BACKGROUND There are various therapeutic options for the treatment of pyogenic granuloma (PyG), but the results are frequently unsatisfactory, especially at difficult sites and with extensive lesions.

OBJECTIVE To evaluate the success of treatment of PyG using the 1,064-nm neodymium-doped yttrium aluminum garnet (Nd:YAG) laser and to compare it with state-of-the-art treatment methods.

MATERIALS AND METHODS Twenty patients with PyG were treated using the long-pulsed 1,064-nm Nd:YAG laser with fluences of 60 to 180 J/cm², a spot size of 7 mm, and a pulse duration of 40 ms. One to four treatment sessions were necessary for complete removal.

RESULTS Recurrence-free healing occurred in 19 of 20 patients (follow-up \(\geq\) 6 months, maximum 22 months). Because of heavy bleeding, one nonresponder was successfully treated using a carbon dioxide laser. The cosmetic results were good; textural changes of the skin were slight, if present at all.

CONCLUSION When used with the right strategy and patient cohort, the long-pulse 1,064-nm Nd:YAG laser is an effective, low-risk, minimally invasive method of treating PyG. This type of laser is a good therapeutic option that achieves good cosmetic results, particularly in PyG with a large diameter that are not suitable for treatment using the pulsed dye laser.

Background

Poncet and Dor, who called it “botryomyco-sis,” first described pyogenic granuloma (PyG) (synonyms: eruptive hemangioma, lobular capillary hemangioma) in 1897.¹ PyG is a benign vascular tumor marked by rapid exophytic growth within a few days to weeks.² It is often caused by minor trauma but can also occur spontaneously. Clinically, PyG appears as erythematous papules that tend to bleed; their size ranges from a few millimeters to a few centimeters. It is most likely to be located on the head (especially the lips) and extremities (especially the fingers) but can occur anywhere on the skin (and intraorally). In the past few years, many therapeutic approaches have been described: conventional excision, cryosurgery, electrocautery, and topical external agents.³⁻⁸ Good results were achieved with various laser systems, such as carbon dioxide \((\text{CO}_2)\), argon, pulsed dye and neodymium-doped yttrium aluminum garnet \((\text{Nd:YAG})\) lasers.⁹⁻¹²

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The criteria for successful treatment in this context were not only the complete removal of PyG, but also nonrecurrence and esthetic results. In a prospective study, we evaluated the success (defined according to esthetic results and nonrecurrence) of PyG treatment using the 1,046-nm Nd:YAG and compared it with the state-of-the-art treatment methods. In doing so, we aimed to evaluate the validity of the growing number of case studies in an original paper, especially with regard to their applicability to difficult sites (fingertip or nail matrix) and to extensive lesions.

**Materials and Methods**

In a prospective 16-month study from April 2009 to August 2010, 20 patients (10 female 10 males) with PyG were treated using the long-pulsed Nd:YAG laser (Apogee Elite, 1,064 nm, Cynosure Inc., Westford, MA). Histologic evaluations were performed in all cases (Dermatopathology Friedrichshafen, Germany) to verify the diagnosis and exclude malignant tumors. The target criteria were nonrecurrence and good cosmetic results. A scale with whole numbers from 0 to 2 was used (0 = no visible changes, 1 = slight textural changes, 2 = visible scar [atrophic, hypertrophic, keloid]) so that any possible artefacts were reflected as well. Selected results of these evaluations and treatments have been compiled in Table 1. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki and was approved by the institution’s human research review committee.

For the purposes of standardization, the same doctor performed the laser treatments in the same manner each time. The energy was slowly increased during the sessions. The therapeutic endpoint was visible coagulation. “Stacking” (quick series of pulses on one spot) was avoided. Pulses were delivered slowly at intervals of at least 30 seconds. When the PyG was located in the periorbital area, stainless steel lid plates were used, and the laser handpiece was pointed away from

**TABLE 1. Patient Characteristics**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>Site</th>
<th>Diameter, mm</th>
<th>Maximum energy, J/cm²</th>
<th>Treatments, n</th>
<th>Results*</th>
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<tbody>
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<td>170</td>
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<tr>
<td>m</td>
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<td>130</td>
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<td>1</td>
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<td>4</td>
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<td>Right scalp</td>
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<td>120</td>
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<tr>
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<td>Right shoulder</td>
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<td>1</td>
<td>0</td>
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<td>160</td>
<td>2</td>
<td>1</td>
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<td>Left cheek</td>
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<td>160</td>
<td>1</td>
<td>0</td>
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<tr>
<td>f</td>
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<td>150</td>
<td>1</td>
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<tr>
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<td>Left upper lip</td>
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<td>140</td>
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<td>140</td>
<td>1</td>
<td>1</td>
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<tr>
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<tr>
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<td>Left upper arm</td>
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<td>60</td>
<td>1</td>
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</tbody>
</table>

*0 = no visible changes, 1 = slight textural changes, 2 = visible scar (atrophic/hypertrophic/keloid).

