A COMPREHENSIVE GUIDE TO ORTHOFACIAL SURGERY

PLANNING AND OPERATIVE TECHNIQUES

Maurice Y. Mommaerts
I have known Maurice Mommaerts for a long time. Our backgrounds and careers in some ways were like mirror images of each other: he was well grounded in hard tissue maxillofacial techniques from his training with Hugo Obwegeser in Zurich, and came across the Atlantic to learn from Ralph Millard, the master of plastic surgery of soft tissues. I had travelled in the other direction after my training with Millard, to learn about hard tissues from Paul Tessier, Olympic champion of orbitocranial surgery, with frequent visits to Hugo Obwegeser and Jacques Dautrey to learn about surgery of the tooth-bearing structures.

I recall a visit to Miami years ago by my good friend Emil Steinhauser, Obwegeser’s first trainee and then Chief of the Maxillofacial Service in Erlangen, who I had visited there several times. Emil came to my operating room, and was watching over my shoulder as I did some fairly extensive orbital alterations through a coronal approach, coupled with a facelift, all for purely aesthetic goals. Emil said “You know Tony, I could never do that in Germany.”

This type of work — coupling major skeletal alterations with concomitant soft tissue alterations — can be called interface surgery, and is now carried out on both sides of the Atlantic by plastic surgeons with training in craniofacial surgery, and maxillofacial surgeons with training in soft tissue alterations. Both sides have learned from each other, and can agree that adequate training is the one essential.

Paul Tessier was not altogether pleased with the commonly used descriptor of “Craniofacial Surgery” for the surgical specialty that he had created, and even less happy with the term “Craniomaxillofacial Surgery,” that some read as an attempt to extend the lebensraum of a specialty. He liked the term orbitocranial, used above, and also orthomorphic. Orthoproposomorphic, while correct in the use of Greek roots, was just too much of a mouthful, as Maurice points out.

In the picture shown below, taken at Dr. Tessier’s 70th birthday celebration in the Club de Chasse in Paris, Dr. Tessier is shown holding a framed object. Next to him is Madame Delegue, his pediatric anesthesist, then myself, then Hugo Obwegeser.

In the frame was a copy of a frontispiece of a 1828 book by J. Delpech entitled “L’Orthomorphie” which I had found in The New York Academy of Medicine. Dr. Tessier was delighted to find that the term had been around for 150 years.
Dr. Mommaerts has chosen to call his book “A Comprehensive Guide to Orthofacial Surgery”, providing one more attempt to find a proper term for interface surgery. He meticulously documents his work in both the hard tissue and soft tissue areas.

For a plastic surgeon, the sections on use of the simulation lab and splint fabrication, surgical simulation from 3-D CT images, as well as orthognathic surgery, will be useful to read. For the maxillofacial surgeon, the descriptions of aesthetic procedures such as rhinoplasty, facelift, Botox, fat injections and other fillers, and even hair transplants, will be of interest. All of the chapters are well referenced from the respective literatures.

The surgical procedures are copiously documented with operative photographs, albeit somewhat small in size. There were some drawings, and I felt myself looking for more.

Dr. Mommaerts has decided to separate his material in a new way: the description of the techniques, and their indications comes in the first half, and the presentation of results comes in a second half, entitled “Showcase,” with nicely documented results in larger format photographs.

I will certainly want to have a copy of this book in my library, and I would expect that many involved in both plastic and maxillofacial surgery will as well. Both specialties have contributed to interface surgery, and both will continue to learn from each other.

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Over a decade ago, I published my first textbook, *Comprehensive Facial Rejuvenation*, that endeavored to cover the full gamut of facial cosmetic work as it relates to the aging face. After reading Dr. Mommaerts’ magnum opus, I see how far more impressively he has achieved his titular objective with seminal prowess. Unifying the fields of facial plastic surgery and ortho-maxillo-facial surgery under the rubric “Orthofacial Surgery” in a single edition by a single author is a paramount achievement that I believe will be instructive to both the neophyte and the seasoned surgeon interested in the discipline.

Having met Maurice in my clinic 5 years ago, I never imagined that this humble, soft-spoken man held the stature and renown that the rest of the world clearly acknowledges. My ignorance, which I hope he has since forgiven, stemmed from my limited acquaintance with the pantheon of CMFS giants to which he undoubtedly belongs. During his visit to Dallas, he mentioned that he would invite me to Bruges the following year to speak. It was not until I arrived in his lovely hometown to witness the grandeur of the EACMFS spectacle, which he helmed as President, that I finally fell on the epiphany of his esteemed position. Holding this hefty tome in my hands only further cements my profound respect for my friend and colleague.

Orthofacial surgery, or any cosmetic intervention for that matter, must be the product of both artistry and technical delivery. This book compels the reader to understand the primacy of both, without which aesthetic outcomes will fall far short of the intended mark. The facial cosmetic and reconstructive surgeon must thoughtfully and passionately embrace the social, psychosocial, and cultural ramifications of his work, as the author rightfully exhorts. Viewing every patient in this comprehensive light should inform the diligent surgeon’s strategy so as to engender life-changing and fulfilling transformations that can beautifully touch the lives of both the surgeon and the patient.

As the author extols the mastery of art and science as the requisite underpinning of cosmetic surgery, no other organization represents this magical union better than Apple, Inc. Its erstwhile visionary, Steve Jobs, concluded his affecting oratory to Stanford University in 2005 with this impassioned appeal, “You’ve got to find what you love. Your work is going to fill a large part of your life, and the only way to be truly satisfied is to do great work. And the only way to do great work is to love what you do. If you haven’t found it yet, keep looking. Don’t settle.” This book is an arduous labor of love and a testament to a lifetime of dedicated and passionate pursuit of excellence for his craft. Bravo, Maurice.

