The surgical technique of vertical subcondylar osteotomy for correction of mandibular prognathism

A 10-year survey

Knut Tornes and Ole T. Gilhuus-Moe
Departments of Maxillofacial Surgery, Haukeland Hospital, and
Oral Surgery/Oral Medicine, University of Bergen, Bergen, Norway

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In the period 1975–1985 extraoral vertical, subcondylar osteotomies of the mandibular ramus (EVSO) were performed in 203 patients with mandibular prognathism at Haukeland University Hospital, Bergen. Refinements of this surgical technique are described. Clinical and surgical observations were analyzed as to preoperative orthodontic treatment, operation time, pre-/post-operative complications, and hospital stay. The findings confirm that the EVSO procedure is a safe technique, with minimal discomfort and morbidity for the patients. Even though intraoral procedures are the trend for surgical correction of mandibular prognathism at present, there are substantial indications for the use of EVSO. □ *Mandibular prognathism; surgery*

Knut Tornes, Department of Maxillofacial Surgery, 5016 Haukeland Sykehus, Bergen, Norway

Surgical correction of mandibular prognathism has long traditions (1–3), and various methods have been described (4–13). At present vertical osteotomies and sagittal splitting of the mandibular ramus are the operations most favored by oral surgeons (14–16).

Vertical subcondylar osteotomy, also called oblique sliding osteotomy, of the mandibular ramus is performed by an extraoral (EVSO) or an intraoral (IVSO) approach. The EVSO was the first technique described, and later reports on the surgical techniques, refinements of these, and the stability of the resulting postoperative intermaxillary relations have been published (17, 18). Hall et al. (19) suggested in 1975 that the intraoral technique may be the better one, and stated in 1980 (20) that the IVSO is preferred to the older extraoral technique in most instances. Niebergall & Mercuri (21), in a questionnaire to the Oral and Maxillofacial Surgery Program Directors in The United States, observed that for correction of mandibular prognathism the IVSO was the surgical preference in 60% and the EVSO in 18%. In Norway the EVSO has been widely used, but the IVSO has dominated in recent years (16).

In our department the EVSO has been a routine procedure in the treatment of mandibular prognathism since 1968. During this time we have gradually simplified and refined our technique. The aims of this report are to present our surgical technique, and to discuss per- and post-operative factors, and to evaluate the morbidity related to this procedure. The latter is of particular importance when analyzing the cost/benefit of any surgical procedure.

Materials and methods

In the period 1975–1984 the EVSO was performed on 203 patients with true mandibular prognathism at the Department of Maxillofacial Surgery, Haukeland Hospital, Bergen. The operations were performed mainly by us and to some extent by residents assisting one of us. The sex and age distributions of the patients are given in Table 1. The mean age of the patients at the time of surgery was 24.2 years.

Table 1. Age and sex distribution of 203 patients*

	Age groups, years							
	15–19	20–24	25–29	30–34	35–39	40–49	>50	Total
Female, *n*	39	33	15	3	9	6	2	107
Male, *n*	19	50	15	4	4	4	0	96
Total, *n*	58	83	30	7	13	10	2	203

* Mean age, 24.2 years.

Preoperative planning

The diagnosis of mandibular prognathism was based on cephalometric analysis and clinical findings. Only patients with true mandibular prognathism or with a maxillary deficiency and a prognathic mandible, in whom the latter was the major problem, were operated on with this technique (Table 2). Patients with open bite exceeding 2 mm were treated with other surgical procedures.

Of the 203 patients, 174 (86%) had had orthodontic treatment before surgical correction. The total period of orthodontic treatment, including orthodontics not directly related to the surgical procedure, is shown in Table 2. The younger age groups had the longest treatment time. No differences were found between the sexes.

Cap splints were adapted on 27 patients; in 2 edentulous patients Gunning splints were constructed for the intermaxillary fixation.

The patients were admitted to the hospital 1–2 days before surgery. All patients had been medically evaluated before the presurgical orthodontic treatment. On admission routine physical examination was carried out, including standard laboratory tests.

