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CASE REPORT

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Minimally invasive surgical removal of bilateral impacted mandibular supernumerary teeth using 3D surgical guide template: a case report

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Abstract

Impacted supernumerary teeth are defined as the presence of one or more teeth in a patient's upper and lower jaws in addition to the normal number of teeth in the dental arch. It has an incidence rate of approximately 1%–14% and more frequently occurs in males than females, may be single or multiple, unilateral or bilateral, erupted or impacted. In this article, we describe the case of a patient with two supernumerary teeth between the roots of the mandibular second premolar and the first molar, which influenced the effectiveness of the first orthodontic treatment. The special anatomical position of the complex supernumerary teeth made tooth extraction challenging. Given the higher risk status of surgery, we implemented a novel tooth extracting technique for this patient. Thus, in this study, we describe a case of minimally invasive extraction of bilateral mandibular impacted supernumerary teeth using a digital 3D positioning guide plate.

Keywords

Supernumerary teeth; 3D surgical guide plate; Minimally invasive; Tooth extraction

1. Introduction

Supernumerary teeth most commonly occur in the anterior part of the upper jaw, lying symmetrically on one or both sides of the jaw, followed by maxillary fourth molars, maxillary premolars and mandibular premolars, in descending order [1, 2]. Clinically, supernumerary teeth, irrespective of a normal or deformed shape, may lead to difficulties in permanent teeth eruption, malocclusion, resorption of adjacent tooth roots and failure of orthodontic treatment. They usually affect the efficacy of orthodontic treatments and generally require extraction [3]. However, given their special anatomical location, their extraction is challenging due to the need to remove large amounts of bone during surgery. In addition, surgery-induced trauma may cause unnecessary complications, further affecting the effectiveness of orthodontic treatments [4]. Three-dimensional (3D) positioning guides have helped reduce trauma during impacted supernumerary tooth extraction [5]. In this report, we report our experience using digital 3D surgical guide templates *via* minimally invasive extraction of the bilateral mandibular impacted supernumerary teeth, providing a reference for clinicians.

2. Case report

A 14-year-old male patient, accompanied by his father, presented to the Department of Stomatology of the People's Hospital of Xinjiang Uygur Autonomous Region (Urumqi, Xinjiang, China) with the chief complaint of irregularity of his mandibular anterior teeth for 5 years, which affected his appearance. His father described that two years earlier, the patient underwent an orthodontic treatment at another hospital, but due to the limited medical conditions at the local hospital, the attending doctor encountered difficulties in treating the condition, the results were not satisfactory, and they were suggested to visit our hospital for further treatments (Fig. 1).

The patient personal and past medical history was not associated with any syndrome related to the presented condition. His parent provided a signed informed consent prior to the treatment. Upon observation, we noticed that the facial surface type was symmetrical, and there was no deflection, with the average type in the frontal view and the convex type in the lateral view. On intraoral examination, oral hygiene was fair, the lower anterior teeth were crowded with 3 mm crowding, the upper midline was 3 mm to the left, the lower midline was 1 mm to the left. Teeth 24, 34 were missing, the degree of overjet was +5 mm, the overbite was Class II, and the scissor bite was 27, and no anomalies were found upon bilateral buccal and lingual palpation of the mandible.

Panoramic radiography and cone-beam computed tomography (CBCT) were performed, and the scans revealed an impacted supernumerary tooth between the roots of teeth 35 and 36 and another one between the roots of teeth 45 and 46 (Fig. 2a–c).

