



# Removal of Large Wharton's Duct Salivary Stones Using a CO<sub>2</sub> Laser: A Report of Two Cases

Kousuke Matsumoto<sup>1\*</sup>, Makiko Tanakura<sup>1</sup>, Izumi Mitani<sup>1</sup>, Akira Kimoto<sup>2</sup>, Masaya Akashi<sup>2</sup>

<sup>1</sup>Department of Oral and Maxillofacial Surgery, Japan Community Health Care Organization, Kobe Central Hospital, Kobe, Japan

<sup>2</sup>Department of Oral and Maxillofacial Surgery, Kobe University Graduate School of Medicine, Kobe, Japan

## \*Correspondence to

Kousuke Matsumoto, DDS, PhD;  
Department of Oral and  
Maxillofacial Surgery, Japan  
Community Health Care  
Organization, Kobe Central  
Hospital. Tel: +81-078-594-  
2211; Fax: +81-078-594-2244;  
Email: kousuke312@hotmail.  
co.jp

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## Abstract

**Introduction:** Salivary stones inside the Wharton's duct adjacent to the mylohyoid muscle are often removed by a little incision of the mouth floor under local anesthesia. However, in the case of relatively large salivary stones, a large incision is required, which is commonly accompanied by hemorrhage and the need for surgical hemostasis, resulting in prolonged surgery. Furthermore, troublesome sequelae such as ranula and lingual nerve paralysis can occur after surgical procedures.

**Methods:** Two patients who had relatively large salivary stones (>1 cm diameter) in the Wharton's duct were underwent incision of the mouth floor soft tissues with a CO<sub>2</sub> laser.

**Results:** In both patients, the stone was removed in a few minutes without causing abnormal bleeding, nerve injury, or sublingual gland disorders and was completely healed.

**Conclusion:** We report the usefulness and safety of the CO<sub>2</sub> laser in two patients with relatively large salivary stones, who underwent successful surgical removal.

**Keywords:** CO<sub>2</sub> laser; Salivary Stone; Wharton's duct.

## Introduction

Sialolithiasis in the submandibular gland or Wharton's duct is frequent and may cause acute or chronic submandibular sialoadenitis.<sup>1</sup> Sialoadenitis-causing salivary stones located within the submandibular gland or at the duct transition site can be treated with percutaneous removal. Those located within the duct and posterior to the mylohyoid muscle can be removed with a careful lingual nerve-sparing intraoral approach.<sup>2</sup> Although the above procedures are commonly performed under general anesthesia, salivary stones inside the duct adjacent to the mylohyoid muscle are often removed under local anesthesia on an outpatient basis. However, relatively large salivary stones with a diameter greater than 1 cm have been reported.<sup>3,4</sup> With these salivary stones, a large incision is required, which is commonly accompanied by hemorrhage and the need for surgical hemostasis, resulting in prolonged surgical time and potential complications.<sup>5</sup>

A CO<sub>2</sub> laser with a wavelength of 10.6 μm has several advantages. It is easily absorbed by water, acts superficially, has the high hemostatic ability, induces minimal thermal injury to the surrounding tissues, and is easy to operate.<sup>6</sup> For these reasons, a CO<sub>2</sub> laser is commonly used for resection or vaporization of soft tissues in the mouth.<sup>7-11</sup> However, there have been only a few reports of its use for salivary stone removal.<sup>12-14</sup>

Since the sublingual gland and lingual nerve are located in close proximity to the submucosa of the floor of the mouth, troublesome sequelae such as ranula and lingual nerve paralysis can occur after surgical procedures in this region.<sup>15</sup> Therefore, "separation procedures of submucosal tissue" are usually performed and laser dissection has not gained popularity. Furthermore, local healing and saliva excretion mechanisms after laser dissection of Wharton's duct are not well understood. We report the usefulness and safety of the CO<sub>2</sub> laser in two patients with relatively large salivary stones (>1 cm diameter), who underwent successful surgical removal.