†Heavy bleeding occurred with this patient, so the neodymium-doped yttrium aluminum garnet laser could not achieve sufficient coagulation. The PyG was treated successfully using a carbon dioxide laser. No visible textural changes (scale value = 0).
the eyes. In these regions, the interval between successive pulses was 2 minutes, to prevent the protective eye shields from heating up. Initial bleeding after the biopsy was stopped by swabbing with a compress. The following laser parameters were used: wavelength 1,064 nm, pulse duration 40 ms, spot size 5 or 7 mm. The treatment sessions were performed under cold air cooling (Cryo 6; Zimmer Medizinsysteme GmbH, Neu-Ulm, Germany; cooling level 5). The cooling was mainly administered to thermally protect the adjacent tissue. Patients were informed about the occurrence of crusting and the potential risk of wound infection, pigmented abnormalities, and scars.

After having been thoroughly informed about possible side effects, patients provided written informed consent. Digital photographs were taken before and after each treatment session (EOS 350D with Macro Lens EF-S 60 mm f/2.8 USM; Canon, Inc., Tokyo, Japan). The wounds were treated using povidone-iodine ointment and tape.

Results

Results from 20 patients were evaluated. At the time of treatment, the patients were aged 7 to 61 (average 35.5 ± 15.9, median 38). Fourteen (70%) had Fitzpatrick skin type II, and six (30%) had Fitzpatrick skin type III.13 Their PyGs were located on the head in seven cases (35%), on the upper extremities in nine cases (45%), on the genitals or groin area in two cases (10%), on the torso in one case (5%), and on the lower extremities in one case (5%). In seven cases (35%), there had been prior unsuccessful treatment with cryosurgery, CO₂ laser, or surgical intervention. In 17 cases, it was possible to determine how long the PyG had existed (range 1 week to 7 months, average 71 ± 58.6 days, median 60 days). Three patients could provide only imprecise information about duration. Before laser treatment, 14 patients (70%) received local anesthesia (lidocaine 1% with epinephrine 1:100,000), and three (15%) received Oberst anesthesia (mepivacaine 1%). In three patients, the treatment was provided without anesthesia. The size of the PyG ranged from 4 to 9 mm (average 5.5 ± 1.6 mm, median 5 mm). Prospective target criteria were recurrence-free removal with as little scarring as possible. At the end of the study, all patients had been recurrence free for at least 6 months (average 12.8 ± 3.8 months, median 13 months). The number of required laser treatments ranged from one to four; in 14 patients (74%), one treatment was sufficient, three (16%) needed two treatment sessions, and one patient each (5% each) required three and four sessions (Figures 1–3). The following fluences were required to achieve visible coagulation: 120 to 160 J/cm² with a spot size of 7 mm and 160 to 180 J/cm² with spot size 5 mm (average 146.5 ± 23.9 J/cm², median 150 J/cm²). In one case, a fluence of 60 J/cm² was sufficient. The aforementioned 14 patients with one single treatment session needed 2 to 10 pulses (average 4.8 ± 2.3 pulses, median 4.5 pulses) applied with an average fluence of 145 ± 26.9 J/cm² (median 150 J/cm²).

In one patient, we could not achieve effective coagulation during the treatment (nonresponder). The

Figure 1. PyG on right forearm of a 35-year-old patient (A) before treatment and (B) 1 year after two treatment sessions with the long-pulsed Nd:YAG laser (maximum fluence 170 J/cm²).
PyG was located on the upper lip and started to bleed heavily during the biopsy, so we treated it successfully with the CO2 laser operated in continuous and ultrapulsed modes. Crusting occurred in all patients after the laser treatments, but there was no secondary bleeding or infection. Cosmetic results were evaluated corresponding to the aforementioned scale; the treated area showed no textural changes in nine patients (47%) (scale = 0) and only slight changes in 10 patients (53%) (scale = 1). Visible scars were not observed. All patients were satisfied with the cosmetic results.

Discussion

There are numerous therapeutic options for treating PyG, and a trend toward the use of laser systems can be observed. Several case studies of successful treatments, especially of larger PyG, were recently published. In every therapeutic approach, it is critical that the central afferent vessel be included. Flat PyG can be treated successfully using the pulsed dye laser (PDL). Treatment using the dye laser is gentle, especially at anatomically difficult sites, such as periungually. Thanks to its wavelength (585–595 nm) and the subsequent limited penetration depth, the PDL is a therapeutic option with few side effects, although its use is restricted to flat, small PyG, which means it is not suitable for most of the PyGs in our study. For venous malformations, combined treatments with PDL and the long-pulse Nd:YAG laser were suggested. This approach should be transferable to treating PyG. The use of two passes of PDL treatment increases the depth of vascular injury, which may increase the efficacy of treatment in vascular lesions. This may also be true for treating PyG.