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ABBREVIATIONS FOR LIDOCAINE ADMINISTRATION

XA3D: Lidocaine 3% with adrenaline (via short dental needle)
XA1W: Lidocaine 1% with adrenaline (via Whitacre spinal needle)
X2D: Lidocaine 2% without adrenaline (via short dental needle of 0.3 mm diameter)
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ACKNOWLEDGMENTS

To my former coworkers in Bruges, I extend my deepest gratitude, with special thanks to Walter Jacobs, in Herentals, and to the fine circle of referring physicians and orthodontists who so readily entrust me with their patients.

Many thanks are likewise owed to all of the surgeon trainees with whom I have had the privilege and pleasure of collaborating during the past 22 years. Teaching does not end with mere instruction. Above all, it is a forum where relationships are forged; and in the course of these relationships, I was steadfastly driven to uphold the very principles for myself that I had laid out for others.

Much appreciation also goes to the European Association for Cranio-Maxillo-Facial Surgery, and to the many Fellows of this organization who frequented Bruges and Brussels, contributing immeasurably to my understanding of managing facial deformity. I shall be forever indebted to all of them (too numerous to name here) for their poignant scientific challenges and their welcomed camaraderie.

My professional growth has always been graciously nurtured by my wife, Greetje, whose kind understanding enabled many uninterrupted weeks at my desk, foregoing snowy slopes or sunny beaches with my family. Warm hugs are likewise conveyed to my three boys at home—Paul, Maurits and Karel—and my charming daughter, Anna, as a tribute to their infinite patience and expressions of love.

Last but not least, by any means, I humbly offer my deepest praise to the countless patients with various facial deformities and deficiencies who have sought my care. It has been my honor to treat them over the past two decades, and it is to them that I dedicate this book.
WHY THIS BOOK?

Veni etinam, nolens volens.
[To this I came, keen or not.]

My interest in facial plastic surgery developed during my third year of dental school, when I was 20 years old. As is common at the university, a student may be inspired by a charismatic teacher to enter a particular field. For me, it was the docent in head and neck cancer surgery who influenced my pursuit of medical school. Permission was needed from both camps (the Dean of the Medical Faculty and the Director of the Dental School) in order to matriculate, but neither side felt that I should combine these studies. I persisted, nonetheless, and in retrospect, I am gratified by the path I chose, despite a considerable increment (11½ years) in university training.

The very same docent, Eric Fossion, later on amazed me with his dexterity in the handling of soft tissues, as did Hugo Obwegeser (my second mentor) with his command of cranio-maxillo-facial skeletal surgery. Although my next mentor, Ralph Millard, Jr, may aptly be described as a man of few words, he was quite clear on the matter of achieving perfection in aesthetics. His Principilization of Plastic Surgery had a profound impact on my surgical technique, and I continue to instill his spirit in my trainees and fellows.

Visits to plastic craniofacial surgeons Paul Tessier and Daniel Marchac, and to the facial plastic surgeon Rudolph Meyer, were a must in the days of postspecialty preceptorships, but these renowned surgeons failed to impress me. Perhaps I was at a point beyond blind admiration. However, I must confess that recent visits with Sam Lam and Daniel Labbé did succeed in resurrecting the “Aha!” feeling of my first day of training in Zurich. It was there that I assisted the esteemed Milivoj “Vojo” Perko with a unilateral cleft lip repair.

After my 1990 appointment as staff maxillo-facial surgeon in Bruges, I was able to focus on facial deformity and congenital craniofacial malformations. For 10 years, I combined this forte with cancer surgery and engaged in other outlets for maxillo-facial surgery, such as traumatic injuries, joint disorders, bone atrophy, cysts, and infections. Gradually, with the appointment of new staff members, I was free to revisit my foremost passion of facial corrective surgery—developmental, congenital, and age-related.

Ultimately, all of my efforts with surgical innovations, publications, and various workshops (notably, the renowned “Lobster” course), including presiding over and organizing the 2010 Meeting of the European Association for Cranio-Maxillo-Facial Surgery in Bruges, led me to the University of Brussels as Chair of the European Face Centre.
Many surgeon trainees and fellows have expressed interest in a solid reference book for orthognathic surgery. From my perspective, there are but a few on skeletal facial surgery to recommend, although a plethora exists for soft tissue remodeling. This book is intended for both areas, combining orthognathic and plastic maxillo-facial procedures. As early as 1996, I contemplated its writing, but I remained undecided on the vantage point—for the author or for the reader? While Ralph Millard’s career was centered on his prolific writing, Hugo Obwegeser released his first book in retirement. I have obviously chosen the seasoned route, allowing my skills and experience to appreciably mature.

In describing corrective surgery of the skull and the face, Paul Tessier favored the term “orthoproposomorphic.” It literally means “making the shape of the face right” and while difficult to pronounce, the word says it all.

Surgical corrections of the face typically are under siege, unless dignified by organic, functional rationales. Interestingly, facial enhancements abound in all “primitive” cultures, as social custom—for example scarifications, tattooing, skull deformations, neck lengthenings, and earlobe or lip extensions. Our Western culture has made arbitrary, mind-boggling distinctions in this regard: piercing of the earlobe is normal, but tongue-piercing smacks of rebellion; eyeliner, brow, and lip tattooing are reasonable, but small, artful tattoos of the face are “just not done”; mandibular advancements, blepharoplasties, and rhinoplasties are socially acceptable, but lip augmentations, face-lifts, and hair transplantations are shrouded in secrecy.