Surgical technique

All patients in this study were operated on with the following technique: after preoperative medication, general anesthesia via the nasoendotracheal route was performed. The skin area adjacent to the incision line was surgically draped. The inferior border and the angle of the right mandible and the proposed site of the skin incision were outlined with a surgical pen (Fig. 1). A slightly curved incision of 2–3 cm was made, starting just below the ear lobe and 1 cm posterior, parallel to the mandibular posterior border. This incision was not supposed to be caudal to the mandibular angle. The incision was carried through the skin, and the subcutaneous fat tissue was bluntly dissected. The incision was then pulled anteriorly with retractors to the posterior part of the masseter muscle. No attempt was made to identify the facial nerve. By blunt dissection with scissors through muscle and periosteum the lateral surface of the mandibular ramus was exposed. With a specially fitted retractor, subperiosteal visualization of the lateral mandible from the sigmoid notch to the mandibular angle was achieved.

Table 2. Preoperative diagnosis/orthodontic treatment

Diagnosis	Duration of orthodontic treatment					No orthodontic treatment	Total
	<1 year	1–2 years	2–3 years	3–4 years	>4 years		
Prognathism, *n*	28	42	23	10	22	26	151
Prognathism/ laterognathism, *n*	10	6	2	2	5	1	26
Prognathism/ apertognathism, *n*	4	4	9	2	5	2	26
Total, *n*	42	52	34	14	32	29	203

Table 3. Peroperative hemorrhage

Estimated blood loss				
<50 ml	51–100 ml	101–200 ml	201–300 ml	301–500 ml
147	47	5	3	1

The posterior border of the mandibular ramus and the deepest point of the sigmoid notch were used as guidelines, bringing the osteotomy superior/posterior to the mandibular foramen. The bony cut was performed with a Lindemann bur or a crosscut fissure bur and a dental handpiece. After osteotomy and mobilization of the proximal fragment and stripping of the periosteum and muscle tissue attachment on the medial aspect of the proximal fragment, this was positioned lateral to the major distal fragment. The fragment was left mobile, and no direct wiring was used. Coronoidotomy was performed in two patients. The wound was packed with saline-moistened gauze, and an identical procedure was then performed on the left side.

Intraorally the mandible was placed in the planned new relationship to the upper jaw and fixed to it with elastics or 24-gauge steel wires. A preformed occlusal splint was used when the new occlusion was not ideal and the patient needed postoperative orthodontic treatment. The intermaxillary fixation was augmented by nasomandibular wiring in 35 patients in whom a tendency to open bite was anticipated.

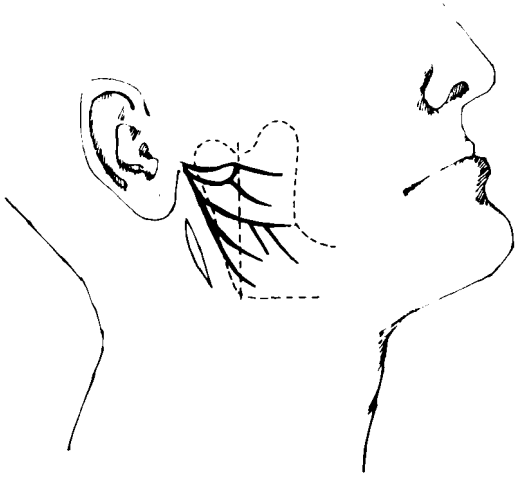

Fig. 1. Schematic sketch showing incision line, position of the facial nerve, and outline of the osteotomy in the ascending ramus.

The positions of the proximal fragments were checked. In five patients a lateral angulation of the condylar fragment occurred, resulting in poor bony contact. In these cases a small triangular piece of bone in the area of the sigmoid notch was removed, enabling a medial rotation of the proximal fragment. The wound was closed in layers; however, sutures were avoided in the parotid gland tissues.

Operation time, estimated blood loss, the use of skeletal fixation, and peroperative complications were registered. Prophylactic antibiotics were used only when contamination from saliva was suspected.

All patients received prophylactic antiemetic treatment (perphenazine, 5 mg) 10 min before the end of the operation. Postoperative nausea and vomiting were, however, observed in some patients. Since all patients received the same anesthetic agent (nitrous oxide–narcotic–relaxant combination) and procedure except for premedication, the relationship between the drugs used in premedication and the postoperative nausea and vomiting was evaluated.

