

# Intraoperative and Perioperative Complications in Anterior Maxillary Osteotomy: A Retrospective Evaluation of 103 Patients

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**Purpose:** To study the intraoperative and perioperative complications associated with anterior maxillary osteotomy (AMO), and assess its safety and predictability in orthognathic surgery.

**Patients and Methods:** We performed a retrospective evaluation of 103 patients undergoing AMO as a single procedure, or in combination with other osteotomies over a period of 5 years, with a mean follow-up of 3 years.

**Results:** Twenty-seven (26.2%) patients in our series of 103 had complications of varying severity: 43.3% of these were soft tissue-related, and 36.6% were attributable to dental causes. All other complications accounted for the remaining 20%.

**Conclusion:** Although its indications are limited, AMO is a safe and reliable procedure in routine orthognathic surgery.

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Anterior maxillary osteotomy (AMO) is a versatile procedure in the management of a variety of deformities of the anterior maxillary dentoalveolar component. The first description of AMO was given by Cohn-Stock in 1921. The procedure has evolved and is currently practiced in 3 popular variations: the

Wassmund, Wunderer, and down-fracture techniques described by Cupar, and later modified by Bell and Epker.<sup>1-6</sup> The Wassmund procedure involves only subperiosteal tunneling and no flaps, and maintains both the palatal and labial vasculature. The Wunderer method involves a palatal flap elevation with preservation of the labial pedicle, and is an out-fracture technique. The down-fracture method uses a circum-vestibular incision for labial osteotomies, and tunneling for the palatal osteotomy. Although both the Cupar and Wunderer techniques are versatile in their function, the down-fracture method is recommended when superior or combined superior and posterior repositioning is required, whereas the Wunderer techniques is useful for antero-posterior repositioning.<sup>1,2</sup> The Wassmund modification ensures the best vascularity.<sup>2</sup>

Indications for AMO in our study included:<sup>7-10</sup>

- 1) Bimaxillary dentoalveolar protrusion;
- 2) Anterior open bite;
- 3) Excessive inclination of anterior teeth;
- 4) Excessive vertical or anteroposterior development of the maxillary dentoalveolar process in patients where relationships between the posterior teeth are acceptable; and
- 5) Duration of treatment, a relative indication in the Asian Indian population, insofar as some patients

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**TABLE 1. NUMBER OF PATIENTS WHO UNDERWENT AMO ALONE OR IN CONJUNCTION WITH OTHER PROCEDURES, WITH DETAILS**

Surgical Procedure	Number of Patients
AMO only	67
AMO (anterior nasal spine not removed)	1
AMO (interdental osteotomy)	1
AMO + midline split	4
AMO + mandibular subapical osteotomy	13
AMO + genioplasty	10
AMO + lower subapical osteotomy + genioplasty	2
AMO + bilateral sagittal split-ramus osteotomy	3
AMO + bilateral sagittal split-ramus osteotomy + paranasal augmentation	1
AMO + bone substitute onlay	1

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want quick results and do not have adequate time for a formal orthodontic correction.

Although orthognathic surgery involves considerable scientific data and technical descriptions, the majority of studies concern total jaw procedures, and very little information is available on segmental osteotomy procedures such as AMO. This study involves a retrospective analysis of a series of 103 AMOs in a 5-year period with a mean follow-up of 3 years or more at a single center. Our aim was a discussion of perioperative complications involved in AMOs, to demonstrate the simplicity and reliability of this versatile procedure.

## Patients and Methods

The study involved a total of 103 patients treated at our center, where AMO was performed for a variety of indications, as described earlier. The period of study comprised 60 months between 1999 and 2004.

All patients underwent standardized presurgical clinical evaluation, including radiological, model, and cephalometric analysis. A thorough presurgical anesthetic evaluation was conducted. The procedure was performed under general anesthesia with nasotracheal intubation. A routine postoperative regimen of analgesics, anti-inflammatory, and antibiotic drugs followed. All patients were discharged on the first or second postoperative day. The normal follow-up regimen included fortnightly reviews for the first 2 months, followed by recalls every 6 months.

An analysis of surgical and postoperative records was performed to evaluate complications reported

intraoperatively and in the perioperative period, excluding long-term undesirable effects such as relapse patterns. All short-term complications were taken into account during the postoperative period.