The media do play a part. Television programs, such as TLC’s “Ten Years Younger,” Fox’s “The Swan,” and ABC’s “Extreme Makeover,” unquestionably have softened the stigma and fear of facial surgery. When the German Society of Aesthetic Plastic Surgery boycotted a regional production of “Extreme Makeover,” the motivation very likely was self-interest, rather than public concern. I am convinced that none of the members would decline a sound makeover request.

During my tenure as president of the European Association for Cranio-Maxillo-Facial Surgery, I helped found a Fellowship in Cosmetic and Plastic Facial Surgery program, thereby promoting easier access to comprehensive specialty training and accredited orthofacial programs for young physicians. I sincerely hope that this book will also be helpful to the next generation of surgeons passionate about facial reconstruction.

“Everything is in the face”
Cicero
CONCEPTUALIZATION

Le Fort I osteotomy with maxillary impaction—whether done posteriorly to effect closure of an anterior dental open bite, or anteriorly and posteriorly to correct a gingival smile and lip incompetence—inherently leads to autorotation of the mandible as the teeth seek to make contact. This maneuver elevates the lower lip, augments chin projection, reduces anterior facial height, and confers a horizontal mandibular plane. All of these changes are usually positive, sometimes obviating the need for other surgery, such as mandibular osteotomy, genioplasty, or submental liposuction.

By definition, mandibular autorotation involves changes in the vertical and horizontal direction, and of the occlusal plane. If vertical repositioning of the maxilla dictates the extent of autorotation, the mandible then dictates horizontal maxillary repositioning to achieve proper occlusion. The surgeon must know beforehand whether the maxilla will be set back or advanced, and gauge the magnitude of the change. Excessive setback can result in a concave profile and necessitate bimaxillary surgery.

The center of autorotation (CAR) is not in the center of the condyle, per se, or even found in the joint region. I hypothesized that mouth opening and overclosure would have the same center of rotation, and Nasser Nadjmi conducted a study of this hypothesis as part of his training program. CAR can be precisely ascertained using two profile cephalograms or a single dynamic cone beam computed tomography examination. If the mandibular dental midline is off-center, a unilateral or bilateral sagittal split of the mandible is needed and the CAR loses its significance.

TECHNIQUE (WITH CEPHALOGRAMS)

Two lateral cephalograms are taken preoperatively. One is for analysis of centricity and uses a thin acrylic wafer (Unifast) fabricated on the spot for stabilization (Ceph 1).

1. Acrylic wafer fashioned “in vivo,” after separating occlusal interface with Vaseline; this ensures correct dorsal condylar positioning (centric relationship).
2. Second wafer constructed “in vivo” over tongue spatulas; pressure at corners of mouth forces dorsal positioning of condyles.
The lateral cephalogram is obtained at a jaw opening of 10 mm, stabilized by layering an acrylic bite block (Unifast) over wooden tongue spatulas. The mandible is manipulated into its most retruded position (Ceph 2).

The thin wafer and bite block are both fashioned with the patient relaxed, lying in a recumbent (horizontal) position. The patient is asked to curl the tip of the tongue into the oropharynx while the surgeon or an assistant exerts gentle dorsal pressure on the mandible. The transversely placed tongue blades retract the corners of the mouth, forcing dorsal positioning of the mandible.

CAR determination is done in four consecutive steps. Initially (step 1), the lower incisal edge (Il1) and Gonion (Go1) are established as landmarks on Ceph 1.

3. Il1 and Go1 landmarks on Ceph 1.
4. Il2 and Go2 determined by superimposition.

Il2 and Go2 are subsequently transferred from Ceph 2 to Ceph 1, aligning cranial base outlines of the superimposed images (step 3).

5. Transfer of Il2 and Go2 to Ceph 1 (cranial base outlines aligned).

Thus, four landmarks are delineated on Ceph 1: lower incisal edge and gonion, before and after opening the jaw.
The CAR is ultimately mapped on Ceph 1 using the method of Rouleaux (step 4). Perpendicular bisectors are first determined by conventional means (with a compass). Points Ia and Ib define the II1/II2 bisector (i.e., the line perpendicular to and bisecting the distance from II1 to II2). Similarly, points Ga and Gb determine the Go1/Go2 bisector. The intersection of these bisectors (II1/II2 and Go1/Go2) is the CAR.

The CAR usually is situated posterior and cephalad to the condyle. Positioning the CAR further anterior and caudal should be reserved for a Sunday (dual) bite position with the mouth closed. Because this has skewed past results, we take the cephalogram for analysis of centricity with an acrylic wafer.

References to Literature

European patients commonly present with long faces, exhibiting maxillary vertical excess with paranasal, infraorbital, and malar hypoplasia. Such patients are good candidates for a malar valgization osteotomy, in combination with surgical impaction of the maxilla, and sometimes with rhinoplasty for functional and/or aesthetic reasons. When lecturing in Asia and South America, I have noticed that opposite features are often the impetus for facial contouring, namely broad faces with deep bite and overly prominent malar and jaw angles. Many of my Dubai and Gulf-Arab patients prefer Caucasian-style malars.

For centuries, high “Slavic” cheekbones, situated 1.5 cm below the lateral canthus, have been a sign of beauty in Europe and North America. Malar hypoplasia is readily recognized by placing an index finger obliquely on this particular landmark.

