

# Treatment of Deep Vascular Lesions using Ultrasound-guided Intralesional Laser Photocoagulation

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**Purpose:** The treatment of large, deep-seated vascular lesions in the orofacial region is often very challenging. The Nd:YAG laser has already proved to be an effective mode of treatment for vascular lesions. Our goal was to determine the efficacy and safety of ultrasound (US) guided Nd:YAG laser treatment of deep-seated vascular lesions.

**Patients and Methods:** A prospective study was conducted in which 9 patients with deep vascular lesions in the orofacial region were treated under local anaesthesia with US-guided photocoagulation (PhC) using the Nd:YAG laser. The same US probe as used for US-guided aspiration biopsy was used for the procedure, with the fiber-optic cable inserted into the needle mounted on the US probe. The needle was then inserted directly into the lesion, its position clearly visible on the screen. Photocoagulation was then performed in a systematic sequence under US control, until the whole vascular lesion was coagulated. Follow-up was conducted in all of the cases, time until resolution of swelling was recorded, as were also postoperative complications.

**Results:** In patients undergoing intralesional PhC, there was no tissue sloughing as the surface epithelium was not injured. Swelling was present for about one week. There were no cases of inadvertent bleeding. Three patients required two sessions of US-guided PhC. One patient developed a local intraoral infection, which was controlled with broad spectrum oral antibiotics.

**Conclusion:** US-guided laser photocoagulation is a safe and effective tool for the treatment of large vascular lesions.

**Keywords:** hemangiomas, Nd:YAG laser, ultrasound, photocoagulation, vascular malformations.

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Vascular lesions, including hemangiomas and vascular malformations, are common pathological entities in the head and neck region. In the past, many different treatment modalities have been used for their removal: surgery, embolization, steroid therapy, cryosurgery, electrodesiccation etc.<sup>1,2</sup>

In the 1990s, neodymium:yttrium-aluminum-garnet (Nd:YAG) laser emerged as a very effective treatment tool for removal of vascular lesions.<sup>3-6</sup> The Nd:YAG laser beam has a 1064-nm wavelength; its poor absorption in water allows deep penetration into human

tissues. Gradual heat emission causes coagulation down to a depth of about 10 mm, a process called photocoagulation (PhC). Additionally, its selective absorption in hemoglobin causes selective PhC within blood vessels. The Nd:YAG laser beam is delivered via a flexible fiber-optic cable, which is excellent for the treatment of vascular lesions, as it very easy to handle.<sup>2,4,5,7</sup>

Superficial lesions are usually treated with transmucosal or transcutaneous PhC, whereas deep lesions (eg, intramuscular) cannot be reached by the laser beam with this approach. In these cases, intralesional



**Table 1** Locations and sizes of vascular lesions in patients treated with US-guided PhC

|   | Patient | Age | Sex | Location        | Dimensions (mm) |
|---|---------|-----|-----|-----------------|-----------------|
| 1 | S.I.    | 40  | f   | l. masseter     | 13x7x15         |
| 2 | L.F.    | 62  | m   | r. masseter     | 45x15x30        |
| 3 | M.K.    | 24  | f   | r. masseter     | 26x10x20        |
| 4 | M.L.    | 23  | f   | l. preauricular | 45x45x35        |
| 5 | M.M.    | 25  | f   | l. temporal     | 47x17x21        |
| 6 | K.B.    | 27  | m   | l. masseter     | 15x15x15        |
| 7 | V.I.    | 40  | f   | r. temporal     | 18x22x22        |
| 8 | Š.E.    | 46  | m   | l. masseter     | 17x9x17         |
| 9 | T.K.    | 34  | f   | l. masseter     | 23x6x15         |

PhC is utilized, in which the fiber-optic cable is directly inserted into the vascular lesion via a wide bore needle, and PhC is performed from within. Simultaneous ultrasonic (US) monitoring shows the position of the fiber-optic cable tip, as well as the extent of the PhC being performed, in real time.

In our study, 9 patients with intramuscular vascular lesions were treated with the Nd:YAG laser, using US-guided intralesional PhC, our goal being the determination of efficacy and safety of this mode of treatment.

## PATIENTS AND METHODS

### Patients

In 5 years (2005 to 2010), 9 patients (6 female, 3 male, age range 23 to 62 years) with deep intramuscular vascular lesions were treated at the Department of Maxillofacial and Oral Surgery of the University Medical Centre Ljubljana, using the Nd:YAG laser. Six lesions were located in the masseter muscle, 2 in the temporal muscle, and 1 in the preauricular soft tissues (Table 1).

### Procedures

After taking the patient's history, the vascular lesion was thoroughly examined. Magnetic resonance imaging

(MRI) was performed for precise three-dimensional assessment, and Doppler ultrasound was conducted to rule out a possible high-flow lesion. In selected cases, angiography should also be performed.<sup>8</sup>

The laser used was the Nd:YAG component of the combined Er:YAG/Nd:YAG Twinlight laser (Fotona; Ljubljana, Slovenia). Power settings were in the range of 10 to 12 W per pulse, pulse frequencies 50 Hz and pulse durations (self-set) 125 to 150  $\mu$ s. The wavelength was a constant 1064 nm, and the fiber-optic cable diameter was 320  $\mu$ m.

