LOW REACTIVE-LEVEL 830 nm DIODE LASER THERAPY (LLLT) SUCCESSFULLY ACCELERATES REGRESSION OF STRAWBERRY HAEMANGIOMA IN THE INFANT: CASE REPORTS

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The strawberry haemangioma is a disturbing lesion, especially for the parents of the affected infant. Surgical intervention is unacceptable in most cases, owing to the possibility of severe scarring. Reports have appeared on successful application of laser surgery (HLLT) for smaller lesions, but the possibility of scarring still exists. Because of the success of Low reactive-Level Laser Therapy (LLLT) in promoting circulatory improvement, and photobioactivation of the fibroblast to encourage synthesis of normal collagen, the authors started applying 830 nm diode LLLT (60 mW, 5 s per point) at points around the periphery of the lesion, at a point density of 1 per 10 cm² of the lesion. The results have been excellent in 20 cases treated exclusively with LLLT to date, with speedy regression, restoration of normal colour and configuration, and return to a normal skin texture. Although most strawberry haemangiomas regress spontaneously within 7 years, especially in the larger lesions there is a strong possibility of some remaining colour and configurational abnormality, coupled with abnormal skin texture. Using LLLT, the authors have found that full regression is usually obtained within approximately 4 years maximum, with little or no remaining colour and configurational abnormality. With LLLT, it is possible to restore the elasticity and firmness to the hamartomatous haemangioma tissue, by normalizing the collagen and elastin fibre matrices, and replacing the deeper cavernous component of the lesion. LLLT is totally noninvasive, and well-tolerated in the younger patient. Case reports are presented, and a discussion of the mechanism and timing of the therapy is given.

KEY WORDS Strawberry haemangioma Strawberry mark LLLT Photobioactivation

Introduction

The strawberry haemangioma, or strawberry mark, is a vascular hamartoma, made up of tissue normal for the site of the lesion, but immature. It contains both capillary and cavernous components, and it has been suggested that up to 10% of infants get a strawberry haemangioma during their first year of life.¹ According to reports, less than one-third of strawberry marks are reported at birth, and more than 85% appear within the first month.² Those that are seen at birth are most usually noted as a flat, haemangioma simplex-like mark, which subsequently enlarges to form the reddish lobulated mass, which gives the lesion its name. They can be distinguished from haemangioma simplex by their enlargement, raised appearance, histology, and

subsequent involution. Almost all strawberry marks peak in growth within the first year, and thereafter spontaneously regress, 50% having disappeared by the fifth year, and over 70% by the seventh year, without any form of therapy.³

Those lesions which show no sign of regression by the second or third year will probably not involute spontaneously. Also in larger lesions, involution may not be complete, leaving an abnormality of both configuration and colour, with remnants of both the capillary and cavernous components. Unless the lesion is obstructing some vital organ, such as the eye; is causing difficulties in breathing, such as those which involve the nasal alae and turbinates; is in an anatomical site where it may well deform cartilage such as the eyelid; or is posing a risk to general health by spontaneous or traumatic haemorrhaging, the consensus of medical opinion is to leave the lesion untreated. However, from the point of future social stigma, and the burden placed on the parents, removal of the lesion should be considered, only if such removal can be successfully accomplished.

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Conventional surgery has proved unsuccessful, with a high blood loss factor and high incidence of scarring. Laser surgery has proved mildly successful in smaller lesions, with the argon and ruby lasers.^{4, 5} Low reactive-level laser therapy (LLLT) has been reported as having a stimulatory effect on blood flow,^{6, 7, 8} and on modulating fibroblast activity in the normalization of collagen production.^{6, 9} Encouraged by these reports, the authors decided to apply LLLT to strawberry haemangiomas. The present study reports on the success of this therapy, and presents some representative case reports.

Materials and Methods

The Laser

The laser used was a gallium aluminium arsenide (GaAlAs) diode laser, giving an output power of 60 mW in continuous wave at 830 nm in the near infrared (OhLase-3D1, Proli, Japan). The spot size at the focal point is approximately 2 mm², giving an incident power density in the region of 3 W cm². The laser was applied around the circumference of the lesion, at a point density of one treatment point

per 10 cm² of lesion, at an exposure of 15 s per point. The energy density delivered per point was thus 45 J/cm². The patients were treated twice per week in the first month, once per week in the second month, and twice per month in the third and fourth months. If involution was insufficient, the therapy was continued once per month until a successful result was obtained.

In the past 6 years, 122 cases of strawberry haemangioma have been treated at the Ohshiro Clinic. Of these, 38 were treated by methods other than laser, 54 were treated with a combination of HLLT and LLLT, and 20 have been treated with LLLT alone. In that last group the results have been extremely good, using only LLLT with no adjunctive therapy.

Case Reports

Case 1

The 5 month-old infant seen in Figure 1 had a strawberry haemangioma on the left of the face. The colour was a deep purple in places, showing

Figure 1. (Case 1) 5 month-old female infant, with pretreatment strawberry haemangioma on left cheek, involving the eye, the nasal ala, and the turbinate

Figure 2. Same patient as in Figure 1, after 8 months diode laser therapy. Beginning of involution, with reduction of growth, restoration of normal colour and texture, and opening of the eye can be seen

Figure 3. (Case 2) 2 month-old infant with extensive strawberry haemangioma involving the right arm

Figure 4. Same patient as in Figure 3, 18 months after the first LLLT session. Involution is well on the way, with return of normal colour, configuration and skin elasticity

sluggish blood flow through the naevus, and the naevus obstructing the eye. Haemorrhagic points can be seen, and the infant had to wear restraints to prevent her from causing further damage. The laser was applied as described above, in light contact mode around the periphery of the lesion. Figure 2 shows the result 8 months after the first LLLT session, after 22 sessions. The result is very good, with the beginning of involution of the naevus, and return of good skin texture and colour.