After discharge from the hospital the patients were checked weekly until removal of the intermaxillary fixation 6 weeks postoperatively. Later follow-up studies were done in collaboration with the orthodontist at 6 and 12 months after surgery.

Prophylactic antibiotics

In 50 (25%) patients antibiotics were administered. Penicillin was the drug of

choice; two patients allergic to penicillin were given erythromycin. The indication for prophylactic antibiotic treatment was the possibility of any salivary contamination of the surgical field during the operation. Some patients were given antibiotics because nasopharyngeal pathogenic bacteria were discovered preoperatively; however, the patients had no clinical symptoms of infectious disease. Surgery was postponed in any patient with manifest nasopharyngeal infection.

Results

Operation time

The operation time for the EVSO ranged (Fig. 2) from 50 min to 180 min, with a mean of 88 min. There was a slight nonsignificant difference in operating time between female patients (mean, 87 min) and males (90 min), and the operation time was considerably longer in patients aged 35 years and older than in the younger age groups. When skeletal wiring was used, the operation time was prolonged by 25 min to 109 min, on average (Fig. 2). Long operation time was also correlated with the use of prophylactic antibiotics.

Peroperative hemorrhage

In 147 patients (72%) the estimated blood loss (Table 3) during the operation was less than 50 ml. The highest registered blood loss was 450 ml. No patient required transfusion. Differences were not observed between females and males, nor between the age groups. Postoperative hemorrhage did not occur; however, one patient developed a postoperative hematoma.

Edema and airway problems

The nasotracheal tube was removed at the termination of anesthesia. Airway problems were not observed.

The postoperative edema was assessed clinically and ranged from minimal to moderate in all but one patient. In this patient edema was characterized as severe but subsided without treatment after a few days.

Nausea and vomiting

Even though all patients in this study received antiemetic treatment, 43 patients were nausated, and 15 patients had postoperative vomiting. The intermaxillary fixation had to be unfastened for a short period in six of these patients. It appears as though patients premedicated with scopolamine/morphine or pethidine had a significantly greater tendency to vomit and be nauseated than patients premedicated with other drugs or receiving no premedication (Table 4).

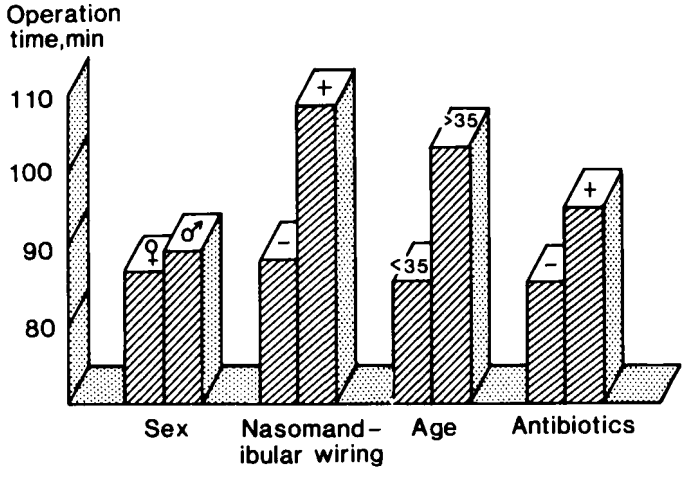

Fig. 2. Factors influencing the operation time. Mean operation time, 88 min.

Table 4. Drugs used for premedication and postoperative nausea and vomiting

Premedication drug	No. of patients	Nausea	Vomiting
Scopolamine/morphine or pethidine, *n*	49	22	9
Diazepam or atropine, *n*	145	17	10
No premedication, *n*	9	4	2
Total, *n*	203	43 (21%)	21 (10%)

Postoperative fever and infections

No patient experienced a postoperative body temperature above 39°C; 15% had temperatures between 38°C and 39°C. In all patients the temperature was normalized within 2 days. Postoperative infection at the osteotomy sites was not encountered in any patient.

Spasm in the masticatory muscles

Muscular spasms were a common problem during the first 1–2 postoperative days (Table 5). A total of 59 patients (30%) experienced such spasms, significantly more in male patients (36%) than in females (22%). No differences were observed between the age groups. The spasms were easily treated with a muscle-relaxing drug; diazepam was mostly used. Muscular spasms did not represent any problem in the later postoperative course.