Diagnosis

• Angle Class II, division 1

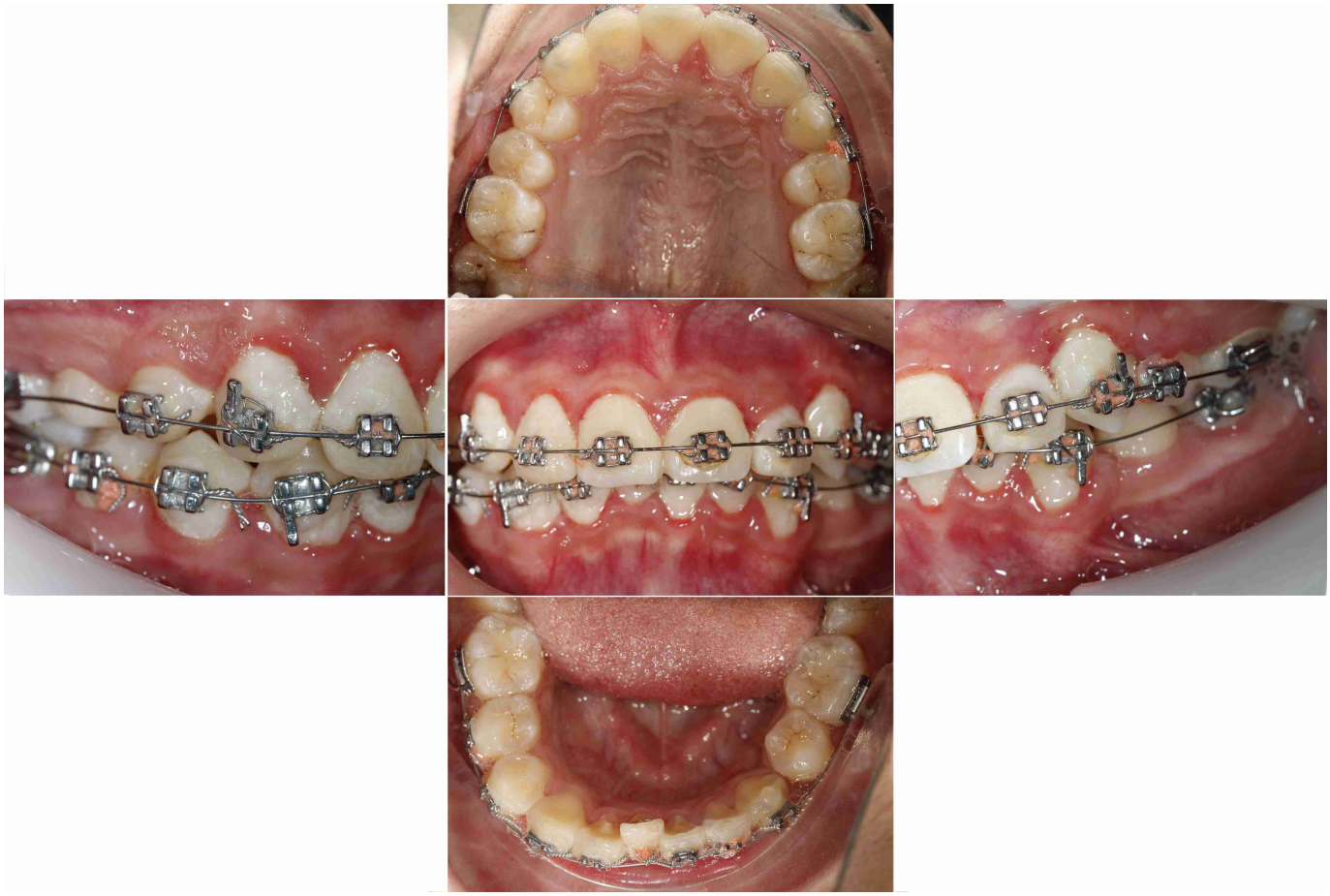

FIGURE 1. Intraoral photographs of the 14-year-old male patient.

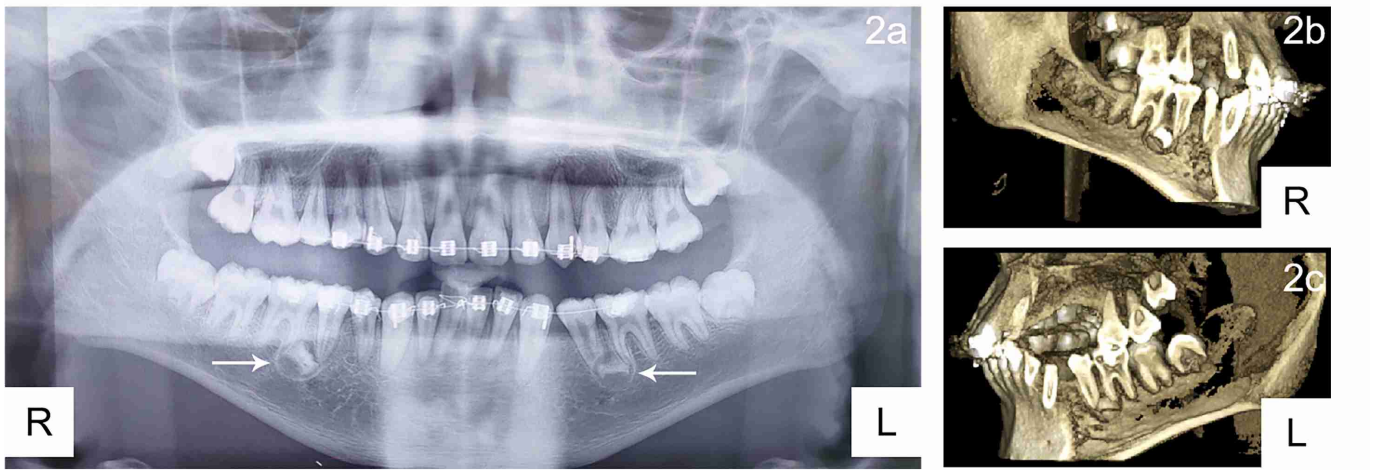

FIGURE 2. Preoperative radiographic examination. Preoperative panoramic radiography (2a) and cone-beam computed tomography (2b, 2c).