Case 2

The 2 month-old infant in Figure 3 has an extensive strawberry mark on the right arm. There was also a lesion on the forehead, not shown in the picture. The lesions were treated as described above for three months, 15 sessions. Figure 4 is the condition 18 months after the last session, and Figure 5 shows the excellent condition at 3.5 yrs posttherapy, with good involution, and no residual abnormalities.

Case 3

The 5 month-old infant in Figure 6 has a strawberry haemangioma of the left cheek. Figure 7 shows the result at 18 months and after 35 treatment sessions.

Figure 5. Same patient as in Figure 3, 3 years and 6 months after treatment was started: the colour and configuration are excellent

The regression is excellent with normal elasticity restored to the skin over the lesion site, although regression is incomplete, but still occurring. Figure 8 shows the condition 3 years and 11 months after the last session, with the young patient displaying her pleasure at the result (compare the expressions in Figures 6 and 8).

Figure 6. (Case 3) A 5 month-old female infant with strawberry haemangioma of the left cheek

Figure 7. The same patient as in Figure 6, after 19 months of LLLT: involution has started, and normal colour and configuration are returning

Discussion

The psychological impact of a strawberry mark is naturally much greater at least initially on the patient's parents, as the infant is blissfully unaware that anything is 'wrong'. On larger, growing lesions, the chances of full spontaneous involution become less, and the possibility of the child's suffering socially in the early pre-school and primary school years is increased. Very often in the larger lesions, the blood flow is very slow, with a purplish cyanotic appearance. Histologically, the collagen in the raised portion of the lesion is of the immature type II, loose structured and highly eosinophilic, with ectatic capillaries in the raised portion, and a cavernous haemangioma component in the deeper layers. As involution starts, the collagen production normalizes, as does the lysis, thus gradually restoring the correct balance.

As the diode laser at 830 nm in the near infrared has been shown to have a stimulatory effect on the blood flow, it was applied to the strawberry marks to increase the flow rate and oxygenation, and thus decrease the degree of cyanosis. Low incident levels of laser energy have a stimulatory effect on collagen production, and it is suggested that the laser energy works on the fibroblasts, especially if they are in

the immature growth stage, to encourage production of tighter-knit collagen type I, while at the same time modulating the activity of the collagenase in the lesion, to produce finally a correctly balanced state between collagen production and collagen lysis. Thus it can be argued that applied in this manner, LLLT restores firmness and elasticity to the hamartomatous tissue of the haemangioma, replacing the ectatic blood vessels with normal-walled vessels, and the immature, eosinophilic haemangioma collagen with firm, elastic tissue.

The timing of the treatment was found to have a profound influence on the rate of involution. The volume of the lesion in all patients is measured and noted at each treatment session. Figure 9 shows the growth and spontaneous involution rate of an average untreated lesion, and the lesions in Cases 1, 2 and 3. From our experience, it is much better to irradiate the lesion in the early stages of growth. Irradiation after the growth peak has been reached will still speed up involution, but not so speedily as earlier irradiation does. Even the longest laser-activated period of involution at 4 years is still shorter than the 5 year term for around 50% of the lesions reported in the literature.^{2,3} The added advantage is that involution is enhanced as is the

Figure 8. The same patient as in Figure 6, 3 years and 11 months after the first session

restoration of normal skin colour, texture and elasticity. The difference in the rate of involution is explained by the remaining deeper cavernous component, which does not involute as quickly as the superficial, capillary component. Thus in Figure 9, a levelling-off of the involution rate can be seen in the latter stages. The excellent results in the 20

cases who received only LLLT have encouraged the authors to push ahead with an aggressive treatment programme for strawberry haemangioma.

Laser therapy is easy to apply, is completely noninvasive and forms no wound which could lead to scar formation, unlike the surgical laser, which is only minimally invasive, and which does cause a thermal wound which increases the possibility of scar formation. As there is no pain at all involved in its application, LLLT is thus extremely well-tolerated by the younger patient, in whom surgical operations can cause a great deal of distress.

Conclusions

The authors have demonstrated the following advantages of applying 830 nm 60 mW GaAlAs diode laser LLLT for therapy of strawberry haemangioma:

- (i) Remarkable accelerated involution and decolorization of the lesion
- (ii) Restoration of normal skin elasticity with a fully functional, firm, normal dermal architecture
- (iii) Suppression of haemangioma growth
- (iv) Activation of spontaneous healing
- (v) Restoration of lesion-inhibited functions (e.g. sight)
- (vi) Tolerated well by the infant
- (vii) Reduction in parental anxiety levels

More detailed histological and histochemical studies are needed to ascertain the exact pathways involved, but the authors suggest that the increase in blood flow and oxygenation of the lesion is coupled with photoactivation of normalization of the collagen production/lysis cycle, and a return to normal fibroblast collagen I production.

Figure 9. Schematic diagram showing growth and involution curve of an average strawberry haemangioma compared with the three cases reported in the present study: note average peak growth at 1 year mark, and complete involution by 6 years (range from 5–7 yrs). After starting LLLT, growth tends to continue, but at a slower rate, followed by a quick involution period

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