Anxiety

About 20% of the patients experienced postoperative episodes of anxiety, mainly due to the intermaxillary fixation (Table 5). This appeared more often in the males and in the younger age groups; however, the differences were not significant. Short-term treatment with diazepam appeared to be of great benefit to these patients.

Table 5. Postoperative muscular spasms and anxiety

	Muscular spasms	Anxiety
Females, *n*	24 (22%)	18 (17%)
Males, *n*	35 (36%)	22 (23%)
Total, *n*	59 (29%)	40 (20%)

Nerve injuries

The mandibular branch of the facial nerve was affected in one patient (0.5%), resulting in a transient weakness in the lower lip muscles. It disappeared within 3 weeks. Injuries to the inferior alveolar nerve were not observed.

Saliva retention

Two patients (1%) experienced a painless swelling in one of the parotid glands 5 and 7 days postoperatively, respectively. Aspiration showed retention of saliva. Later a steady flow of saliva, increasing at meal times, was observed. This salivary flow ceased within 3 weeks without any treatment. There were no signs of later symptoms or infections.

Hospital stay

The total period of hospitalization averaged 4.8 days (range, 3–10 days). There were no differences between the females and males, but in the age groups over 40 years the hospital stay was prolonged, on the average by 1 day. Observed factors such as postoperative nausea, vomiting, or spasm did not influence the hospital stay.

Discussion

Of the various surgical techniques that have been advocated in the reduction of the prognathic mandible, the EVSO is a classic and still has merit today (16, 21). Its sound biologic basis has been widely documented by Bell & Kennedy (22). Most investigators report optimal improvement of facial esthetics and minor functional problems post-

operatively. In spite of some relapse in the sagittal plane, stability of the established skeletal and dental relations are the general result (17, 18, 23–26). The long-term stability results are quite similar to those of the later intraoral vertical subcondylar and the sagittal split procedures (27–29). For this reason the surgical technique of choice should be dependent on the technical ease, the per- and post-operative complications, and the morbidity of the patients. This investigation was conducted to ascertain whether there were any compelling reasons to change our approach. In view of our long-term clinical observations and alternative surgical techniques, this appears to be relevant.

The age and sex distributions of this material is close to those observed in other reports (16, 17). All patients were evaluated preoperatively by a surgical/orthodontic team, and presurgical orthodontic treatment was performed in 86% of the patients. The preoperative alignment of the dental arches is preferable, because it facilitates the placement of the lower jaw during the operation. An intermaxillary wafer can then be avoided, enabling speech and food intake. Many of our patients had undergone preoperative orthodontic treatment for too long a time.

In the surgical technique the use of a short incision parallel to the posterior border of the mandible was advocated by Hinds & Girotti in 1967 (30). However, this approach has been an accepted procedure in Norway since the late thirties (3). By this high approach, excellent access to the ascending ramus is ensured. With a few exceptions (31, 32) this approach does not seem to have gained popularity. A longer incision beneath the angle and a submandibular approach to the ramus are preferred by most surgeons (7, 9, 10, 14, 33, 34). Persson & Åstrand (35) changed their high incision to a submandibular approach and felt they had better control with the dissection and thereby diminished the risk of damaging the facial nerve. But this approach is more time-consuming and tends to give some patients bothersome scars (33). Some surgeons (35, 36) prefer to do the bone cut with a saw; in this case the submandibular approach will ease access to the ascending ramus. Performing the osteotomy with a crosscut fissure bur and dental handpiece establishes a safe method. In particular, this seems to prevent hemorrhage from vessels medial and superior to the sigmoid notch area and prevents injury to the inferior alveolar nerve. A Lindemann bur is more efficient in bone cutting, although slightly more hemorrhage may be encountered. The oral surgery residents were urged to use the crosscut fissure bur. The use of a dental handpiece and bur eases the access through a small incision, the bone cut can be curved, an osteotomy of the coronoid process can be performed, and, if necessary, the proximal fragment can easily be reduced in length with the same instrument.

Section of the coronoid processes has been recommended if the push-back exceeded 10 mm (37). We only performed coronoidotomy when unforseen restriction to mandibular retrusion was encountered during the operation. This was needed only in 2 out of 203 patients, and patients without coronoidotomy and a push-back exceeding 10 mm did not have any special postoperative problems.

