A New Hybrid Technique for Performing a Safer Bilateral Sagittal Split Osteotomy: Combining Reciprocating Saw and Piezoelectric Devices

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Abstract

The sagittal split osteotomy (SSO) is an indispensable tool in the correction of dentofacial abnormalities. In elective orthognathic surgery, it is important that surgeons inform patients about the risk of complications related to inferior alveolar nerve damage and unfavorable split. The purpose of this article is to describe a novel, hybrid technique to SSO by combining a reciprocating saw and piezoelectric devices with several advantages over traditional "pure" methods (osteotomies performed by reciprocating saw or piezoelectric devices only) in terms of precision, rapidity, easier splitting, and decreased complications related to inferior alveolar nerve damage and bad split with reduced overall morbidity. The level of evidence was Level IV, therapeutic study.

Keywords

- bilateral sagittal split osteotomy
- osteotomy
- bone
- orthognathic surgery
- bimaxillary
- piezosurgery

Sagittal split osteotomy (SSO) was described by Obwegeser et al in 1955[1] for the correction of both prognathism and mandibular deficiency. The main advantage of this osteotomy was that it provided significant degree of bone contact between the proximal and the distal segment by splitting the rami in the sagittal plane, allowing bony continuity of the distal medial cortex and the proximal lateral cortex. Further advantages include the decreased need of bone grafting and the execution of the procedure using the intraoral approach. The main disadvantage is inferior alveolar nerve damage. DalPont modified the osteotomy by placing the buccal cortical cut in the body of the posterior mandible opposite the molar teeth and oriented it in a vertical fashion, thus increasing the bone contact area and making the technique in particular useful for large advancements. In 1968, Hunsuck[2] further modified the technique extending the medial cortical osteotomy just posterior to the lingula rather than back to the posterior border of the ramus; this technical detail made the procedure easier and safer with preservation of the medial pterygoid muscle insertion of particular utility when performing large advancement accompanied by counterclockwise distal rotation. Epker[3] in 1977 introduced the complete osteotomy of the inferior mandibular cortex with vertical cut.

Nowadays, the sagittal split ramus osteotomy enjoys popularity in any mandibular procedures, allowing mandible movement in any direction (anterior and posterior), rotation to correct lateral asymmetries, occlusal plane abnormalities, and occlusal tilts.

Although the modifications proposed have improved the stability and outcomes, they did not eliminate perioperative and postoperative complications. The mean incidences for bad split (2.3% per SSO), postoperative infection (9.6% per patient), removal of the osteosynthesis material (11.2% per patient), and neurosensory disturbances of the lower lip (33.9% per patient) are reported.[4] Regularly reported risk factors for complications were the patient's age, smoking habits, presence of third

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molars, the surgical technique, and type of osteosynthesis material. Postoperative neurosensory disturbances are the most common and widely reported complication of SSO. These neurosensory disturbances of the inferior alveolar nerve can range from transient hypoesthesia to more severe persistent anesthesia, hyperesthesia, or allodynia. Cases of severe neuropathic pain can be the cause of considerable morbidity. The osteotomies have been performed with several tools: burs, Lindemann burs, mechanics electric saw, pneumatic saw, and more recently with ultrasonic devices.[5] Here, we describe a novel technique to perform bilateral SSO with decreased morbidity in comparison to the current literature.

Materials

A retrospective study included patients who underwent bilateral sagittal osteotomy at the Face Surgery Center (Parma, Italy) by the first author (M.R.) between January 2013 and January 2016. Bimaxillary osteotomies were performed by "mandible first protocol" in 98% of the patients undergoing orthognathic surgery. Exclusion criteria included syndromic patients only, due to anatomical variation that would affect the outcomes. Third molar was always removed at least 6 months before surgery. Institutional review board approval was obtained.

Technique

Under general anesthesia, bupivacaine hydrochloride plus epinephrine (10cc each side) was injected to achieve local vasoconstriction. A 4-cm vestibular incision with a 15-blade extended from the retromolar trigone to the first molar was performed followed by full-thickness incision followed by subperiosteal dissection limited to the outline of the osteotomy. Drilling of the internal oblique line is performed anteriorly to the lingula with an oval bur (►**Fig. 1**) to launch the sagittal osteotomy with reciprocant saw (►**Fig. 2**) (OsteoPower System, OsteoMed) up to the lingual cortical with the planned distal vestibular corticotomy. External corticotomy is performed at the level of the first/second molar (►**Fig. 3**), depending on the advancement required by piezosurgery dissection (Mectron Medical Technology, ADC Dental) extended to the inferior mandibular border (►**Fig. 4**).[6] The split is achieved combining the use of wedges osteotomes with gradual separation of the fragments (►**Fig. 5**) to visualize the neuromuscular bundle. At this time, we recommend to start the separation at the inferior border and then extending it backward. The force necessary to split the mandible should be small and if not, one should check for the completion of osteotomies.[7] A full video showing the steps is available in ►**Video 1**.

