

Introduction to Contemporary Orthognathic Surgery







# Introduction to **CONTEMPORARY ORTHOGNATHIC SURGERY**

**Andrew C. Jenzer, DDS**

MAJ, US Army

Program Director, Oral and Maxillofacial Surgery Residency

Assistant Professor, Department of Surgery

Uniformed Services University of Health Sciences

Womack Army Medical Center

Fort Liberty, North Carolina

**Jonathan L. Czerepak, DMD**

9 Years Active Service US Army

Private practice

South Yarmouth, Massachusetts

**Joseph W. Ivory, DDS**

LTC (R), US Army

Private practice

Montgomery, Alabama

 **QUINTESSENCE PUBLISHING**

Berlin | Chicago | Tokyo

Barcelona | London | Milan | Mexico City | Paris | Prague | Seoul | Warsaw

Beijing | Istanbul | Sao Paulo | Zagreb



One book, one tree: In support of reforestation worldwide and to address the climate crisis, for every book sold Quintessence Publishing will plant a tree (<https://onetreepanted.org/>).



### Library of Congress Cataloging-in-Publication Data

Names: Jenzer, Andrew, author. | Czerepak, Jonathan, author. | Ivory, Joseph, author.

Title: Introduction to contemporary orthognathic surgery / Andrew Jenzer, Jonathan Czerepak, Joseph Ivory.

Description: Batavia, IL : Quintessence Publishing, [2024] | Includes bibliographical references and index. | Summary: "This book draws from the authors' unique experiences as military surgeons to guide readers through orthognathic surgery, from workup, planning, and maxillary and mandibular surgery to managing complications. Useful as both an introduction to oral surgery for new residents and as a concise resource for staff and surgeons"-- Provided by publisher.

Identifiers: LCCN 2023047243 | ISBN 9781647241247 (hardcover)

Subjects: MESH: Orthognathic Surgical Procedures--methods

Classification: LCC RK529 .J46 2024 | NLM WU 600 | DDC 617.5/22059--dc23/eng/20231213

LC record available at <https://lccn.loc.gov/2023047243>



©2024 Quintessence Publishing Co, Inc

Quintessence Publishing Co, Inc  
411 N Raddant Rd  
Batavia, IL 60510  
[www.quintessence-publishing.com](http://www.quintessence-publishing.com)

5 4 3 2 1

All rights reserved. This book or any part thereof may not be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, or otherwise, without prior written permission of the publisher.

Editor: Kristen Clark  
Design and production: Sue Zubek

Printed in Croatia

# CONTENTS



Preface vi

Contributors vii

Dedications ix

- 1** THE EVALUATION APPOINTMENT 1  
*Andrew C. Jenzer*
- 2** THE PRESENTATION 17  
*Andrew C. Jenzer*
- 3** ORTHODONTICS AND TREATMENT PLANNING 41  
*Russell M. Weaver*
- 4** THE PROCESS OF SURGICAL PLANNING 73  
*Frank A. de Latour / Andrew C. Jenzer*
- 5** THE DAY OF SURGERY: PREOPERATIVE PROTOCOLS 107  
*Mark A. Schlam / Andrew C. Jenzer*
- 6** MAXILLARY SURGERY 121  
*Andrew C. Jenzer / Zachary Daniels / James L. Koehler / James Patrick Arnold*
- 7** MANDIBULAR SURGERY 167  
*Jonathan L. Czerepak / Andrew C. Jenzer*
- 8** GENIOPLASTY 225  
*Joseph W. Ivory / Rishad Shaikh*
- 9** MAXILLOFACIAL COSMETICS 245  
*Marc M. Serra*
- 10** COMBINED TEMPOROMANDIBULAR JOINT REPLACEMENT AND ORTHOGNATHIC SURGERY 263  
*Reza Movahed*
- 11** MAXILLOMANDIBULAR ADVANCEMENT FOR OBSTRUCTIVE SLEEP APNEA 311  
*Joseph W. Ivory / Aaron D. Figueroa*
- 12** COMPLICATIONS 343  
*Tyler J. Hagler / Isabella A. Anderson / Christopher J. Smith / M. Caleb English / David B. Powers*

Index 370

# PREFACE



We wrote this book for residents. We want this collection of information to give you a foundational knowledge of orthognathic surgery and be easy to read and understand. We want it to be the kind of book you can pick up and review the evening before you go to the OR to review a procedure or before you go do an evaluation. Some of the best learning takes place when residents and staff discuss surgeries and cases to fill in knowledge gaps and describe the moves and feel of surgery. This book is the distilled essence of those conversations. It is not a dense text filled with historical information and references, because we wanted it to have a more organic feel. The photos and diagrams will build your knowledge of the surgical steps while also explaining *why* things are done in specific ways and highlighting the critical things to think about along the way.

