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Morbidity related to "endo-corticotomies" for transpalatal osteodistraction☆

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SUMMARY. Introduction: **The objective of this study was to evaluate morbidity arising from transnasal, endoscopically assisted corticotomies for transpalatal osteodistraction. This minimally invasive technique utilizes three 1-cm incisions in the nasal vestibule instead of the classical, two lateral and one medial oral vestibule incisions of 2–3 cm and 1 cm long, respectively.** Material and methods: **Fifty-nine patients (33 females and 26 males; age range: 9–50 years, mean 20 years) who underwent surgery in the hub hospital by the senior surgeon were included in a prospective registry. Patients with congenital maxillary hypoplasia were excluded. Difficulties were systematically recorded.** Results: **Mean operative time was 68 min (SD: 15 min) when no other procedures were combined with the transpalatal osteodistraction. Ten difficulties unrelated to either the device or oral hygiene were encountered: rhinorrhoea and minor nasal obstruction (1), nasal bleeding with hospital admission (1), periostitis at the piriform aperture that necessitated revision using local anaesthesia (1), periostitis with spontaneous healing (1), postoperative pain (2), dermatitis (1), infraorbital ecchymosis (1), excessive postoperative oedema (1), and prolonged cheek hyperaesthesia (1).** Discussion and conclusion: **Operative time as well as both percentage and nature of complications was similar to those experienced with "open-sky TPD" (transpalatal distraction), with less pronounced oedema and patient surgical threshold decreased.**

Keywords: **surgery, endoscopic, osteogenesis, distraction, palatal expansion technique, osteotomy, Le Fort**

INTRODUCTION

Tooth-borne, surgically assisted, rapid palatal expansion (SA-RPE; *Brown*, 1938; *Glassman* et al., 1984) and bone-borne transpalatal distraction (TPD) osteogenesis (*Mommaerts*, 1999; *Van Hemelen* et al., 2006) both rely on Le Fort I-level corticotomies and on the dysjunction of the medial palatal suture area for segmental mobility. Septal dysjunction is not necessary; pterygoid dysjunction is only needed when parallel expansion in the axial plane is necessary (*Matteini* and *Mommaerts*, 2001).

Morbidity is always of great concern in elective surgery; approaches to corticotomies have been modified accordingly. Vertical incisions into the oral vestibule (*González Lagunas* et al., 2005) as well as a transnasal approach (*Mommaerts*, 2004) have been proposed. The latter makes use of an endoscope to visualize the horizontal corticotomies in the subperiosteal tunnels. This appealing technique, called "endo-corticotomy for TPD", was in need of (an) evaluation.

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PATIENTS AND METHODS

A prospective clinical study was initiated in 2003 and included 59 patients who underwent endo-corticotomies for non-congenital TPD between February 2003 and July 2005. There were 33 female and 26 male patients, with a mean age at the time of surgery of 20 years, 11 months (min: 9 years, 4 months; max: 50 years, 5 months). All procedures were performed at the same institution (St. Jan General Hospital, Brugge, Belgium) by a single surgeon (M.M.). All jaws underwent bilateral expansion except for three. Pterygoid dysjunction was performed in 13 cases and impacted third molars were removed in 34 cases (57%). Five patients also underwent transmandibular osteodistraction (*Mommaerts*, 2001). The following data were tabulated in a spreadsheet: patient name, birth date, age, gender, angle class, bilateral/unilateral expansion, size TPD, pterygoid dysjunction performed (y/n), date of procedure, accompanying procedures (TransMandibular Distraction (TMD), third molar removal), operative time, latency period, difficulties (excessive oedema, pain, haematoma, nasal bleeding, nasal congestion, nerve injury, and infection), lip posture, and end of follow-up period. Difficulties related to the device and oral hygiene were also assessed but were not evaluated in this study. Inadvertent asymmetrical expansions were also not included since they

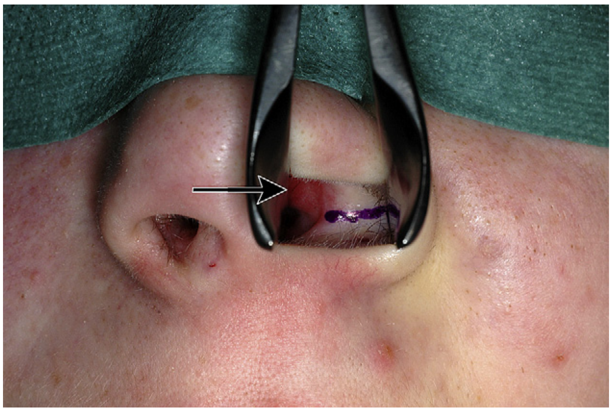

Fig. 1 — Marking of the horizontal incision in the nasal vestibule. The arrow points to the inferior turbinate.

are unrelated to the experimental approach. Raw data are available upon request.