Female cheekbones extend to the level of the nasal base (sometimes lower) and are more rounded than the chiseled, higher cheekbones of males.

A malar valgization osteotomy will not address medial infraorbital hypoplasia, but this may be augmented using hydroxyapatite/fibrin glue cement during the same surgical session (see Further Bony Augmentation, p. 239).

In 1992, I described a malar “sandwich” osteotomy with rotational augmentation (valgization) and for years I used a block of hydroxyapatite or calcium carbonate as the “filling.” However, this was costly and carried a risk of sinus inflammation, so I substituted simple titanium plate osteosynthesis, since relapse is not an issue. Like after a Le Fort I advancement osteotomy, the gap left will eventually also be bridged by bone generated from tented periosteum. The plates usually have four holes, contain three screws, and must be positioned obliquely, from a laterocranial medialcaudal location, to prevent sagging of the malar body.

It was surprising to hear that an experienced surgeon such as Federico Hernandez-Alfaro cited relapse as the chief reason for switching to synthetic implants, because no study has conclusively proven this to be the case. However, many studies have shown initial asymmetry and late displacement with synthetic implants, resulting in inflammation and eventual extrusion.
TECHNIQUE

When not used in combination with a Le Fort I osteotomy, a separate 2.5 cm incision is made in the upper buccal sulcus, running horizontally from the level of the alar base. Typically, malar valgization osteotomy addresses a specific inaesthetic feature of a more complex midface problem and the overall approach is already dictated by a Le Fort I osteotomy incision.

2. Cone beam computed tomography 6 years postoperatively: no relapse after 5 mm valgization of zygoma in 43-year-old female; no ossification of vertical osteotomy but semi-horizontal lines have ossified; concurrent jaw angle augmentation (hydroxyapatite/fibrin glue) perfectly maintained.

3. Elevation lateral to Le Fort I osteosynthesis plate (medial to zygomatic buttress).

4. Index finger at infraorbital rim checks extent of vertical subperiosteal dissection.

Dissection stops a few millimeters short of the rim, leaving the orbital septum intact to prevent eyelid and conjunctival ecchymosis. An osteotomy done higher and semi-horizontally risks entry further back at the orbital floor and may cause fracture of the orbital rim.

Periosteal elevation continues, using a curved Freer in the innominate groove, typically found between the infraorbital rim and malar body. Dissection is again guided by the index finger of the opposing hand, which is placed at the temporofrontal process transition. (This notch was the entry point of a zygomatic suspension awl when zygoma suspension was applied.) Although the zygomaticofacial nerve is regularly severed, no patients have ever complained of numbness.

The third tunnel is made on the posterior wall of the maxilla, at the level of the anterior vertical tunnel, aiming for but not reaching the infraorbital fissure.
A small Obwegeser-Sailer retractor is placed at the infraorbital rim and the curved Freer is moved behind the zygoma. A reciprocal saw upwardly cuts both sinus walls. At this point, the chief surgeon should check for proper osteotomy height.

The Obwegeser-Sailer is kept in place while the curved Freer is hooked behind the notch, tenting the cheek tissues. The reciprocal saw is used here with caution, keeping it very deep so that periosteum above it is protected. The saw first cuts the thick bone of the posterior malar body before cutting the posterior and anterior walls medially.

If in doubt, saw height at the posterior wall can be gauged with another curved Freer. The osteotomy is finished with an 8 mm sharp Obwegeser osteotome.

Mobilization of the zygoma can be done by rotating an 8 or 12 mm osteotome in the vertical osteotomy or with Marchac bone-spreading forceps. I find that rotating an 8 mm osteotome anteriorly in a semi-horizontal osteotomy works best.
With the first two options, infracture of the canine fossa is possible, and with the third, outfracturing of the infraorbital rim is a risk. The latter complication should not occur, given manual control of the rim; but if it does happen, it will heal without a defect. This downward mobilization at the temporozygomatic suture is achieved in a more controlled way than with an outfracturing. The intent is to create a greenstick fracture in the suture, which in older patients may well be full-blown. However, the periosteal envelope is kept intact, so fracture-luxation will not happen. On the other hand, if the posterior osteotomy stops well in front of the notch, the malar bone may fracture too far to the front, creating a cheek depression similar to that seen after traumatic fractures.

After the bony suture gives way, the osteotome is placed in the vertical gaps and the malar body is pushed outward, with counterpressure by the opposite hand on the cheek. Typical outward movement is 5-10 mm.

Due to pivoting at the suture, the malar bone is also repositioned anteriorly, achieving the desired projection below the lateral canthus. The degree to which the projection is augmented is a matter of artistry. Simulation software has yet to provide previews. Slotplates (Moormaerts, 2002) may be used for testing the ideal position, keeping the malar body rotated with an osteotome, after which the soft tissues are redraped and the eyes are uncovered.

A four hole meshplate is bent double.

A hole is made medial to the osteotomy, at a height at which soft tissue support is feasible. The plate is fixed loosely with a screw. Thereafter, the malar body is moved in proper valgus position, and the hole lateral to the gap is drilled and screwed. The initial screw is tightened. The plate should be positioned with two screws in the laterocranial direction to resist masseter pull on the mobilized zygoma.

I usually opt for a plate accepting two medial bone screws. This prohibits rotation even when the plate is in laterocaudal direction.
The sinus is carefully rinsed with saline solution. Closure done is with 4-0 Vicryl Rapide in a single running layer.