## Case 1

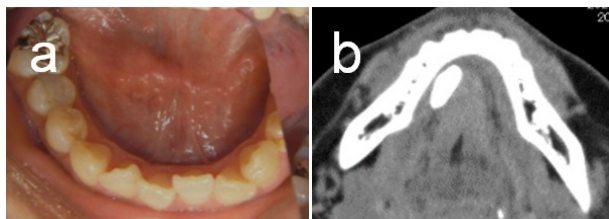
A 47-year-old female patient reported a 5-year history of repeated episodes of swelling and oppressive pain in the right submandibular region. She was referred to our hospital after sialolithiasis was diagnosed at another clinic after an acute episode one month earlier. She had no medical history or allergies. On examination, a protrusion in the mucosa of the right mouth floor 5 mm posterior to the right duct opening site and submucosal sclerosis were detected (Figure 1a). The right submandibular gland was swollen and tender to palpation. No salivary secretions from the duct were observed. Panoramic radiographic and computed tomography (CT) images showed a submucosal 15×7 mm radiopacity (Figure 1b).

Sialolithiasis in the duct was diagnosed.

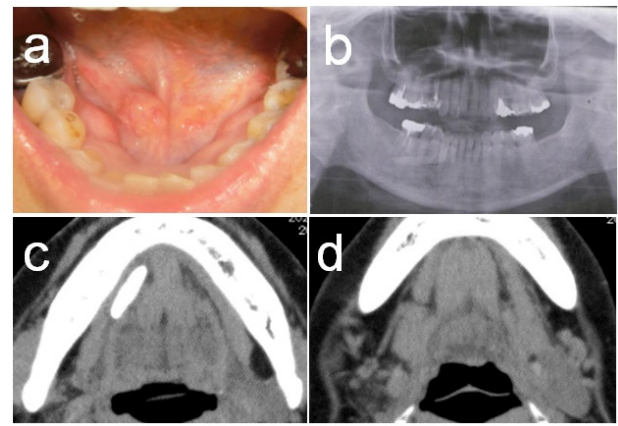
An approximately 1 cm incision was made in the mucosa of the mouth floor directly above the salivary stone using a CO<sub>2</sub> laser (3 W, continuous wave, the spot size 1.00 mm, irradiance 3.18 W/mm<sup>2</sup>, Energy density 191.08 J/mm<sup>2</sup>, Bell laser Plus, Takara Belmont Corp, Osaka, Japan) under local anesthesia with 2% lidocaine with epinephrine. The laser was irradiated until the surface of the salivary stone was clearly identified (Figure 2a). Once exposed, the salivary stone was removed using forceps, taking care not to fracture it (Figure 2b). After stone removal (Figure 2c), salivary secretion was observed after pressing the submandibular gland (Figure 2d). The surgical procedure was successfully completed with no abnormal bleeding. The patient was followed up for 30 days to confirm healing and salivary secretion (Figure 2e).

**Case 2**

A 55-year-old female patient with a history of hypothyroidism and allergy to lidocaine with epinephrine presented with a chief complaint of toothache. On examination, a protrusion in the mucosa of the right mouth floor and submucosal sclerosis were detected