Paley's classification of the clinical difficulties encountered was used to allow comparison with an historical control group (*Neyt* et al., 2002). In this classification, a "problem" represents a difficulty that does not require operative intervention during the distraction treatment in contrast to an "obstacle". A "complication" is a difficulty that remains unresolved at the end of the consolidation period. A complication is considered "major" if it requires operative intervention or "minor" if it can be resolved non-surgically.

SURGICAL TECHNIQUE

The endo-corticotomy technique for TPD has been described previously (*Mommaerts*, 2004). In the course of this study, two modifications were introduced and later abandoned. This deserves a proper description.

Orotracheal intubation was used; it was also employed when other intraoral procedures were to be performed. As it is impossible to check dental occlusions after intubation, the decision to perform either anterior or parallel TPD (*Pinto* et al., 2001; *Matteini* and *Mommaerts*, 2001) must be made preoperatively. Distractor placement can be done either before or after the corticotomy procedure, but preferably preferentially prior to port-site wound closure.

The lateral nasal vestibule and membranous septum were infiltrated with a local anaesthetic solution containing a vasoconstrictor. This must be done preferably before the distractor is installed so that the lateral corticotomy tunnels will be relatively blood-free. A horizontal incision, approximately 1-cm long, was made at the level of the piriform aperture, just below the level of the inferior turbinate (Fig. 1). A sharp dissector[1] tunnelled the mucoperiosteum of the nasal wall for approximately 1.5 cm; the facial wall was also tunnelled cranially to the tooth apices up to the zygomatic buttress.

[1] E.g., Marchac 2 mm periosteal elevator, Stryker Leibinger, Freiburg, Germany.

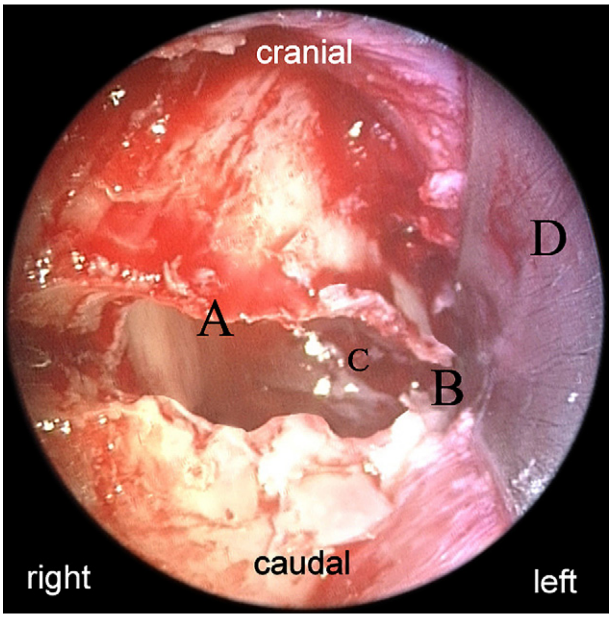

Fig. 2 — Endoscopic view in the cheek tunnel. (A) Osteotomy in the piriform aperture. (B) The osteotomy at the zygomatic buttress needs further widening. (C) Part of the posterior wall osteotomy is visible. (D) Dautrey retractor.

A short, thick Lindemann bur[2] mounted on a 21° angled micro handpiece[3] was used to transect the anterior support; the nasal mucoperiosteum was protected by the sharp narrow-ended dissector and the facial mucoperiosteum was retracted by a larger periosteal elevator.

A straight Dautrey medium spoon retractor[4] was hooked behind the buttress. A standard, orthopaedic, 25° offset-view angle straight endoscope[5] or a wide angle forward-oblique telescope of 30°[6] was used to verify the position of the tunnel as it related to the tooth apices and the infraorbital nerve, and to visualize the strict subperiosteal tunnelling. A round drill bit (3.5 mm) on a medium-long shaft[7] was used to transect the canine fossa and the lateral support (zygomatic buttress) (Fig. 2). At this stage, endoscopic control is necessary to confirm the complete transsection of the lateral aspect of the zygomatic buttress. Further sectioning of the posterolateral sinus wall was performed by a transantral approach using a 3.5-mm drill bit on a 95-mm long shaft.[8] Finally, a 5-mm round drill bit on a 70-mm medium-long shaft[9] was used to enlarge the osteotomy in the zygomatic buttress, and hence, avoiding premature bony contacts upon expansion. The other side was prepared similarly.