Whether combined with a rhinoplasty or lateral osteotomies, execution of this procedure does not differ. In conjunction with a Le Fort I osteotomy, the lateral plate of the maxillary osteosynthesis is shifted medially, but must still attach to bone that can take screws. Mobilization of the zygoma is done very delicately, avoiding any pressure to medial bone. If hydroxyapatite paste is applied infraorbitally, the gap is protected by a collagen fleece (e.g., TissuDura), stabilized with a few drops of fibrin glue (Tissucol/Tisseel). The same fleece protects the gap of the maxillary osteotomy.

13. Two-screw fixation of mesh-plate (possible displacement of malar body downward due to masseter muscle).
14. Use of three screws (preferred); lateral screw prevents palpable and visible prominence.

The sinus is carefully rinsed with saline solution. Closure done is with 4-0 Vicryl Rapide in a single running layer.

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**References to Products and Materials**

Meshplates and slotplates: Surgi-Tec and Titamed
Marchac bone-spreading forceps: Stryker-Leibinger
Obwegeser 8 mm osteotome: Stryker-Leibinger
TissuDura, Tissucol/Tisseel: Baxter Biosurgery

**References to Literature**


**Recommended Reading**

CONCEPTUALIZATION

Prominence of the jaw angle is attributable to hypertrophy of the masseter muscle, bony hypertrophy, or a combination of both. The prominence is usually a consequence of bruxism (jaw clenching). The face appears square in frontal view, whereas in lateral view, the gonial angle is hyperacute and dorsocaudally developed. The condition is often asymmetric.

Correction of one or both factors may be achieved surgically. Muscle reduction is subject to either surgical excision or injection of botulimum toxin type A. Bony reduction is accomplished by lateral corticotomy or posterior/inferior ostectomy (alone or in combination).

TECHNIQUE

Surgical reduction of masseter hypertrophy

The technique was developed by Hugo Obwegeser and is described by Hermann Beckers (1976). An incision is made over the external oblique line and is extended high into the oral vestibule to expose the anterior belly of the masseter muscle.

1. Exposed anterior segment of right masseter muscle.

2. Clamping of medial muscle bundle (two-thirds).

3. Artist’s impression, with section at the insertion site.
One-half or two-thirds of the muscle’s inner aspect is separated with a blunt Freer elevator, reserving the outer one-half or one-third to protect the facial nerve. The muscle is split all the way to the posterior edge, from origin to insertion. The latter is clamped with long, curved clamps and cut using the Colorado-tip cauterity knife to sever clamped muscle fibers. Fibrin glue is sprayed into the cavity and a firm-compression head bandage is applied.

Lateral decortication of the mandible

Incision is similar to that used for a sagittal split, but dissection is limited to the lateral surface. Two Obwegeser retractors for bilateral sagittal split osteotomy are inserted in the same cavity, with handles crossed—one horizontally positioned, anchored behind the posterior border; the other vertically oriented to constrain the inferior edge.

With a long Lindemann bur, monocortical cuts are made in a radial pattern approximately 1 cm apart. The upper ends of the cuts are joined for a sagittal corticotomy. Chisels are used to separate outer from inner cortex and care is taken to remove spurs at the inferior border.

Angle bicortical ostectomy

The approach is similar to that of lateral decortication, as above. An oscillating saw is used to trim the posterior border, but a reciprocating saw is used inferiorly. One can
expect tedious tendon attachments. Subperiosteal dissection is difficult to complete, even
with an Obwegeser mandibular border raspatory at hand. Maintaining symmetry is also
difficult, but a three-dimensional (3D) fluoroscope (3D Pulsera) helps in this respect.

Botulinum injections
After marking the area, botulinum toxin type A (Botox 50-80 IU, 6 injections per site)
is delivered in a cross-hatched pattern. The treatment is repeated every 2 months until
results are pleasing. These injections of muscle are full-thickness. Patients usually return
after 1 year because the bruxism persists.

8.-10. Markings for botulinum
injections. The right side will
receive more than the left.
EMLA cream is applied.

3D Pulsera: Philips Healthcare
Botox-Vistabel: Allergan
Colorado needle tip cautery: Stryker
Freer elevator: Stryker-Leibinger
Obwegeser mandibular border raspatory: Stryker-Leibinger

References to literature
CONCEPTUALIZATION

By definition, surgical site infections (SSIs) are those where infection occurs within 30 days after a procedure. SSIs are classified by nature of incision (superficial or deep) or by organ/space. A stitch abscess does not qualify as an SSI.

Pathogens responsible for SSIs are seeded by the skin and mucous membranes, so efforts to create a sterile surgical field are mandatory and common-sense. However, a sterile field may be unattainable with certain routes of surgical access (transoral and transnasal).

When access is purely transcutaneous, gram-positive cocci (e.g., staphylococci, streptococci) are frequently implicated in the SSIs that occur, whereas streptococci and bacteriodes (anaerobes) are characteristic of SSIs following orthofacial procedures (Spaey et al, 2005). Pathogens refractory to antimicrobial treatment, namely methicillin-resistant \textit{Staphylococcus aureus} or \textit{Candida albicans}, are increasing proportionately. Candida, especially, should not be overlooked in susceptible individuals (e.g., a patient with diabetes taking penicillin).

Shaving of hair from operative sites is not truly necessary unless it is done to facilitate surgery. Razor blades invariably inflict microscopic nicks and cuts of the skin, promoting bacterial contamination. If hair is removed for any reason, the appropriate time is immediately before surgery, and it is preferably done with electric clippers, leaving a 1-2 mm stubble (Jepsen and Bruttomesso, 1993; Nichols, 2001).