## Surgical Procedure

Osteotomies were performed under general anesthesia by different attending surgeons in the unit, and 2 modifications of AMO were used: a modified version of Cupar's procedure, and Epker's modification of Cupar's procedure.<sup>1,5</sup> Cupar's procedure involves a down-fracture method of AMO, with a horizontal circum-vestibular incision on the labial aspect, and tunneling on the palatal aspect. Epker's modification includes horizontal circum-vestibular and vertical incisions near the tooth to be extracted. The former was used in 49 procedures, and the latter in 54 procedures. Seventy-one patients received hypotensive anesthesia, whereas 32 were maintained normotensively. The AMOs were performed isolated, or in conjunction with other osteotomies. Details are presented in Table 1. Details of the site of buccal osteotomy and the dental extraction performed for the procedure are indicated in Table 2. All osteotomized segments were stabilized with stainless-steel miniplate fixation, using a 1.5-mm system. Fixation was performed with L-shaped 4-hole plates in 102 patients, whereas 1 patient received straight plates.

## Complications

Complications were analyzed under different categories as problems with airways, mechanical problems, hemorrhage, vascular complications, and soft-tissue injuries (Table 3).

### PROBLEMS WITH AIRWAYS

One patient had an intraoperative perforation of the endotracheal tube, caused by the surgical drill.

**TABLE 2. SITES OF BUCCAL OSTEOTOMY AND TEETH EXTRACTED FROM PATIENTS**

Site of Buccal Osteotomy, With Tooth Extracted	Number of Patients
Right and left maxillary first premolars	85
Right and left maxillary second premolars	15
Edentulous space of right maxillary second premolar and extracted left maxillary second premolar	1
Edentulous space of right maxillary second premolar and left maxillary second premolar	1
Interdental osteotomy	1

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**COMPLICATIONS ENCOUNTERED WITH NUMBER OF PATIENTS IN EACH CATEGORY**

Type of Complication	Number of Patients (n = 27)
Airway	1
Hemorrhage	1
Dental	
Dental hypersensitivity	9
Undesirable occlusion	1
Increased interdental spacing	1
Soft tissue-related and vascularity-related	
Palatal tear	11
Buttonhole defect	1
Palatal hematoma	1
Partial necrosis	1

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This was immediately identified. The damaged tube was removed, and the patient was reintubated intraoperatively. There was no significant problem with the intraoperative monitoring parameters, and the postanesthetic recovery was uneventful.

#### MECHANICAL PROBLEMS

##### *Difficult Down-Fracture*

Difficulty in down-fracturing the osteotomized segment was evident in one patient. The cause was not reported in the data. However, the procedure was completed with extra time and effort.

##### *Delayed Union of Fragments*

Two patients manifested a delayed union of osteotomy segments in the form of mild mobility. The mobility was self-limiting and resolved spontaneously after 16 postoperative weeks, and required no further surgical intervention.

##### *Palpable Implants*

One patient complained of a palpable miniplate intraorally at the osteotomy site. There was no breakdown in overlying mucosa. The plates were electively removed after 12 postoperative weeks of consolidation.

#### HEMORRHAGE

There was 1 case of excessive bleeding during the procedure, but no mention of any identifiable cause. No life-threatening form of bleeding was present, and the postsurgical recovery profile was uneventful.

#### DENTAL COMPLICATIONS

The most common postoperative dental complication was hypersensitivity of the teeth after osteotomy. These patients were checked for pulpal response

postoperatively, and 9 patients demonstrated a lower threshold to the electronic pulp tester.<sup>11</sup>

#### OTHERS

One patient had to be operated upon again because of an unsatisfactory postsurgical esthetic outcome. A shift of the dental midline was evident in 1 patient, and the wrong tooth was removed from 1 patient, ie, a maxillary second premolar instead of the first premolar, as planned. Increased interdental space at the osteotomy site was recorded in 1 patient, and was resolved using an implant and crown.