Video 1

Complete sequences of surgical technique during live surgery. Online content is viewable at: https://www.thieme-connect.com/products/ejournals/html/doi/10.1055/s-0038-1666788.

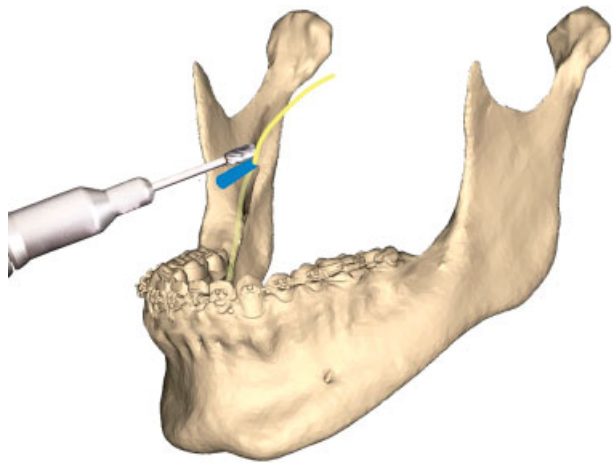

Fig. 1 Schematic representation of the mandibular osteotomy. Drilling of the internal oblique line is performed anteriorly to the lingua with an oval bur (blue). The alveolar nerve is yellow-inched.

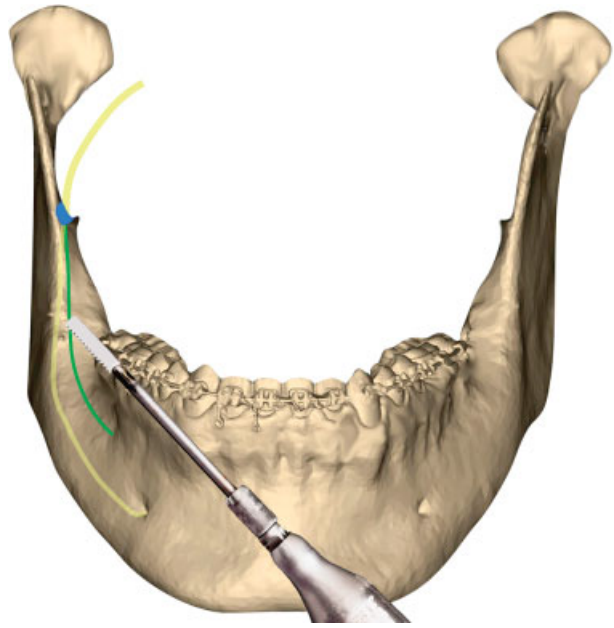

Fig. 2 The sagittal osteotomy with reciprocant saw starts from the drilled point, up to the lingual cortical with the planned distal vestibular corticotomy (green-inched).

In case of fusion between the lateral and medial cortices (medullary absence), the inferior alveolar canal, connected to lateral cortical bone, can be easily opened to safely release the nerve using piezosurgery. Rigid fixation is achieved with one plate with monocortical screws and then reinforced with a single bicortical screw or a second plate. Once hemostasis is performed, incisions are closed with a running suture of Vicryl Rapide (Ethicon Inc.).

Assessment of sensory alterations was conducted using three types of measures: (1) objective electrophysiological measures of nerve conduction, (2) sensory testing (stimulus) measures, and (3) patient report.[8]

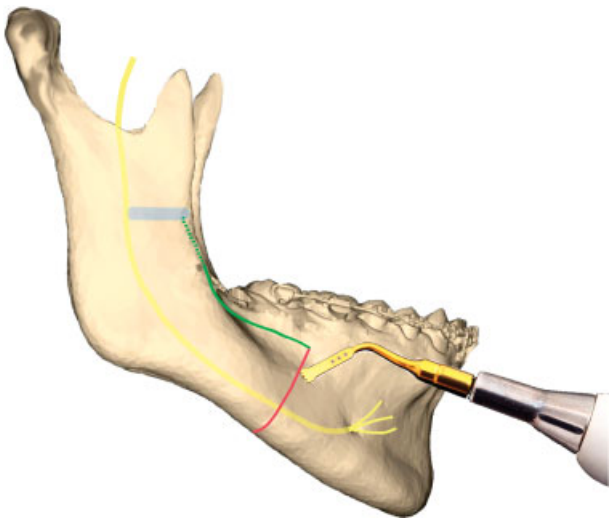

Fig. 3 External corticotomy is performed at the level of the first/second molar by piezosurgery (red-inched)

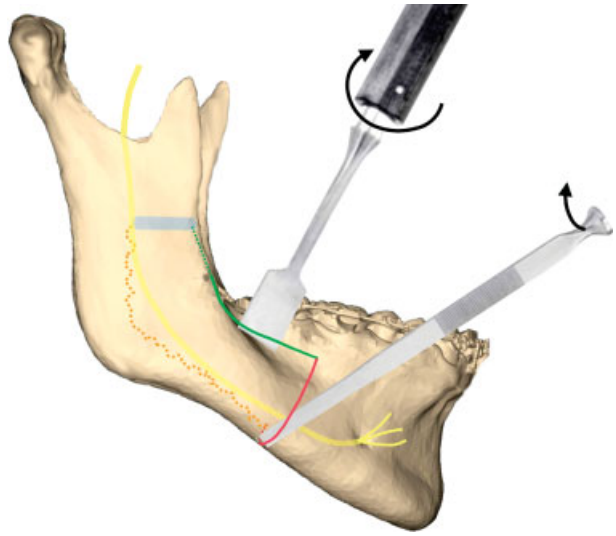

Fig. 5 The split is achieved combining the use of wedges osteotomes with gradual separation of the fragments (brown-inched) to visualize the neuromuscular bundle.