Although method and time of application may vary, both aqueous- and alcohol-based preps are available that meet Food and Drug Administration criteria for surgery. Iodophors (e.g., povidone-iodine 7.5-10.0%), alcohol in solution (caution: flammable!), and chlorhexidine gluconate (0.05-4.0%) are the most commonly used agents. Iodophors and chlorhexidine gluconate have broad-spectrum antimicrobial activity (Mayhal, 1993), but there have been no controlled studies in a surgical setting to adequately compare the efficacies of these preparations.

The Association of periOperative Registered Nurses (AORN, 2012) and European Medical Devices Directive 93/42/EEC currently endorse both reusable cotton and nonwoven disposable surgical drapes and gowns. Nevertheless, cost-effective disposables are the
rule in healthcare today. The drawback is that these fabrics release particulate fibers (lint) into the surgical environment as airborne contaminants. Lint settling on nonsterile surfaces may ultimately be deposited on instruments or tissue, corrupting the surgical field (notably, with *Aspergillus fumigatus*). Maintenance of ventilation systems in operative areas must therefore be fastidious, because the filters used, however expensive, are quickly overcome by lint.

Drape penetration by fluids, known as “strikethrough,” also allows organisms access to the surgical site. Multiple layers are preferred in the draping process for this reason.

Because skin cannot be completely sterilized, deployment of a transparent incise drape encourages a sterile surface. Even so, such drapes are less effective and may unnecessarily complicate the procedure when dealing with orifices (mouth, ear, nose, and navel) or regions of skin (such as scalp) where they do not adhere.

On the other hand, the adhesive on some drapes performs so well that upon removal, cutaneous layers are unavoidably stripped away, exposing the patient to microbes; and removal of drapes is done frequently (up to five times per surgery) to monitor results. Hence, surgical patients are often self-infected (with staphylococci) and not surprisingly, suffer forehead or facial folliculitis. Some even experience hypersensitivity and develop eczema postoperatively. The adhesive has a particular affinity for intubation lines.

It is of utmost importance that the eyes of patients are protected from irritants, such as alcohol, which is used in dilute solution during keratotomy for epithelial debridement. When the eyes are not the object of surgery, they should be lubricated and covered with an adhesive pad. An oval cut from a disposable laminate drape (this being superior to transparent polyurethane material) provides a reasonable mechanical barrier to errant objects (e.g., a falling scalpel).

Disinfection prior to surgery requires an aqueous solution. Povidone-iodine inactivates fibrin glue and is itself inactivated by contact with blood and serum proteins (Mayhall, 1993). It is also incompatible with chlorhexidine. Given that alcohol-based disinfectants...
are noxious to the eyes, nose, and mouth, 0.05% aqueous chlorhexidine is the first choice to prep for orthofacial surgery. A chlorhexidine-type (hexetidine) mouth rinse may be used for oral disinfection. Hours spent over a malodorous oral cavity may otherwise be very distressing.

When surgery is limited to hair or skin, and fibrin glue is not needed, povidone-iodine 7.5% shampoo and 10% solution are satisfactory disinfectants. Likewise, a 5-10% hydro-alcoholic solution (iso-Betadine) is an acceptable prep for the abdomen and extremities, with due caution when using cautery. Of note, light-colored clothing is easily stained by these products.

**TECHNIQUE OF PREPPING AND DRAPING**

**Surgery under general anesthesia**

4. Face is disinfected twice and left wet.
5. 3M adhesive drape covering body up to clavicles.
6. Head drape placed deep under neck with assistance from anesthesiologist.

7. Endotracheal tube clamped to disposable drape, providing lift that relieves pressure on nostril.
8. One laminate drape covers headrest; another tightly wraps endotracheal tube and foam support (at forehead-level).
9. and 10. Split-sheet laminate drape covering ear (not neck); drape does not adhere to oral intubation line, enabling free right-to-left movement.

A drape is placed deep under the neck while the anesthesiologist elevates the patient’s head.

A split-sheet laminate drape covers the ear, but not the neck.
11. Face is dried and oval “eyes” (cut from laminate drape) are placed for protection.

12. Small-sized laminate drape (with side adhesive) covers tube or forehead as needed.

13. 3M XL adhesive drape applied to body (left side) with enclosure of anesthesia station.


15. Draping for limited facial surgery: Op-Tape barrier (two halves) secures laminate drape to lateral face.

Surgery under local anesthesia, with or without IV sedation

For limited surgeries performed under local anesthesia, the patient may remain dressed. The body (trunk and extremities) is covered with a surgical gown or a laminate drape.

The head is also wrapped, covering the ears and shoulders laterally. The laminate sheet is secured with two halves of adhesive Op-Tape barrier. This manner of taping prevents blood from trickling into the hair and ears, but it should not distort the skin.

