference to lamp life and good skin cooling makes a significant difference to pain levels, healing time and customer relations.

**CLAIM 6: Contact Cooling**

**Cool air blowers and/or ice no substitute  
They are patchy and lowering overall skin  
temperature is counter-productive**

**This is the reason that using cooling to  
force Bipolar RF waves deeper into the skin  
is counter-productive and inappropriate**

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**24.** Cool air blowers and/or ice are no substitute for good contact cooling. They are patchy and lowering overall skin temperature is counter-productive to having to raise the temperature gradient to achieve results. This is one of the reasons that using cooling to force Bipolar RF waves deeper into the skin is counter-productive and an inappropriate application of technology. Electricity will always take the shortest path between 2 electrodes and using cold to force the heat down defies common-sense. However commonsense is easily overpowered by good marketing.

**CLAIM 6: Contact Cooling**

**Cooling should be available only for the instant  
that the hand piece touches the skin and fires.**

**Only transparent substance with the heat  
transferring properties of metal is sapphire**

**PLS should have sapphire on the contact face  
Sapphire is very hard and will not pit like glass**



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**25.** The cooling should be available only for the instant that the hand piece touches the skin and fires. The only transparent substance with the heat transferring properties of metal is SAPPHIRE and, although expensive, a reputable PLS will utilize sapphire on the patient contact face. Sapphire is very hard and will not pit like glass, which in turn causes point burns.

**Ask Your Supplier**

1. Is the machine Wide Pulsed with sufficient power?
2. Is it Platform Technology with a selection of good Heads?
3. Is there both machine cooling and patient contact cooling?
4. What number of Flashes are guaranteed?
5. What are the Running Cost Factors [RCF] and the ROI's
6. How long have you been selling and supporting PLS's?
7. How many Pulsed Light Systems do you have installed?
8. Can you provide a reference list of users I can speak to?
9. Can you prove that your PLS delivers consistent results?
10. Do you offer multi country technical support and service?
11. What marketing and business development assistance?
12. Do you have structured training courses, not just Rep's?

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**26.** Here are some questions to ask the FOX.

As we have seen, choosing the correct PLS to enhance your business, and not ruin it, is a complicated equation. It is made all the more difficult by the claims of "snake oil" salesmen that their "cheap" equipment is as good as more expensive equipment. If your patient gets burnt, or their hair grows back after a year or so, or you're running costs prove to be very expensive, then any amount paid is too high. On the other hand, an effective PLS can prove to be an enormously profitable asset allowing a wide range of additional services to be provided and your business expanded.

**The Future**

**THE FUTURE in PLS is PLATFORM TECHNOLOGY: Multiple MODALITIES share same POWER SUPPLY, SCREEN; CASING & COMMON ELECTRONICS.**

**Why buy a Yag laser when you can add a handpiece for less than half the price.**

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## 27. SO WHAT INSIGHTS DO WE HAVE FOR THE FUTURE?

THE FUTURE is PLATFORM TECHNOLOGY in Pulsed Light Systems where multiple MODALITIES will share the same POWER SUPPLY, SCREEN; CASING & COMMON ELECTRONICS.

The machine on the left of the slide, despite its modern appearance, seems to be the same old narrow pulse technology repackaged and remarketed.

Why buy a complete YAG laser when you can add a handpiece for less than half the price?

**The Future**

**What you see on the INBUILT SCREEN WHEN YOU ARE ABLATING LEG VEINS. Eliminate HOT SPOTS caused by too much overlapping.**

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## 28. This is Palomar's YAG head for their STARLUX PLS released at the American Academy of Dermatology conference in FEBRUARY. This is not a dinky toy either. This YAG delivers an amazing 700 J/Sqcm of fluence with 1, 3, 6 & 9mm Spot sizes and 4 1/2 x VIDEO presentation.

This is what you see ON THE INBUILT SCREEN WHEN YOU ARE ABLATING LEG VEINS. This YAG helps eliminate HOT SPOTS caused by too much overlapping. The hot spots, in turn, cause depressed scars

This is what you see ON THE INBUILT SCREEN WHEN YOU ARE ABLATING LEG VEINS. This YAG helps eliminate HOT SPOTS caused by too much overlapping. The hot spots, in turn, cause depressed scars

**The Future**

**Is FRAXEL Technology a PASSING FAD?**

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## 29. FRAXEL TYPE TECHNOLOGY will also be available in a laser head on a Pulsed Light System in the future but I must say that I am not convinced that FRAXEL technology is more than another PASSING FAD.

When I spoke to the Engineers at RELIANT about their FRAXEL laser they said "well it doesn't go very deep; if you want to have a significant effect on wrinkles perhaps if you combine it with deeper treatments such as the mono-polar RF on the THERMAGE and you MIGHT get a better result" – BUY 2 MACHINES at huge cost for a POSSIBLE RESULT – I don't think so.

When I spoke to the Engineers at RELIANT about their FRAXEL laser they said "well it doesn't go very deep; if you want to have a significant effect on wrinkles perhaps if you combine it with deeper treatments such as the mono-polar RF on the THERMAGE and you MIGHT get a better result" – BUY 2 MACHINES at huge cost for a POSSIBLE RESULT – I don't think so.

**The Future**  
**Infra Red Technology**

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**30.** Infra Red Technology is being introduced to Pulsed Light Systems by Palomar.

This takes me back 25 years when this technology was first introduced as low powered therapeutic lasers. The healing power of infra red is well known and I still use a low powered 810 diode laser to cure tennis elbow today!

**The Future**  
**Bipolar RF**

*Differences in Heating Depth and Tissue Volume*

Side View of Tissue Heating Profile through Center of Heated Area\*

**Monopolar RF Heating Profile**      **Syneron Aurora Heating Profile (RF only)**

Syneron heats significantly less volume of tissue, half as deep, and only along edges instead of evenly.

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\*Based on calculated temperature rise in a homogeneous tissue medium with identical tissue impedance assumption for both devices  
\*\* Volume heated above 50°C per square cm of treated area is .110 cm² compared with .0056 for Syneron

**31.** The effect of Bipolar RF is very shallow and according to Dr Patrick Bitter, only adds 15% extra heat.  $34^{\circ}\text{C} + 15\% = 39^{\circ}\text{C}$ , which is useless when  $65^{\circ}\text{C}$  is required to effect the required thermal damage.

RF is an unnecessary complication that can result in train track burns if constant contact is not maintained. After all this time, there are STILL NO peer-reviewed papers to support the technology.

**Don't get plucked!**

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**32.** The FOX may be the LASER SALESMAN who claims his SINGLE PRODUCT LINE CHEAPY does everything that more EXPENSIVE PRODUCTS DO.

The FOX may be the BEAUTY CLINIC, SPA or other SPECIALITY eyeing off your business.

The FOX may be your own colleague who recommends PRODUCTS without stating their PECUNIARY INTERESTS.

We always have the FOXES with us; however ASKING THE RIGHT QUESTIONS and employing some objective tools will help prevent us becoming PLUCKED CHICKENS.



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