### Soft Tissue Injuries and Vascular Considerations

#### PALATAL MUCOSAL TEAR

Palatal mucosal tear was the most frequently encountered complication, and was evident in 11 patients. All these patients had small, palatal lacerations in their free gingival margin, because of excess mucoperiosteal tunneling in the palatal aspect. One patient had a buttonhole tear in the midpalatal region. However, the healing of the osteotomized segment was uneventful. The importance of the integrity of the palatal mucoperiosteum in the down-fracture technique and of its attachment to the underlying osteotomized segment is well-documented, and must be maintained with great care.<sup>12-14</sup>

#### PALATAL HEMATOMA

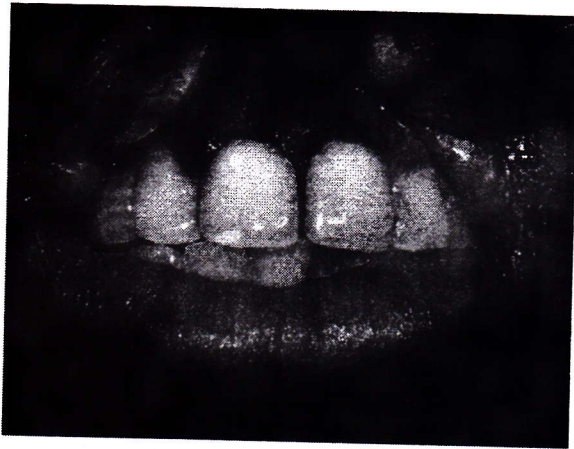
One patient had a palatal hematoma that required no additional intervention. It resolved spontaneously by postoperative day 5.

#### PARTIAL NECROSIS OF SOFT TISSUE

A severe complication in the form of partial mucosal necrosis at the osteotomy site was recorded in 1 patient in whom a circum-vestibular incision with a vertical release incision was used. The entire labial alveolar mucosa, including the free and attached gingiva, showed signs of necrosis, starting on the first postoperative day (Figs 1, 2). However, the necrosed gingiva was exfoliated, and healed completely by postoperative day 50 (Fig 3) because of the good granulation of the osteotomized bone segment.

### Discussion

Anterior maxillary osteotomy is a reliable, simple procedure in the management of deformities of the dentoalveolar region. However, the literature offers very little information about this procedure. The necessity of AMO has declined because of recent advancements in orthodontic-orthognathic treatment



**FIGURE 1.** Intraoral photograph on first postoperative day shows necrosis of labial mucosa over osteotomized segment.

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**FIGURE 3.** Intraoral photograph on postoperative day 50 shows granulation occurring over denuded bone spots and healing of osteotomy segment in premolar region.

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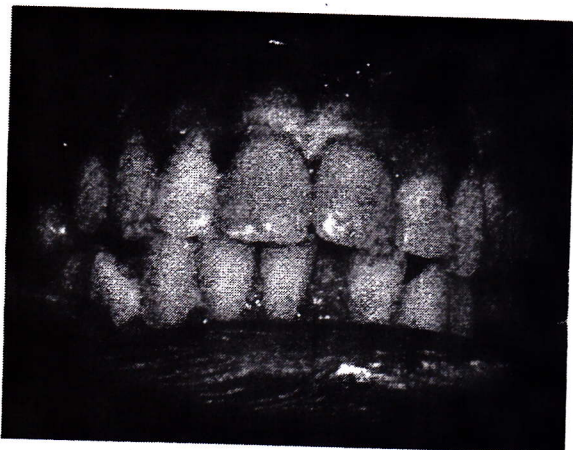
preparations. The scope for a discussion of complications of AMOs is mostly restricted to books, and lacks recent additions.

The spectrum of complications associated with AMOs is very similar to that reported in Le Fort I osteotomies<sup>14</sup> and varies greatly, from minor problems with dental hypersensitivity to fear of loss of an osteotomy segment because of avascular necrosis. However, few complications are exclusive to AMOs that are significantly different from those encountered during a Le Fort I osteotomy, and these merit special mention. Difficulty in planning for surgery, with consideration of the movement desired and the vascularity, calls for attention.<sup>2,12,13</sup> Thirty percent of the patients in this series of 103 procedures had compli-

cations attributable to different causes. Most commonly observed were soft tissue injuries (43.3%) and dental complications (36.6%). All other complications accounted for the remaining 20%.