References to products and materials

3M XL adhesive drape, 150 × 175 cm: Mölnlycke (reference no. 777400)
3M adhesive drape, 175 × 300 cm: Mölnlycke (reference no. 778200)
Head drape 104 × 128 with turban wrap: Mölnlycke (reference no. 826900)
Hexitidine solution: Hexitril, Pfizer Pharma
Split-sheet 146 × 196, split 76 cm: Mölnlycke (reference no. 206)
A prepared set for head and neck surgery may contain the following items:
- Surgical gown
- 1 table cover 150 × 190 cm: Mölnlycke (reference no. 808000)
- 25 standard gauze abdominal swab 30 × 45 cm: Mölnlycke (reference no. 175260)
- 10 Gauze swab 5 × 5 cm: Vernon Carus (reference no. 48735)
- 1 syringe bulb, 50 ml, 3 parts: Tyco Healthcare (reference no. 1100-56500)
- 1 syringe, 5 ml, 3 parts l/l conc: Becton-Dickinson (reference no. 309603)
- 1 skin marker regular green with ruler: Tyco Healthcare (reference no. 3114592)
- Adhesive Op-Tape Barrier 9 × 49 cm: Mölnlycke (reference no. 381030)
- Adhesive Towel Barrier 75 × 75 cm: Mölnlycke (reference no. 706500)
- 1 syringe, 20 ml, 3 parts l/l conc: Bekton-Dickinson (reference no. 300629)
- 1 needle, green hypodermic, 21G × 50 mm: B. Braun Medical (reference no. 4665503)
- 3 blade scalpel no. 15: Swann-Morton (reference no. 205)
- 2 kidney bowls 700 ml: DeRoyal Europe (reference no. 395-0700)
- 2 adhesive towels, 75 × 75 cm: Mölnlycke (reference no. 706500)
- 1 suction tube, PVC, 30 ch, 300 cm: Dahlhausen (reference no. 99.068.30.3)
- 1 suction catheter, soft PVC, 8 ch, 52 cm: B. Braun Medical (reference no. 4302087)

References to Literature


Recommended Reading


Nagy K, Mommaerts MY, Ignác Semmelweis, the rescuer of mothers. AJCS. 2008;25:73-77.
KEYING THE OCCLUSION

The art of applying proper intermaxillary fixation (IMF) may have spawned the specialties of maxillofacial and plastic surgery. Charles Auguste Valadier, a United States citizen of French descent, aided British troops in France during World War I. Using a Rolls-Royce equipped as a mobile dental laboratory, Valadier was able to repair the broken jaws of soldiers through IMF.

Harold Delf Gillies of New Zealand, an ENT surgeon lauded as the father of European plastic surgery, was appointed to Valadier’s hospital in Wimereux. While there, Gillies immersed himself in the repair of facial injuries and was determined to become a facial plastic surgeon (McAuley, 1974).

Varaztad Kazanjian, initially as a dental technician, then dentist, and later as a medical doctor, treated the broken jaws of American soldiers and pioneered plastic surgery in the United States. Collaborating with John Marquis Converse, another luminary in plastic surgery, Kazanjian coauthored the 1920 landmark textbook *Plastic Surgery of the Face*, paying homage to Valadier’s work.

The specialty text guiding my co-internship in general surgery was *The Surgical Treatment of Facial Injuries* by Kazanjian and Converse (1974). At that time, surgical reconstruction (mobilization, reduction, and wire osteosynthesis) had already gained in popularity, but IMF was still the counterstone of treating facial fractures.

CONCEPTUALIZATION

IMF is always used when occlusion is surgically altered. The array of currently used techniques is described in a workbook offered by the European Association for Cranio-Maxillo-Facial Surgery (EACMFS): *Intermaxillary Fixation Techniques* (2010). As a joint effort by myself, Julio Acero, and Jose Arcas Lopez, this publication is freely available online in PDF format: www.mauricemommaerts.eu, go to “publications”, make yourself a log-in and go to “general cranio-maxillo-facial surgery.” There pick “2010 Intermaxillary fixation techniques”. The file used to be on www.EACMFS2010.org and on www.eurofaces.com. The first site was replaced and the file was removed from the second.

For all orthognathic surgeries, custom archbars make a good lifeboat.
I always have these at hand in case fixation via orthodontic brackets fails. Custom archbars of a heavier build (casted chrome-cobalt) are essential for segmental osteotomies, although they are not comfortable for the patient.

Transpalatal bars of the Goshgarian type help maintain overcorrection in Le Fort I midline splits with expansion if the orthodontist has selected lingual sheets on molar bands. Sizes vary and can be adapted through surgical modeling. The bars are fixed to lingual sheets using 0.3 mm ligature wire.

When twisting a wire, it is critical to tighten clockwise. Failing to do so leads to considerable frustration due to wire breakage and lost time.

TECHNIQUE

Elastomeric ligature modules

For many applications, small elastomeric ligature modules (e.g., Sanitie) have replaced wire in securing the arch wires in brackets. These modules are installed with a twirl-on instrument or a mosquito.

Kobayashi tie hooks

Kobayashi tie hooks are available in long and short versions of .010, .012, and .014 wire. Although orthodontists often opt for the comfort of .012 “Koba’s,” the short .014 version is actually the best choice.
5. Hook on bracket, Kobayashi tie hook, and power pin (all in one arch).

6. Kobayashi tie (gently bent at neck) slipped horizontally over bracket.
7. Twisted tie with loop directed cranially.

Crimpable hooks
A crimpable hook is mounted on the arch wire between two adjacent brackets prior or subsequent to placement of the arch wire in brackets. If mounted prior to placement, a closed hook is used; if mounted subsequent to placement, a peripherally split hook is used. Both options allow appropriate positioning of the hook along the arch wire, and there is no laboratory time involved. The surgeon can easily apply the surgical hook to the arch wire as needed. The crimpable hook, as designed for surgical patients, has a rectangular body with four interconnected walls that enable use of a rectangular wire.