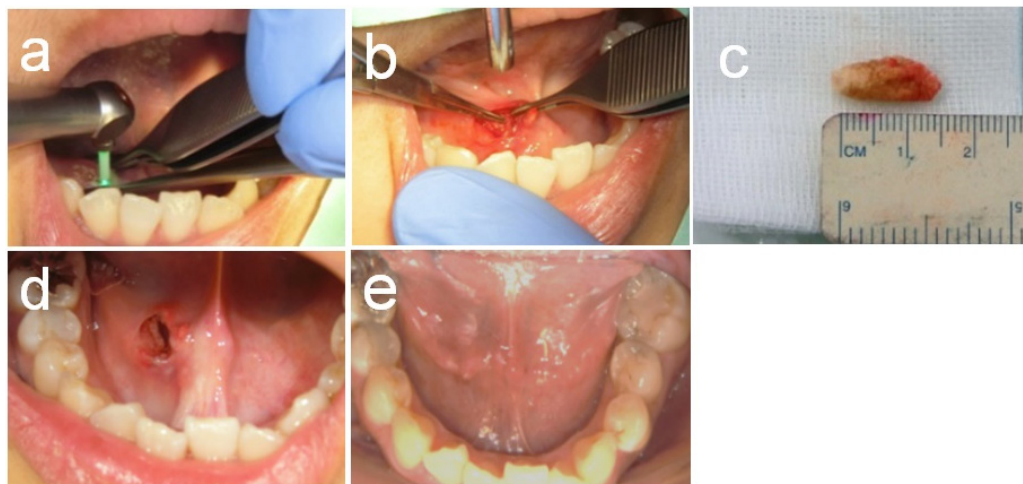
**Figure 1.** Intraoral Photograph and CT Images on the First Examination of Case 1. (a) Intraoral photograph showing a protrusion on the mucosa of the right mouth floor. (b) CT image showing a 15x7mm radiopaque in the submucosal area of the mouth floor.



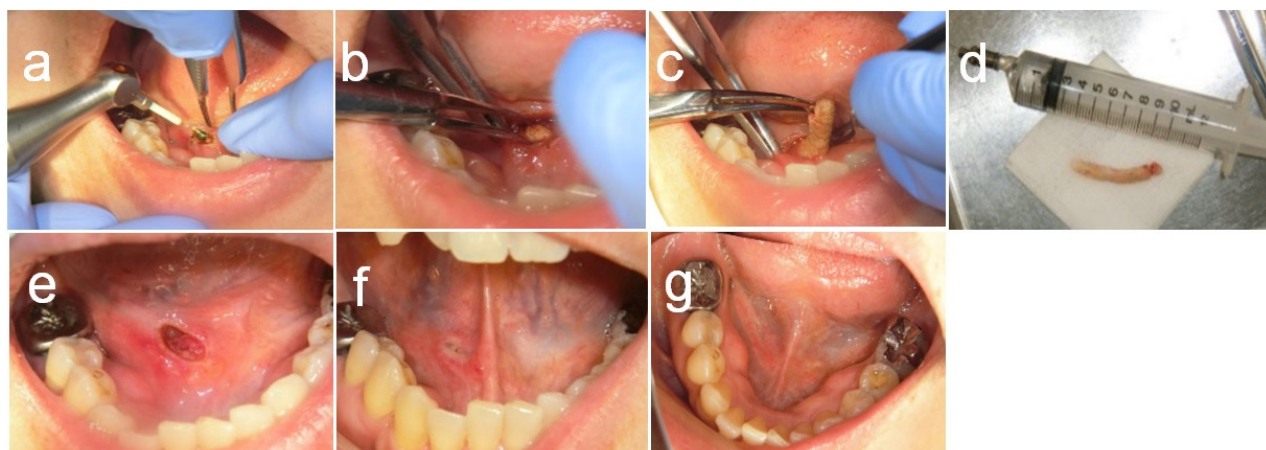
**Figure 3.** Intraoral Photograph and Panoramic Radiographic Images and CT Images on the First Examination of Case 2. (a) Intraoral photograph showing a protrusion on the mucosa of the right mouth floor. (b) Panoramic radiographic images showing a long and thin radiopaque finding. (c) CT images showing a 31 x 6 mm radiopaque in the submucosal area of the mouth floor. (d) CT image of the submandibular gland slice shows the disappearance of the right submandibular gland.

(Figure 3a). Although panoramic radiographic images showed a long thin radiopacity in the area between the right submandibular incisor tooth and the first molar (Figure 3b), no corresponding subjective symptoms were felt. CT images showed a 31x6 mm radiopacity in the submucosal mouth floor (Figure 3c) and atrophy or disappearance of the right submandibular gland (Figure 3d). Sialolithiasis in Wharton's duct was diagnosed.

