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The role of the Lumina intense pulsed light system in the treatment of port wine stains—a case controlled study

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Summary The pulsed dye laser has been the treatment of choice for port wine stains over the past 20 years.

In the past 5 years there has been increasing discussion of the role of other light treatments, such as the intense pulsed light system in the treatment of port wine stains. These systems use high-energy lamps, which emit noncoherent broad-spectrum light. Cut off filters are applied depending on the treatment modality to limit the wavelengths emitted.

We present the results of a 3-year prospective within patient controlled clinical trial using an intense pulsed light system called the Lumina, developed by Lynton Lasers of Cheshire, England.

Our aims and objectives were to assess the effectiveness of the system in the treatment of port wine stains in a human model and to record the optimum treatment parameters and the incidence of side effects.

Following ethical approval 12 subjects were enrolled into the trial. In order to meet the requirements of the local ethics committee these were all adults with port wine stains located in less visible areas of the body.

The results showed that eight of the 12 subjects had some degree of fading of their port wine stain as measured on a percentage scoring system. Of the four who failed to show any response, all had pink port wine stains. It did seem the case that the darker the port wine stain, the better the fading seen. Furthermore, the more distal lesions tended to be less responsive than those situated closer to the head area. However, it is difficult to draw any definitive statistical conclusions due to the small number of patients in the trial.

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Port wine stains are benign congenital malformations that affect 0.3–0.5% of newborn infants.[1] They are characterised by ectatic dermal blood vessels, which increase in size with increasing age. They most commonly present on the face and neck but can be located anywhere on the body.[2]

The treatment of port wine stains has improved dramatically in the last 15–20 years. Prior to this time various treatments were employed in an effort to mask or fade the lesions. These included the use of ionising radiation,[3] tattooing the lesion[4] and excision and full thickness skin grafting.[5] All of these methods proved to be less than satisfactory in terms of cosmesis. Furthermore, with respect to radiotherapy the development of skin cancer in later life is now a recognised complication.[6]

The first lasers to be successfully used in the treatment of port wine stains were ruby and argon lasers.[7,8] The ruby laser worked at a wavelength of 695 nm. The argon laser was pulsed mechanically and worked on a mixed wavelength between 450 and 513 nm with a pulse width of 20 ms. The pulsed dye laser was then introduced, working initially at a wavelength of 577 nm later modified to 585 nm[9,10] and typically using a pulse width of 0.45 ms. The pulsed dye laser has remained the mainstay of treatment for about the last 15 years. More recently slightly longer wavelength pulsed dye lasers have been developed in the 590–595 nm ranges. These newer machines are also able to deliver a wider range of pulse widths.

The introduction of the pulsed dye laser was based upon both the theory of selective photothermolysis and the improved understanding of thermal relaxation times as outlined by Anderson and Parrish.[11] The wavelengths of the pulsed dye laser (585–595 nm) selectively target oxyhaemoglobin within the abnormal blood vessels. This energy is then converted to heat and is taken up by the walls of the blood vessel. These walls rupture and collapse down as a result and the vessel is sealed, thus helping to fade the port wine stain. The wavelengths used (585–595 nm) are longer than the wavelengths of the earlier lasers and this enables the beam to penetrate deeper into the dermis and hence to reach the deeper elements of the port wine stain. The pulse of energy delivered by the original pulse dye lasers was fixed between 0.45 and 0.5 ms.

Whilst pulsed dye lasers are effective at fading port wine stains they do not usually completely remove the lesion. Figures do vary but approximately 75–80% of patients with port wine stains gain some benefit from laser treatment.[12] The majority achieve between 50 and 75% improvement.[13–15] There are three well-recognised side effects from laser therapy, namely hyperpigmentation, hypopigmentation and scarring. The reported incidences of these also vary, but temporary hyperpigmentation is seen in about 10% of cases, hypopigmentation in 4% of cases and whilst it can be permanent it is usually a transient effect.[16] Scarring is seen in less than 1% of cases.[17]

In the past 5 years there has been increasing discussion of the role of other light treatments, such as the intense pulsed light system (IPL) in the treatment of port wine stains. Intense pulsed light systems have been available since 1994 and were initially developed by Goldman and Eckhouse in 1990.[18] These systems use high-energy lamps, which emit noncoherent broad-spectrum light. Cut off filters are applied depending on the treatment modality to limit the wavelengths emitted. In the treatment of vascular lesions light is filtered to the range of 500–1100 nm. It is postulated that this device may be effective in treating port wine stains for three reasons;

1. By using longer wavelengths deeper penetration into the lesion can be achieved.
2. Employing the theory of selective photothermolysis,[11] a smaller absorption peak for oxyhaemoglobin at about 900 nm can be targeted along with the larger peak at 575–580 nm.
3. The device can be set to treat at variable pulse widths, which may be of benefit.[19]

Various IPL systems have been tested in a number of clinical trials. Strempel and Klein[20] compared port wine stain treatment using the pulsed dye laser and an IPL system. Raulin and Schroeter et al.[21] carried out a retrospective study with pulse dye laser resistant port wine stains, using a different IPL system. Finally a recent paper by Bjerring, Christiansen and Troilius[22] used an IPL system to treat patients again with dye laser resistant port wine stains.

We proposed to conduct a prospective within patient controlled clinical trial using an intense pulsed light system called the Lumina, developed by Lynton Lasers of Cheshire, England. The device was first designed by Dr Jon Exley of Lynton Lasers whilst a PhD student at Manchester University. During its development he ran a computer simulation on the Lumina to ascertain its effectiveness in treating a port wine stain. The results of this model are presented as part of the discussion. Our intention with the clinical trial was to use the Lumina to treat a number of previously untreated port wine stains. Our aims and objectives were to assess the effectiveness of the system in a human model and to record the optimum treatment