• Two impacted mandibular supernumerary teeth

Treatment options

• Extraction of the impacted supernumerary teeth between the roots of teeth 35 and 36 and the roots of teeth 45 and 46

• Extraction of teeth 14 and 45

• Continue orthodontic treatment after tooth extraction

Equipment and software

• CBCT (Planmeca Promax 3D Classic, Planmeca, Helsinki, Finland)

• 3D printing (HT560Pro, Jiangsu Rich-Opto Technology, Zhenjiang, China)

• Carestream Intraoral Scanner (CS 3600, Carestream, Rochester, NY, USA)

• Materialise's Interactive medical image control system (Mimics Research 19.0, Materialise NV, Leuven, Belgium)

• 3Shape Dental System (TRIOS® Design Studio, 3shape, Copenhagen, Denmark).

Treatment progress: CBCT and oral scans were performed preoperatively, and computer software (Fig. 3a) were used for digital 3D positioning surgical guides. After complet-

ing the relevant preoperative examinations, excluding those contraindicated for surgery, the supernumerary teeth were extracted under local anesthesia in our stomatology clinic. Prophylactic antibiotics and analgesics were administered 30 min preoperatively to prevent postoperative infection and pain. Moreover, 2% lidocaine was injected for block anesthesia and articaine for infiltration anesthesia. The surgical incision and flap range between the roots of teeth 35 and 36 on the tongue side was designed depending on the position of the ambush tooth. After exposing the bone surface, the sterilized digital 3D positioning guide was put in place (Fig. 3b), and anchors were attached to it. After grinding a part of the bone and fenestration, the dentist removed the tooth sac to relieve resistance and used a minimally invasive elevator to extract the left supernumerary tooth (Fig. 3c–e). Then, saline was used to rinse the alveolar fossa, and the mucosal flap was repositioned. The gum tissue was aligned and sutured using resorbable sutures, and the right side of the contralateral supernumerary tooth was removed using the same method as the left side after extracting teeth 45. After the procedure, pressure was applied for 40 min to prevent bleeding. The surgery lasted for 30 min and was smoothly completed. There was no obvious bleeding, infections, other symptoms, damage to the adjacent teeth or neurosensory abnormalities.

Follow-up: After 6 months, CBCT showed proper healing of the extraction sockets, the adjacent teeth and neural tubes were not damaged, and new bone tissue had formed at the boneless site of the tongue side, indicating total healing (Fig. 4a,b). Oral examination showed that both wounds healed remarkably (Fig. 4c,d). The patient reported no discomfort or complications, such as adjacent teeth and nerve damage.

3. Discussion

The cause of supernumerary teeth is generally related to genetic factors during embryonic development, especially during the development of the oral and maxillofacial area and teeth [6]. Supernumerary teeth buried in the jaw are generally not clinically uncomfortable, and most cases are found by plain X-ray shooting. In this present case, the patient had previously received orthodontic treatment in another hospital, but the results were unsatisfactory. After presenting at our hospital, X-ray imaging revealed two complex supernumerary teeth between the roots of teeth 35 and 36 and teeth 45 and 46. Therefore, a treatment plan was developed after evaluation by an orthodontist, who performed orthodontic treatment after extracting the two impacted mandibular supernumerary teeth.

