An ultrapulsed CO\textsubscript{2} laser combined with a long-pulsed Nd:YAG laser for the treatment of oral and maxillofacial pyogenic granuloma

Dear Editor,

Pyogenic granuloma (PG), also known as lobular capillary hemangioma, occurs in the face, neck, and upper limbs at any age and most patients have a single lesion.\textsuperscript{1} The patients generally have no symptoms except occasional erosion and exudation. However, since PG usually occurs in an exposed area and does not resolve without treatment, most patients visit the clinic for cosmetic reasons. A few patients present with bleeding or pain. Various clinical treatments have been developed for PG, including surgery, cryotherapy, laser ablation, and medicatiion therapy.\textsuperscript{2-4} Laser therapy has been proven effective and safe for the treatment of PG. In clinical practice, we explored an ultrapulsed CO\textsubscript{2} laser combined with a long-pulsed Nd:YAG laser for the treatment of oral and maxillofacial PG.

Our research subjects were enrolled in the Department of Oral and Maxillofacial Surgery at Liaocheng People’s Hospital. The whole treatment procedure was conducted as follows.

With local infiltration anesthesia, a sterilized cotton swab was placed at the root of the lesion, and the granuloma was forced to a pale ischemic state. The ultrapulsed CO\textsubscript{2} laser beam was focused and directed at the lesion root for carbonization and vaporization, and the lesion was separated from the root. Then, under a 50-fold magnifying glass, the lesion base was vaporized and cleaned layer by layer. The long-pulsed Nd:YAG laser was then applied to irradiate the lesion area vertically, covering the base area. No gray area was observed after irradiation, and erythromycin ointment and hydrocolloid dressing (algoplaque) were applied every 2-3 days for 2 weeks. The patients revisited our clinic 4 weeks after treatment, and their healing and recovery conditions were evaluated at revisit. Follow-up information was collected 12 months after the operation. The healing time, adverse effects, and pain score assessed by the visual analogue scale (VAS) were analyzed to evaluate the therapeutic effect.

Detailed patient information, including the affected site and lesion size, treatment parameters, healing times, pain score and adverse effects are listed in Table 1. Photos of two representative cases are shown in Figure 1. The involved cases showed a cure rate of 100%. No recurrence occurred during the 12-month follow-up. No obvious scars were observed after complete wound healing, and all patients were satisfied with the treatment outcomes.

PG usually has certain cosmetic effects, and laser therapy has become a widely applied strategy in clinic.\textsuperscript{5} An ultrapulsed CO\textsubscript{2} laser produces a fine, focused spot to precisely control the range of the treated site and causes less irritation to the surrounding tissue, therefore reducing adverse effects such as local edema, hyperpigmentation, hypopigmentation and scar formation, and producing a clean operating view field and curative effect.\textsuperscript{6} However, CO\textsubscript{2} ablation also creates open wound which has a certain

| Case ID | Age | Sex | Affected site | Size\textsuperscript{a} | Etiology | Symptoms | Times of treatment | CO\textsubscript{2} laser energy (W/cm\textsuperscript{2}) | Nd: YAG laser pulse width (ms) | Nd: YAG laser energy (J/cm\textsuperscript{2}) | Healing time(days) | Pain Score (visual analogue scale, VAS) | Adverse effects |
|---------|-----|-----|---------------|-------------------------|----------|-----------|-------------------|-------------------------------|-----------------------------|-----------------------------|----------------|-------------------------------|-----------------|
| A       | 55  | M   | Upper lip mucosa | 3 | unknown   | Asymptomatic | 1 | 2.5 | 5 | 90 | 12 | 3 | Temporary redness |
| B       | 6   | M   | Cheek         | 2 | scratch    | Bleeding     | 1 | 3   | 5 | 100 | 13 | 4 | Temporary redness |
| C       | 6   | M   | Lower lip mucosa | 1.5 | geneogenous | Asymptomatic | 1 | 2   | 10 | 100 | 9  | 3 | Temporary redness |
| D       | 3   | M   | Lower lip mucosa | 2 | unknown    | Bleeding     | 1 | 3   | 5 | 100 | 12 | 3 | Temporary redness |
| E       | 4   | M   | Paranasal     | 2 | geneogenous | Asymptomatic | 1 | 2   | 10 | 90  | 10 | 5 | Temporary pigmentation |

\textsuperscript{a}Size was measured by the longest diameter.

The first two authors contributed equally to this paper.
Bin Zhang and Li-Cheng Jiang should be considered joint corresponding author.
A long-pulsed 1064 nm Nd:YAG laser was reported to have cosmetically favorable therapeutic outcomes for PG. Its typical features include deep tissue penetration, oxyhemoglobin thermocoagulation effect, and capillary contraction induction, and the deep penetration character can effectively reduce the recurrence of PG.

In our clinic practice, with the principle of selective photothermal ablation, the ultrapulsed CO2 laser and long-pulsed Nd:YAG laser combined therapeutic strategy can effectively reduce bleeding during the operation, improve the accuracy and safety of this medical cosmetic treatment, and present patients with content outcomes. Future research with a controlled design, larger sample size and longer follow-up duration would be helpful further to verify the efficacy of this combined laser treatment.

**CONFLICT OF INTEREST**

The authors declare that no competing interests exist.

**DATA AVAILABILITY STATEMENT**

The datasets used and/or analyzed in the current study are available from the corresponding authors upon reasonable request.

**ETHICS STATEMENT**

This study was approved by the Ethics Committee of Liaocheng People's Hospital. All patients or parents of the child participants provided written informed consent.

**AUTHOR CONTRIBUTIONS**

Jian-Lin Liu and Li-Cheng Jiang recruited the subject, and performed the operation; An-Qi Zhang and Jian-Lin Liu contributed to the data analysis and interpretation, and An-Qi Zhang wrote the paper; Di Zhang acquired patients' clinical data; Bin Zhang and Ke-Yi Li revised critically the manuscript for important intellectual content; Li-Cheng Jiang and Bin Zhang conceived the study. All authors revised the manuscript and approved the final version.

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