Results

A total of 310 patients (620 osteotomies) entered the study. The total time needed for a single osteotomy was evaluated and then compared with our previous experience with reciprocating saw only (410 patients; 820 osteotomies) (range 3–8, mean 4 minutes) and with piezoelectric devices only (290 patients; 580 patients) (range 7–12, mean 8 minutes) recorded on previous patients. In the present case series, the mean surgical time was 5 minutes (range 8–4 minutes) using a mixed technique (reciprocating saw and piezoelectric devices). Three sides (0.4%) experienced "partial external bad splits" recovered by piezosurgery with consequent osteotomies successfully completed and complications avoided. "Partial external bad splits" means the surgeon realizes that the split has not been performed completely since the external cortex (proximal segment) is not getting free due to some resistance in the deepest portion or some initial green stick fracture starts in the outer cortex. In one case (0.1%), mandibular canal was close to the inferior border of mandible and it was injured during SSO; although it was repaired by epineural suture, permanent monolateral hypoesthesia of the inferior right lip was reported after 1 year. In the present cases series, inferior alveolar nerve disturbances consisted in anesthesia and included thirteen sides (2%) at 12 months postoperatively.

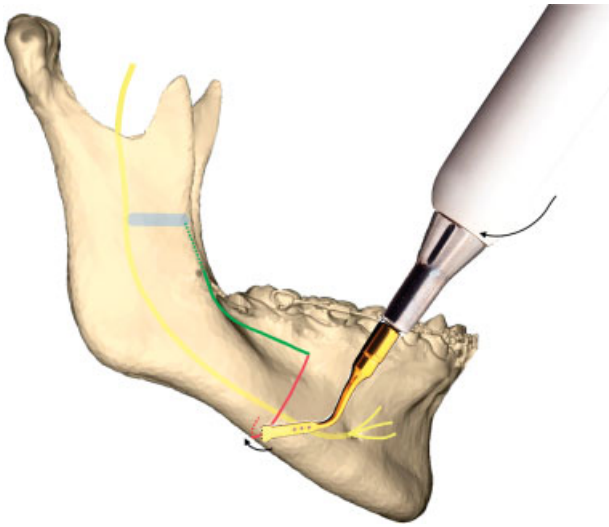

Fig. 4 The corticotomy is then extended to the inferior mandibular border (red-inched).

Discussion

The primary purpose of this retrospective study was to determine the effectiveness of this new surgical technique with special regard to the inferior alveolar nerve injury and the "bad split"-related complications. Piezosurgery involves the use of 60 to 200 µm/s ultrasonic microvibrations at 24 to 29 kHz to cut mineralized tissue, allowing soft tissue to remain unharmed at this frequency.[9] Piezoelectric devices ensure total preservation of the soft tissues including microvessels surrounding the perineurium of alveolar nerves, avoiding stretching, and warming of the nerve. This mechanism could explain the faster recovery and wound healing following piezoelectric surgery with the only disadvantage being the time.[10]

An unfavorable and unanticipated pattern of the mandibular osteotomy fracture is generally referred to as a "bad split." The literature shows the incidence of "bad" splits varies from 0.21 to 22.7%.[11]

Risk factors are a thin mandibular ramus, a high mandibular lingula, third molars, incorrect inclination of the osteotome, or even the inexperience or lack of attention of the surgeon. The most frequently reported bad splits were various unfavorable fracture patterns of the buccal plate of the proximal segment (52.7%) and lingual fractures of the posterior aspect of the distal segment (42.9%).[12] Bad split during "mandibular first protocol" in a bimaxillary sequence may preclude the

repositioning and fixation of the mandibular segments forcing to abort the subsequent repositioning of the maxilla.

In the literature, there is a wide variation in the reported incidence of inferior alveolar nerve disturbances following bilateral sagittal split; the reported range is from 0 to 85% at 12 or 24 months postoperatively compared with the 2% of disturbances of the present study.[13] The incidence of permanent nerve damage during bilateral SSO has been reported to vary from 1.3 to 80%, while in our sample we reported only one case of nerve transection (0.1%).[14]

In conclusion, mixed piezo/saw osteotomy has advantages over traditional "pure" methods in terms of precision, rapidity, easier and safer splitting, and decreased complications related to inferior alveolar nerve damage and bad split with reduced overall morbidity.

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