Boyne (38) demonstrated excellent osseous healing between the fragments without decortication in rhesus monkeys, and most recent authors (29, 39, 40) do not recommend decortication. Reitzik (41) claimed that cortex-to-cortex healing after vertical osteotomy, even under ideal healing conditions, will take 25 weeks before full bony strength is attained. To avoid relapse, he recommended decortication of the fragments and rigid internal fixation. We did not use decortication or osteosynthesis between the fragments. Åstrand & Ericson (42) found in their material no correlation between the angulation of the proximal fragment and the postoperative positional changes of the mandible, and Åstrand et al. (43) concluded that with regard to postoperative stability of the mandible, no advantages of wiring the fragments could be demonstrated.

Positional changes of the mandible during the fixation period are well documented (24, 26, 29, 44). To avoid this relapse, it is recommended (45, 46) to supplement the intermaxilllary dental fixation with nasoman-

dibular wires, especially in patients with a tendency to an open bite.

Ash & Mercuri (47) reported 279 ml to be a mean estimated blood loss for mandibular osteotomies. Wang & Waite (14) estimated a blood loss for the EVSO technique of between 50 and 650 ml, with a mean of 180 ml. Åstrand et al. (48) found the hemorrhage negligible. The present report supports this view, and our observed blood loss seems to be less than in other mandibular osteotomies (14). In contrast to this, serious bleedings have been described with the intraoral vertical ramus osteotomy (49).

In spite of limited draping and isolation of the operation field and changing of surgical gloves between the intraoral fixation and the extraoral surgical procedure, the mean effective operation time was 88 min. The duration was longer than that reported by Nordenram & Waller (31)—55 min—but shorter than the results of Åstrand et al. (48)—108 min—and Wang & Waite (14) —212 min. We have found that the EVSO takes less time than the intraoral vertical osteotomy and the sagittal split procedure.

There is some controversy in the use of antibiotic prophylaxis in intraoral orthognathic surgery (50–52). Zallen & Strader (53) concluded that extraoral procedures performed with a sterile technique without communication with the oral cavity require no antibiotic coverage. The present investigation supports this view.

Postoperative edema and hematoma seemed to be negligible; consequently, use of steroids and suction drainage was not indicated.

Wang & Waite (14) reported postoperative nausea in 56% and vomiting in 42% of their patients. They found no effect from the use of prophylactic antiemetic treatment. In this study all patients were treated with antiemetic prophylaxis, but nausea (20%) and vomiting (10%) were still a problem. Premedication with a narcotic agent (morphine, pethidine) showed more tendency to postoperative nausea and vomiting. We prefer diazepam as the drug of choice in premedication of the orthognathic patient.

Spasms in the masticatory muscles were a common problem during the first postoperative days, specially for the male patients. Attention has been devoted to this phenomenon in the literature. These spasms may be caused by inbalance in the muscle activity, although there seemed to be a relationship to postoperative anxiety. Both these problems are easily solved with diazepam.

One reason to perform the ramus osteotomies via the transoral route is to avoid injury to the facial nerve (40). In the present material only one (0.5%) patient experienced a transient weakness in the mandibular branch of the facial nerve, parallel to the findings of Åstrand et al. (48) and Egyedi et al. (33). Thus the risk of damaging the facial nerve with the EVSO technique is negligible.

Parotid fistulas have been described (54) as a complication of an EVSO procedure. Two of our patients experienced parotid saliva retention, probably as a result of a suturing within the parotid tissues.

Compared with other techniques for correction of mandibular prognathism, the hospital stay after EVSO is short (16, 48). The intermaxillary fixation period of 6 weeks is followed by 1 week with elastics. Wisth (18) followed up 44 of our patients for 10 years and observed fairly good stability and patient satisfaction. The skin incisions lead to nearly invisible scars. No patients complained of a scar problem.

The EVSO procedure is a safe surgical technique with few complications and minimal discomfort for the patients. Short operation time and hospital stay are also advantages of this technique. At present the intraoral approach is the standard operation for retruding the mandible in our department. However, in patients with excess vertical ramus dimensions or in whom the retrusion exceeds 12 mm, we still prefer the extraoral vertical ramus osteotomy.

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