Two-dimensional X-ray imaging cannot accurately reflect the specific location and adjacent relationships of the supernumerary teeth and cannot provide sufficient support for designing the incision and fenestration to extract the affected teeth. Comparatively, CBCT can show clinicians the morphology of the sides of the tooth crown, integrity, number of roots and length [7]. In addition, the adjacent relationship around the affected tooth can be observed and measured preoperatively, such as the distance from the nerves, blood vessels, gaps, maxillary sinuses, nasal base, *etc.*, and the high point of the tooth shape and the closest position, range and size of the bone wall can be accurately judged. Although CBCT can indicate the three-dimensional position and anatomical relationship of the affected tooth [8], it cannot accurately relay the preoperatively designed fenestration position and direction to the patient's mouth. Therefore, deviations from the actual fenestration position and the expected position are inevitable. In severe cases, it can even damage important anatomical structure if in the absence of a guide template, traditional surgical methods will be limited by the surgeon's clinical experience, individual patient differences and unpredictable intraoperative circumstances. First, because the bilateral mandibular impacted supernumerary teeth were close to the mental nerve and lower adjacent to the inferior alveolar nerve, sharp and blunt injuries had to be avoided during surgery, and the operation could not be too long; otherwise, it might have increased the risk of nerve damage. Second, an inaccurate fenestration position could have damaged the root of the adjacent tooth, resulting in complications such as loose adjacent teeth, periapical periodontitis or root fracture. In addition, the supernumerary teeth were close to the tongue side and obstructed surgical vision. It might have caused blood vessel rupture leading to bleeding at the bottom of the mouth or the displaced teeth, and serious complications might have occurred if the teeth had entered the adjacent space.

A digital 3D positioning guide can provide clinicians with more intuitive and detailed patient information, preoperative surgical rehearsal, correct assessment of the risks and potential difficulties of the planned procedure, design of surgical incision and fenestration, and operation angle and depth [9]. Therefore, in this case, after preoperative discussions, we developed a surgical plan for using digital 3D positioning guide templates to accurately extract the impacted supernumerary teeth *via* minimally invasive techniques. Through preoperative CBCT, the supernumerary teeth were found closer to the lingual bone, which made it feasible to remove the impacted teeth from the lingual side using a guide template. In the 3D positioning guide plate design, we chose resin material because it is not easy to deform. We also chose the bar connection method, which did not block the view as much as possible, and the fenestration size was based on the maximum circumference of the impacted mandibular supernumerary teeth. The guide plate was a dental support guide plate, but the fenestration position was close to the bone closure to avoid suspension, and to a certain extent, we used the thickness of the guide plate to limit the operation depth. A bump was locally designed at the bottom of the guide plate, which played the role of a small draw hook and could open the mucosa during the operation. In addition, the left and right were marked on the guide plate to facilitate rapid positioning during the operation and avoid confusion (Fig. 5).

The digital 3D guide templates were placed smoothly during the operation, which quickly exposed the location of the impacted teeth after fenestration [10]. In addition, the technique implemented reduced surgical trauma, shortened operation time, and led to the remarkable recovery of the patient. He reported no discomfort during follow-up, indicating that the implemented orthodontic treatment was smooth and effective.

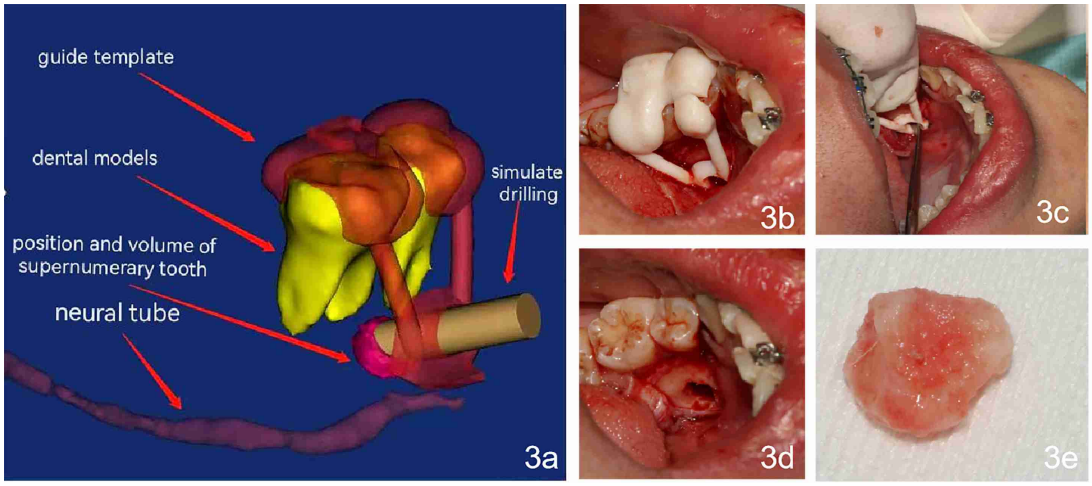

FIGURE 3. Guide template design and surgical procedure. (3a) Design drawing from the guide plate. (3b) The guide plate was placed into position. (3c) Minimally invasive teeth extraction. (3d) Extraction of the sockets. (3e) Removal of the left supernumerary tooth.