The modifications relate to the horizontal osteotomies. Two devices used for endoscopic subcondylar fracture treatment were adapted to allow for drilling under direct

[2] Komet, Lemgo, Germany.
[3] Aesculap, Tuttlingen, Germany.
[4] Pilling Weck Canada L.P., Markham, Ontario.
[5] Panoview plus — R. Wolf, Knittlingen, Germany.
[6] Karl Storz GmbH, Tuttlingen, Germany.
[7] 70 mm — Komet, Lemgo, Germany.
[8] Komet, Lemgo, Germany.
[9] Komet, Lemgo, Germany.

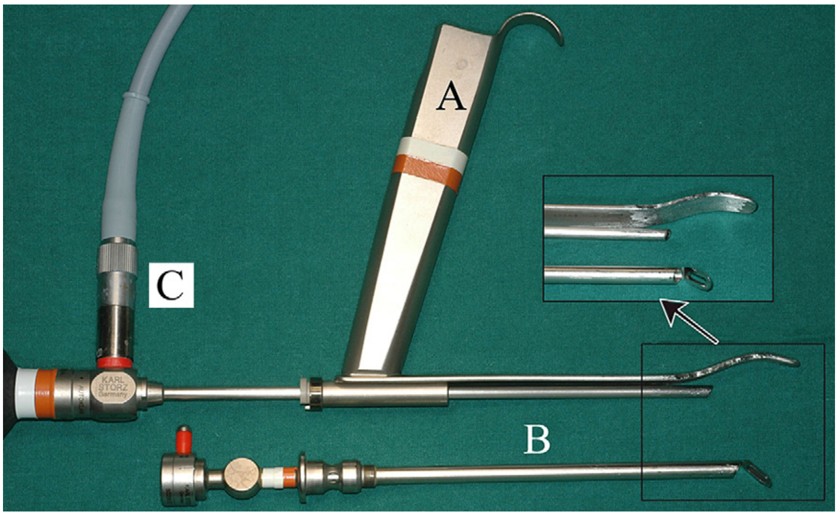

Fig. 3 – The instruments that were used for direct endoscopic control during the osteotomy procedure. (A) Modified optical retractor, with handle, width of distal end 8 mm reduced to 5 mm, with fixation screw for control of penetration depth of endoscope, with telescopic sheet (Karl Storz GmbH, Tuttlingen, Germany). (B) Optical dissector, with distal spatula, fenestrated, small, sharp, for use with Hopkins® Telescopes 30° (Karl Storz GmbH, Tuttlingen, Germany). A and B allow direct vision of the drill bit in work, but smudging of the lens made these instruments impractical. (C) Wide angle forward-oblique telescope 30°, enlarged view, diameter 4 mm, length 18 cm (Karl Storz GmbH, Tuttlingen, Germany).

visualization. One problem with the modifications (Fig. 3) was the multitude of instruments used simultaneously in the port: the endoscope in the retractor, the suction device, and the micro handpiece. The main problem, however, was that the surgical cavity could not be sealed. Hence, irrigation for cooling had to be suctioned and the lens was quickly smudged by blood and bone debris.

The median support (mid-palatal suture area) was also addressed by a transnasal approach. A 1-cm horizontal incision was made in the membranous septum (Fig. 4) and mucoperiosteal dissection was performed over the anterior nasal spine. An 8-mm wide, sharp osteotome[10] was hammered and wedged into the suture, not deeper than the incisive canal(s), and used to mobilize the maxillary halves (Fig. 5). The wounds were closed with polyglactine 910.[11] When pterygoid dysjunction was needed, two 5-mm long vertical incisions behind the maxillary tuberosities were often required to position the curved osteotomes.

RESULTS

The average operative time for the 17 cases that did not receive transmandibular osteodistraction, pterygoid dysjunction, or third molar removal was 68 min (SD: 15 min). This time included incision until the end of anaesthesia.

The latency period lasted an average of 8 days (SD: 1.5 days).

Ten difficulties unrelated to the device or oral hygiene were encountered. Seven were described as "problems", two as "obstacles" and one as "minor complication". Major complications were not seen. The seven problems included rhinorrhoea and minor nasal obstruction up to 2 months postsurgery (1), postoperative pain (2) in which one patient had headaches upon activation, dermatitis around the nasal base and upper lip (1), infraorbital ecchymosis (1), periostitis for 4 months at the piriform aperture (1), and excessive postoperative oedema (1). The obstacles found included nasal bleeding (1) with hospital admission and periostitis (1) at the right piriform aperture in a heavy smoker. Antibiotics did not relieve hypersensitivity. Lysis of the scar tissue using local anaesthesia 1 month postoperatively resolved this. The minor complication was hyperaesthesia in the cheek that lasted for 6 months.

Nine difficulties were related to the TPD device (five technical, four inflammatory difficulties, and one palatal artery bleeding with hospital admission), but are not the focus of this investigation.