8. and 9. Crimpable hook.
A standard pair of wire cutters or other crimping device is used to secure the gingival and occlusal sides of the tubular member onto the arch wire. This appliance incorporates an elongated bar/arm with a ball-shaped free end for patient comfort, eliminating a sharp point that could snag a surgeon’s glove.

The major disadvantage of crimpable hooks is that the excessive force required for fastening may result in distortion or gabling of the arch wire or introduce unwanted wire tension. If distortion of the arch wire occurs after impressions are made and the splint is constructed (during surgical modeling), the teeth may not fit into the splint at the time of surgery due to positional disparity. This point underscores the need for integrating timing and techniques in combined surgical-orthodontic treatments.

All currently manufactured crimpable or collapsible hooks and/or stops suffer from lack of adequate friction, tending to slide along the wire even when forcibly crimped. Arch wire hooks that slide when loaded during IMF are a source of frustration for surgeons, although they remain functional.

The sliding is generally limited to interbracket distance. On the other hand, hooks that spin about the arch wire are functionally inadequate. The superior performance of coated hooks is conferred by a hard, abrasive tungsten carbide finish that generates significant friction when forcibly challenged. Once in place, they resist sliding and twisting around the softer stainless steel arch wires.

**Power pins (arms)**

A power pin is a traction hook that can be fitted in the bracket’s vertical slot. Fashioned from soft stainless steel, it will normally insert from the gingival aspect and be fastened in-slot by a 90-degree bend in the occlusally projecting tail. The bend should be directed opposite to elastic pull. This will discourage a loosely turned pin from rotating 180 degrees and being ripped from its mooring by elastic.

In side view, it is evident that the head of the power pin is angled relative to the shaft. The pin should therefore be inserted with the head inclined away from rather than toward the tooth or gingival margin. Once fitted, the power pin can be left in place for as long as...
necessary; it does not interfere with arch checks. The power pin is easily removed by straightening its tail to be clipped by ligature cutters.

**Buttons**

Buttons are ideal on buccal surfaces when lingual orthodontics are in place and surgery is indicated, and on palatal surfaces for cross-elastics. Metallic buttons are glued to dental enamel by first applying a self-etching primer (Transbond plus) for 3-4 seconds and using an adhesive paste (Transbond XT) that sets in 6 seconds under luminous curing light (Ortholux). Drying and rinsing are not required, facilitating application during surgery.

**Mini-Mold**

For an inexpensive and aesthetically pleasing solution in equivalent time, composite buttons (Mini-Mold) may be shaped in a number of ways from a transparent mold. The appliances are light-cured firmly in place.
Applying the intermaxillary loops

The wafer (splint) is adjusted the evening before surgery. Any premature contacts or interference points (as indicated by surgical model) are removed using a green silicium carbide bur.

After a type of hook is selected, loops are applied over a wafer with soft stainless steel 0.4 mm wire (Remanit) using Obwegeser wire twisters (2) and Luniatschek tools (2).

A 0.5 mm wire wire supports the mandible in advancements.

Twisting of loops is done swiftly by rotating the wire twister around the ring finger. Through experience, one learns to judge whether the degree of twisting is sufficient. Placing an index finger on the loop (with fingernail directed at the breakpoint) will indeed cause the wire to break where intended. The difference in wire temperature while under fixation creates a weak spot.
28.-33. Twisting and cutting IMF loops.

With the use of Mini-Molds, fixation is via dental floss or Vicryl sutures. Metallic wire may loosen the brackets.

34. Two-piece Le Fort I osteotomy stabilized with Mini-Mold (composite arch bar between two molds) and Vicryl suture as means of IMF.

Skeletal suspension

Infraorbital, supraorbital, and zygoma suspensions are no longer in use, and certainly not for orthognathic surgery. Occasionally, however, a piriform aperture suspension is useful for sandwiching the maxilla between the mandible and the rest of the skull. Rigid IMF (preoperatively) and elastic IMF (postoperatively) keep open bites closed, without extrusion of upper segment(s).

35. and 36. A piriform aperture suspension wire, fixed above the Le Fort I osteotomy line through a small hole in the bone; the wire pierces the incision wound and suspends the mandible while sandwiching the maxilla (complex facial rotation in hemifacial microsomia).
Protection of lips and wounds from the pins and hooks

Utility wax or orthodontic wax in small bits or as a short strip are pressed onto the brackets and hooks. Patients are instructed on proper care after each meal and with tooth brushing. Gishy Goo, a two-component silicone available as an alternative to wax, is more durable but costs more.

37. and 38. Orthodontic wax and Gishy Goo silicone compound for covering hooks, pins, and ligatures, to protect oral mucosa (cheek and lip).
39. Intramaxillary fixation of 2-piece Le Fort I osteotomy with self-curing acrylic (Unifast).

References to products and materials

Gishy Goo: Opal Orthodontics
Green silicon carbide bur: Komet Gebr. Brasseler
Kieferbruchschiene Hart/Weich: Scheu Dental GmbH
Kobayashi tie hook: Ortho Organizers, TP Orthodontics
Luniatschek gauze and wire director: Stryker
Mini-Mold: G&H Wire Company
Obwegeser wire twister with tungsten carbide inserts: Stryker
Orthodontic wax: Vitis, Dentaid SL
Ortholux: 3M Unitek
Remanit soft-weich: Remanium, Dentaurum
Sanitie: GAC
Transbond plus: 3M Unitek
Transbond XT: 3M Unitek
Tungsten carbide coated crimpable hooks: TP Orthodontics
Unifast: GC

References to literature