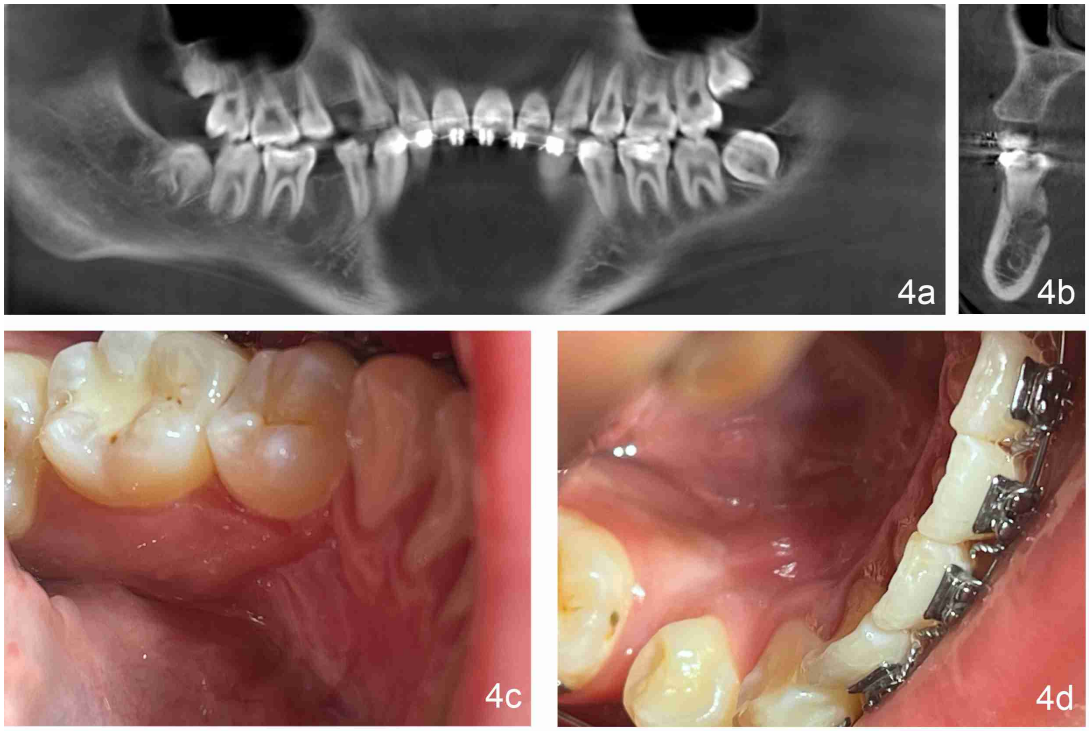

FIGURE 4. Postoperative follow-up 6 months following the surgery.

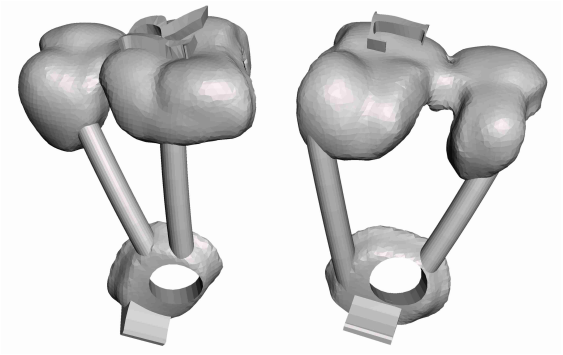

FIGURE 5. 3D positioning of the guide template.

4. Conclusion

Modern alveolar surgery aims to minimize damage to the body and soft tissues, preserve the alveolar bone, reduce postoperative reactions, and accelerate wound healing and patient recovery. The objective is to perform a safe, precise, comfortable and minimally invasive surgery [11]. Based on the observed results, the application of digital 3D surgical guide templates for treating the impacted supernumerary teeth allowed for minimally invasive treatment to be performed. For this case, lingual fenestration would have increased the difficulty of surgery, and the application of the 3D surgical guide template solved the problem of locating and ensuring the safety of adjacent nerves. Fenestration and bone removal

under the guide template achieved minimal trauma to the underlying hard tissues, rapid recovery, and decreased the risk of complications. The postoperative wound was sutured tightly, with minimal bleeding and no exposed wound, which enhanced the conditions for the rapid recovery of soft and hard tissues [12].

AVAILABILITY OF DATA AND MATERIALS

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

AUTHOR CONTRIBUTIONS

YA—wrote the manuscript, XLZ—collected data, JHZ—designed the template, JPM—performed the surgery, and RG—helped draft the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Consent was obtained from parents of the patient for publication of this report and any accompanying images, and ethical approval was obtained from the ethics committee of People's Hospital of Xinjiang Uygur Autonomous Region (KY2019062618).

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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