Mechanical and technical difficulties in AMOs depend to a great extent on the technique employed. The difficulty in performing an AMO is attributable to restricted access for a palatal osteotomy, especially with the down-fracture method. Inexperience in performing the procedure can lead to intraoperative complications such as difficulty in down-fracturing the segment, as recorded in 1 case where a resident performed the procedure. Delayed union in the maxillary segments is another complication that must be addressed. The healing of a maxilla is more fibroosseous in nature, compared with the true bony union of the mandible.<sup>12</sup> This may be delayed in certain cases by poor bone contact, improper fixation or stabilization of segments, or infection at the osteotomy site. Two delayed unions were reported, but without evidence of infection or inadequate fixation.

The most frequent complication in our series was injury to the palatal mucoperiosteum, in the form of tears in the free gingival margin, which in some cases extended across the attached mucosa. One patient had a buttonhole defect on the palatal vault. Aggressive instrumentation and use of excessive force were documented as the main reasons for this problem. Careful instrumentation and the gentle handling of tissues should maintain absolute integrity of the flaps, which is essential in maintaining good vascularity during segmental osteotomies. One patient had a large palatal hematoma in the apex of the vault that regressed spontaneously after 5 days, without any intervention.



**FIGURE 2.** Intraoral photograph on postoperative day 30 shows denudation of bone over central incisors and near canine, first premolar region.

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Dental complications were the second most prevalent. Nine patients reported persistent dental hypersensitivity in the maxillary anterior teeth. This may be attributed to the increased pulpal blood supply in the osteotomized segments between postoperative weeks 1 and 3, representing hyperemic and hyperactive pulp.<sup>11,15,16</sup> Endosteal, periosteal, and pulpal vascularity suffer transient ischemia in the immediate postoperative period. Within a week, there is increased vascular refill, and minimal evidence of intrasosseous or intrapulpal ischemia.<sup>16</sup>

Undesirable postoperative occlusion can be prevented by proper surgical planning and accurate re-creation of the model surgery, with the use of constructed occlusal guidance splints. The use of rigid-fixation methods in osteotomies necessitates meticulous planning and attention to technique, because subsequent manipulation with elastics may not be possible.

Hemorrhage was indicated as the most common complication in maxillary orthognathic surgery.<sup>14</sup> In contrast to the incidence of life-threatening hemorrhage in the case of Le Fort I osteotomy, its occurrence in AMO is less significant. In contrast to a Le Fort I osteotomy, where the proximity of the maxillary and descending palatine arteries to the osteotomy site may be responsible for the increased risk, the AMO poses no significant risk in terms of major hemorrhage. The necessity for transfusion, secondary to severe blood loss, never arises. However, 1 patient in our series exhibited a brisk and persistent ooze that could not be attributed to any specific cause.

This series reported on 2 rare complications that are nonetheless of significant interest. One patient had partial mucosal necrosis of the labial mucosa in the osteotomized segment. The labial mucosa of the osteotomized segment underwent complete necrosis, and the entire labial gingiva was exfoliated. The denuded bone was kept clean with saline washes, and the patient was subjected to regular observation. The gingiva healed completely by postoperative day 50, via granulation of the osteotomized bone segment. Granulation over the bone showed that the osteotomized segment was not devascularized. An important detail in this patient concerned the incision design, ie, Epker's modification of the down-fracture method, where the labial vertical release was over the second premolar, rather than the conventional first premolar extraction. A transient kinking of the palatal pedicle, with a larger mucosal area depending on the periosteal supply for vascularity, and transient ischemia during the mobilization may be regarded as the etiology for this event.<sup>13,17</sup> Another cause may have been the hypotensive field maintained during the surgical procedure.

The other rare complication encountered in this series was damage to the endotracheal tube by the

drill. This is a potentially hazardous complication, underscoring the importance of protecting the secured airway in orthognathic procedures, insofar as both the surgeons and the anesthetists share the same anatomical region. The use of good monitoring devices, including end-tidal CO<sub>2</sub> monitors, are mandatory in such surgeries, and allow for the detection of such complications at a very early stage, and enable immediate intervention and management.

The form of AMO that was extensively practiced in the early days of orthognathic surgery has been slowly phased out, owing to advancements in orthodontic-surgical treatment planning and management, and better results using planned full-jaw procedures. We present this series to indicate that the AMO, although seldom used these days, is still very reliable and simple in the hands of a skilled surgeon in the management of dentoalveolar deformities, especially in patients with no orthodontic adjunct.

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