Four asymmetrical expansions were noted. Three could be resolved by cross-elastics prior to the end of the consolidation period, whereas one received a planned Le Fort I osteotomy in a second surgical session and the off-centre position of the maxilla was handled at the same time. Reasons for asymmetrical expansion are likely due to differences in resistance (pterygoid plates/tuberosity anatomy, lateral nasal wall thickness, interference at the zygomatic buttress [should have been prevented], and the patient seeking positional comfort by choosing one side over the other for interdigitation).

DISCUSSION

Rohner et al. (2001, 2003) reported endoscopically controlled osteotomies at the Le Fort I-level in six cadavers and two patients. Four vertical entry incisions, at the piriform aperture and at the zygomatic buttress, were used. Plating was performed under direct visualization. The

[10] Martin Gebrüder AG, Tutlingen, Germany.
[11] Vicryl rapide 5-0, Ethicon, Dilbeek, Belgium.

Fig. 4 — Marking of the incision on the caudal septum.

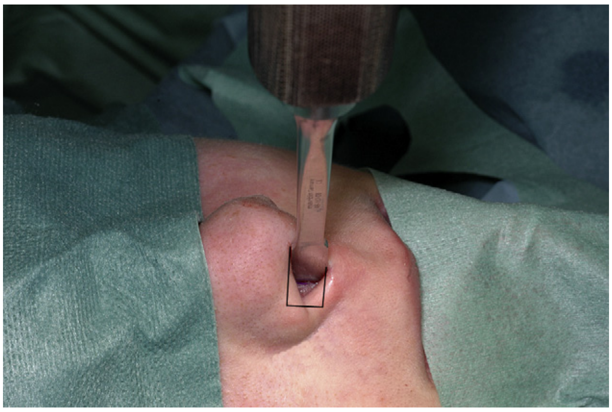

Fig. 5 — An 8-mm sharp osteotome (Martin Gebrüder AG, Tuttlingen, Germany) with heavy handle with which to apply torque. A less manoeuverable handle would tempt the surgeon to drive the osteotome deeper, hence endangering the contents of the incisive canal(s).

clinical procedures lasted for 1.5 h and lower oedema was reported.

Wiltfang et al. (2002) and *Wiltfang* and *Kessler* (2002) studied endoscopically controlled maxillary osteodistraction in four human cadavers and three patients. In two patients, they performed a transverse maxillary expansion with tooth-borne devices; in one patient, they used a buried distractor to correct a sagittal growth deficit. They also made use of a visualization port to the maxillary sinus.

Endoscopic pterygomaxillary dysjunction has been attempted for Le Fort I-type osteotomies with a similar entry technique (*Sakai* et al., 1996); the use of a long bur, distant soft tissue support for the hand, and difficulties providing for entries for both endoscope and drill makes this a hazardous task when done via an entry incision in the nasal vestibule.

In general, the advantages of endoscopy in digestive tract surgeries are decreased morbidity, both early and late, quicker recoveries with a reduction in the length of hospitalization, a reduction in attendant costs of medical care, and an earlier return to work (*Ure* et al., 1995; *Guller* et al., 2004). Disadvantages include higher hardware costs, a prolonged learning curve, longer operative time, and an incidence of rare but potentially severe complications (*Gainant*, 2003).

The digital time recordings of 17 patients who had undergone consecutive surgeries by the then-used open-sky approach by the same surgeon from January 2002 to January 2003 were averaged. No other procedures besides TPD were performed. From incision to discharge from the operating room, the average time was 62 min (SD: 17 min). Hence, there was no time difference between an endoscopically performed procedure and an open-sky procedure.

We have compared this series of 59 consecutive endo-TPDs with the 57 consecutive open-sky TPDs (*Neyt* et al., 2002). In both series, 10 (17%) non-device related difficulties were listed and were quite similar: nasal bleeding and ecchymosis/haematoma were listed as problems encountered and one prolonged sensitivity problem (hyposensitivity/hypersensitivity) in the infraorbital region as a minor complication. Wound infections in the open-sky approach presented as frank cheek abscesses (problems); in the endo approach, infections included periostitis in the piriform aperture (one problem and one obstacle).

Fifty-nine transnasal endoscopically controlled corticotomies do not appear to result in decreased morbidity; hospitalization length did not change. Both the open-sky oral vestibule approach and the endoscopic nasal vestibule approach were day-case operations. Costs did not increase since a standard orthopaedic endoscope was used and no extra surgical instruments had to be purchased.

Although not measured in this study, facial oedema was less pronounced and more quickly resolved due to the tunnelling technique that avoids more extensive mucoperiosteal stripping and muscle transaction.

Another advantage appears to be the positive perceptions of both patients and referring doctors towards this minimal access surgery.

CONCLUSION

Compared to the gold standard, open-sky TPD, the endo-TPD has no drawbacks. Complications of the corticotomy procedure are similar in number and nature.

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