The fiber-optic cable was inserted into the lesion via a long, wide-bore needle using the same US probe as used for US-guided needle aspirational biopsies (Fig 1). As the ultrasound properties of the vascular lesion change instantaneously upon coagulation, in vivo control of the extent of treatment was possible. The US probe was moved to different positions and the needle with the fiber-optic cable inserted to various depths, until complete coagulation of the whole lesion was visible on the ultrasound monitor.

All of the patients were treated under local anesthesia; some of them received additional sedation with midazolam. Postoperative pain was controlled with oral analgetics, ketoprofen and diclofenac, sometimes in combination with acetaminophen. Patients were monitored until resolution of swelling, and check-ups were conducted at one week, one month, six months, and one year after the procedure.



**Fig 1** US probe with needle mounted and fiber-optic cable inserted into needle.



**Fig 2** Vascular lesion in right masseter muscle, before treatment.



**Fig 3** Vascular lesion in right masseter muscle, after treatment.

## RESULTS

In the first week after treatment, the treated area was edematous and painful. Later, the edema subsided, and gradual shrinkage took place due to interstitial scarring. In the following months, the scar softened to a certain degree. There was no tissue sloughing in any of the cases, as the surface epithelium remained undamaged.

In one young female patient, the venous malformation was very extensive and included the parotid gland with its subcutaneous space, the masseter muscle, the retromandibular space and pterygoid muscles. Photocoagulation of the whole lesion was not performed in this patient, as this would have endangered vital struc-

tures (ie, the facial nerve and large vessels). Instead, systematic ultrasound-guided intralesional PhC of the whole affected subcutaneous area was performed, down to the parotid capsule, our goal being the creation of a thick, flat subcutaneous scar, which would prevent troublesome subcutaneous bulging of the lesion. After treatment and initial swelling, the bulging was substantially reduced. Another session of treatment was performed, using simple intralesional PhC in a similar manner, which resulted in the lesion's bulging becoming barely perceptible.

In 5 cases, the lesions were clinically completely removed, and the patients were satisfied with the result (Figs 2 to 5). In 3 cases, a touch-up procedure was



**Fig 4** Vascular lesion in right temporal muscle, before treatment.



**Fig 5** Vascular lesion in right temporal muscle, after treatment.

required for complete removal. In the young female patient described above, complete removal was not the goal.

There were no cases of bleeding or inadvertent nerve injury. One patient developed a local infection, which was easily controlled with broad-spectrum oral antibiotics (amoxicillin with clavulanic acid), after which healing was uneventful.

## DISCUSSION

As a rule, hemangiomas and vascular malformations are benign and tissue sampling can cause unnecessary and troublesome bleeding.<sup>8</sup> Pretreatment tissue biopsies were therefore not taken. Moreover, although hemangiomas and vascular malformations are two pathologically separate entities, the diagnostic and therapeutic procedures used were identical, as were the healing phases after treatment.<sup>1,8</sup> In this paper, we refer to both hemangiomas and vascular malformations simply as vascular lesions. In specific cases, the distinction between hemangiomas and vascular malformations was made clinically.

Deep vascular lesions in the head and neck region are usually bothersome to the patient for two reasons: discomfort and disfigurement. Intramuscular vascular lesions within the masticatory muscles are often tender on palpation and chewing. Their subcutaneous

bulging, which becomes more obvious during chewing, can cause the patients substantial psychological stress.

In cases of deeply located vascular lesions (eg, masseter muscle, submandibular gland), blind intralesional PhC is dangerous, as inadvertent injury of nearby structures can occur, eg, the facial nerve.<sup>9</sup> US guidance is excellent for performing intralesional PhC of deep vascular lesions, and was first described by Werner et al in 1998.<sup>5</sup> The position of the guiding needle and the fiber-optic cable tip, as well as control of the extent of PhC, were monitored in real time throughout the procedure.

The layers of tissue and the location of the fiber-optic tip can be precisely determined on the monitor. Additionally, the location and extent of PhC can be directly observed and controlled *in vivo*, as the density of tissues and thereby their echoing properties change instantaneously upon coagulation, as does the image on the ultrasound monitor. In this way, the whole vascular lesion can be thoroughly coagulated under direct vision, step by step, without endangering vital structures.<sup>5</sup> As the whole procedure is performed subcutaneously, special protection of the skin is not necessary.<sup>10</sup>

When performing simple intralesional PhC without US guidance, on the other hand, very little coagulation effect is immediately seen, and it takes some experience before the clinician can estimate the degree of deep coagulation during treatment, and also to predict the extent of interstitial scarring that follows.<sup>8,9</sup>

In cases of vascular lesions in regions with vital structures, complete removal is not always the goal, and often patients are satisfied with reduction.<sup>7,9</sup> In the event that the lesion should enlarge again, treatment under local anesthesia can be easily repeated. One has to be especially careful in the vicinity of nerves, as they may be damaged irreversibly by PhC.<sup>4</sup>

Observing these precautions, the complication rate in Nd:YAG laser treatments is very low, and in this series of cases it was lower than anticipated.

## CONCLUSION

Ultrasound-guided intralesional laser photocoagulation with the Nd:YAG laser is an effective and safe mode of treatment for removal of deep vascular lesions. The treatment is quick, bloodless, safe, and can be performed under local anesthesia. Postoperative problems and discomfort are minimal, and there is no visible scarring, as the whole procedure is performed subcutaneously. Ultrasound guidance enables the operator to assess the exact location and volume of tissue coagulation. With this procedure, surgical excisions of vascular lesions, which are often difficult and mutilating, can usually be avoided.

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