An incision of approximately 1 cm was made in the mucosa of the mouth floor directly above the salivary stone using a CO<sub>2</sub> laser (3 W, continuous wave, the spot size 1.00 mm, irradiance 3.18 W/mm<sup>2</sup>, Energy density 127.39 J/mm<sup>2</sup>, Bell laser Plus, Takara Belmont Corp, Osaka, Japan) under local anesthesia with mepivacaine hydrochloride. The laser was irradiated until the surface of the salivary



**Figure 2.** Photographs of the Operative Procedure of Removal of the Salivary Stone Using a CO<sub>2</sub> Laser. (a) Laser irradiation to mucosa just above the salivary stone. (b) Removal of the stone using forceps. (c) The stone shown on a scale. (d) The immediate postoperative surgical site, which was remained open. (e) Complete healing on day 7 after the operation.



**Figure 4.** Photographs of the Operative Procedure of Removal of the Salivary Stone Using a CO<sub>2</sub> Laser. (a) Laser irradiation to mucosa just above the salivary stone. (b), (c) Removal of stone using forceps. (d) The stone shown on a scale. (e) The immediate postoperative surgical site, which was remained open, and disappearance of salivary flow. (f) Poor healing on day 7 after the operation. (g) Complete healing on day 20 after the operation.

stone was clearly identified (Figure 4a). Once exposed, the salivary stone was removed using forceps, taking care not to fracture it (Figure 4b, c, d). After stone removal, no salivary secretion from the duct was observed, even after pressing the submandibular gland. The procedure was successfully completed with no abnormal bleeding (Figure 4e). On day 7 after the procedure, the site did not heal (Figure 4f); however, on day 20, complete healing was confirmed and the patient reported no after-effects or discomfort (Figure 4g).

### Discussion

We reported two patients with large salivary stones (>1 cm diameter) in Wharton's duct, who underwent surgical removal using a CO<sub>2</sub> laser to incise the mucosa and submucosal tissue of the mouth floor overlying the stone. In both patients, the stone was removed in approximately 10 minutes without causing abnormal bleeding, nerve injury, or sublingual gland disorders such as ranula. Compared to other lasers (< 2 μm wavelength) used in the oral cavity, a 10.6 μm wavelength CO<sub>2</sub> laser is easily absorbed by water, distributes energy superficially, and does not penetrate tissue deeply.<sup>6,16,17</sup> Considering the anatomic relationship of the salivary glands, nerves, and blood vessels in the submucosa of the floor of the mouth, we believe that the CO<sub>2</sub> laser is well-suited for use in this region. Although mepivacaine hydrochloride without epinephrine was used for local anesthesia due to allergy in case 2, the CO<sub>2</sub> laser enabled us to perform the procedure rapidly with almost no bleeding. The surgical incision was not sutured in either patient because there was minimal bleeding and we wanted to maintain saliva export. Both incisions completely healed, but the passage of saliva was retained in case 1 only, as the submandibular gland had atrophied or disappeared in case 2 and no saliva was secreted postoperatively.

Although the timing of the laser reaching the salivary stones can be confirmed using the tactile sense with a finger or forceps, this may be difficult in practice. We found that a spark occurred when the laser directly hit the stone, which can also be confirmatory. Using this visual indicator as a sign to stop laser irradiation can prevent thermal injury to the surrounding tissues.

Time to complete healing differed between our two cases. In case 2, healing was delayed and salivary secretion had ceased due to submandibular gland atrophy or disappearance. This suggests that the self-cleaning action of Wharton's duct was impaired and minute pieces of foreign matter could not be cleansed away due to lack of saliva. Alternatively, a lack of salivary enzymatic healing action may have caused delayed epithelialization.<sup>18</sup>

### Conclusion

A CO<sub>2</sub> laser can be used to successfully and safely remove relatively large salivary stones from Wharton's duct through an incision of the mouth floor.

### Patient's Consent

Written informed consent was obtained from each patient.

### Conflict of Interests

The authors declare no conflict of interest.

### Funding

None.

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