From 1996 to 2007, Sud and Tan treated 51 PyGs using the method of flat excision or PDL. In 2010, they published the following therapeutic recommendations: up to a size of 5 mm, treatment with PDL only; larger than 5 mm, treatment with a combination of surgical flat excision immediately followed by treatment with dye laser and then, if necessary, further dye laser treatments.

Treatment using the CO2 laser had excellent results in small and larger PyGs. In 2002, we published a study with 100 patients. We used the CO2 laser and a combination of continuous and ultrapulsed

Figure 2. PyG in the left auricle of a 61-year-old patient (A) before treatment and (B) 11 months after four treatment sessions with the long-pulsed Nd:YAG laser (maximum fluence 160 J/cm²).

Figure 3. PyG on the left thumb of a 12-year-old patient (A) before treatment and (B) 5 months after one treatment session with the long-pulsed Nd:YAG laser (maximum fluence 160 J/cm²).
modes. The continuous mode was to achieve coagulation of the central afferent vessel. The adjustment to the adjacent tissue was done gently in the pulsed mode. In 98 patients, this combined use led to complete removal of the PyG in one session. In 88 patients, the lesions healed free of scars.

In 2009, Galeckas and Uebelhoer stated in a case study that treating PyG using a combination of laser therapy (Nd:YAG, 1,064 nm) and sclerotherapy with glycerin can also lead to satisfactory cosmetic results.

In 2010, Gilmore and colleagues compared all current therapeutic options for PyG; they emphasized in this context that the available evidence was poor. There were only 824 documented cases in literature. According to this group, there is not “the one” optimum therapy, because each method had advantages and disadvantages; the more invasive a therapy (e.g., surgical excision), the more likely visible scars were, although the probability of recurrence and the number of treatment sessions was lower. In Gilmore’s opinion, the advantage of laser therapy is the low probability of scarring. (There are only studies with CO₂ and dye lasers.)

In our study, we report the successful treatment of PyG using the long-pulsed Nd:YAG laser. In 47% of the patients, there were no visible textural changes, and in 53%, there were only slight textural changes. Visible scars were not observed. This cosmetic outcome is satisfying, because most of the PyGs in our study were not suitable for PDL treatment because they were voluminous and broad based. This cosmetic outcome is satisfying. This good result is also evident in the fact that all patients were satisfied with the results.

Bourguignon and colleagues first described this therapy in a case study in 2006, when they used the Nd:YAG laser in three patients with PyG. We confirmed their findings in 2010 when we showed in two patients that the long-pulse Nd:YAG laser is especially suitable for the treatment of extensive lesions at difficult anatomic sites.

Because of its wavelength of 1,064 nm, it is possible to coagulate large and deep vessels using the Nd:YAG laser, unlike with the dye laser. In doing so, the fluence must be increased in small steps until coagulation becomes visible so that the afferent vessel closes. Stacking (quick series of pulses on one spot) should be avoided because of the danger of scarring, which occurs because of the dermal accumulation of the administered energy that cannot be purged quickly enough using epidermal cooling. For this reason, we applied pulses to the same spot at intervals of at least 30 seconds. We also ensured sufficient external cold air cooling, which also has analgesic effects, and was thus important for patients who chose not to receive local anesthesia. We recommend the application of a local anesthetic with epinephrine to reduce blood circulation in the treated area. This makes it easier to biopsy the lesions, which tend to bleed strongly. Because we treated voluminous PyG, the remaining tissue was sufficient to achieve enough laser absorption. Initial bleeding after the biopsy was stopped by swabbing with a compress. The combination of swabbing and the use of a local anesthetic with epinephrine made it possible to perform the laser therapy immediately after the biopsy.

In one patient, it was not possible to remove the PyG on the upper lip using the Nd:YAG laser. Heavy bleeding occurred after the biopsy, which meant that sufficient coagulation was not possible. Based on this experience, we recommend keeping the biopsy site as small as possible when using the Nd:YAG laser. Judging by our experience and as a result of theoretical considerations, we prefer the CO₂ laser in cases of small, heavily vascularized PyG. The Nd:YAG laser is especially suitable for broad-based, voluminous PyG, because these have sufficient absorption potential, whereas the effect with smaller-based PyG is not as good, because the required heat cannot be absorbed sufficiently to destroy the PyG.
The shortest follow-up period in our prospective study was 6 months. Recurrences after this period are unlikely.

Treatment using the Nd:YAG laser is minimally invasive for patients. After injection of the local anesthetic, the treatment can be performed quickly; only a minimal surface wound remains, which means that postinterventional pain is minor. In many cases, it is also possible to perform the treatment with cold air cooling alone if the patient requests it.

Conclusion

Treating PyG using the long-pulse Nd:YAG laser yields good cosmetic and recurrence-free results, given the right approach and because of the ideal action profile. It is thus a recommendable alternative, especially for voluminous and broad-based PyG that are not suitable for treatment using the PDL.

References


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