Orthognathic surgery is beautiful. You can truly change someone's life in a brief procedure. This book will help you learn the basics, refresh your memory of the steps, and possibly make you question and think about the reasoning involved in each step. Anyone can learn a cookbook sequence of steps, and it is okay to follow a basic formula as you learn, but as you grow, you should question each maneuver and its purpose. Enjoy the journey.

—Andrew, Joe, and Jon

# CONTRIBUTORS



**Isabella A. Anderson, DMD**

CPT, US Army  
Winn Army Hospital  
Fort Stewart, Georgia

**James Patrick Arnold, DMD**

COL (R), US Army  
Private practice  
Aberdeen, North Carolina

**Jonathan L. Czerepak, DMD**

9 Years Active Service US Army  
Private practice  
South Yarmouth, Massachusetts

**Zachary Daniels, DMD**

MAJ, US Army  
General Leonard Wood Community Hospital  
Fort Leonard Wood, Missouri

**Frank A. de Latour, DDS**

MAJ, US Army  
Program Director  
Oral and Maxillofacial Surgery  
Eisenhower Army Medical Center  
Fort Eisenhower, Georgia

**M. Caleb English, DMD, FACS**

LTC, US Air Force  
Langley Air Force Base  
Hampton, Virginia

**Aaron D. Figueroa, DDS, FACS**

Private practice  
Northbrook, Illinois

**Tyler J. Hagler, DMD, MPH**

MAJ, US Army  
Evans Army Community Hospital  
Fort Carson, Colorado

**Joseph W. Ivory DDS, FACS**

LTC (R), US Army  
Private practice  
Montgomery, Alabama

**Andrew C. Jenzer, DDS**

MAJ, US Army  
Program Director, Oral and Maxillofacial Surgery  
Residency  
Assistant Professor, Department of Surgery  
Uniformed Services University of Health Sciences  
Womack Army Medical Center  
Fort Liberty, North Carolina

**James L. Koehler, DMD**

MAJ, US Army  
Womack Army Medical Center  
Fort Liberty, North Carolina

**Reza Movahed, DMD, FACS**

Clinical Assistant Professor  
Department of Orthodontics  
Saint Louis University  
St Louis, Missouri  
Visiting Professor  
Department of Oral and Maxillofacial Surgery  
Nova Southeastern University  
Fort Lauderdale, Florida  
Private practice  
St Louis, Missouri  
Bay Area, California

**David B. Powers, MD, DMD, FACS, FRCS (Ed)**

COL (R), US Air Force  
Professor of Surgery  
Vice Chair and Chief of Oral and Maxillofacial Surgery  
Director, Duke Craniomaxillofacial Trauma Program  
Division of Plastic, Maxillofacial, and Oral Surgery  
Duke University Medical Center  
Durham, North Carolina

**Mark A. Schlam, DMD**

9 Years Active Service US Army  
Private practice  
Bend, Oregon



**Marc M. Serra, DDS, FACS**

LTC, US Army  
Program Director, Oral and Maxillofacial Surgery  
Clinical Associate Professor of Surgery  
Uniformed Services University of Health Sciences  
Madigan Army Medical Center  
Joint Base Lewis-McChord, Washington

**Rishad Shaikh, DMD, FACS**

Private practice  
St Louis, Missouri

**Christopher J. Smith, DDS**

LTC, US Air Force  
Brooke Army Medical Center  
Joint Base San Antonio, Texas

**Russell M. Weaver, DDS, MS**

LTC (R), US Army  
Private practice  
Pinehurst, North Carolina

**Disclaimer:** *The views expressed herein are those of the authors and do not reflect the official policy of the Department of the Army, Department of the Air Force, the Uniformed Services University of Health Sciences, Department of Defense, or the US government, nor any institution. None of the authors have any relevant disclosures to report.*



# DEDICATIONS



To my surgery mentors who dedicated their careers to teaching and instructing, many of whom are contributors to this book. To Michelle Hood, Jason Untrauer, and the teachers and mentors I had along my journey who inspired the curiosity, fire, and passion for science and learning. To my parents, Thea and Jurg, for always inspiring and supporting me, and to my brother Max for being my best friend. And to my loving wife, Ariana, thank you for your patience and support.

*Andrew C. Jenzer*

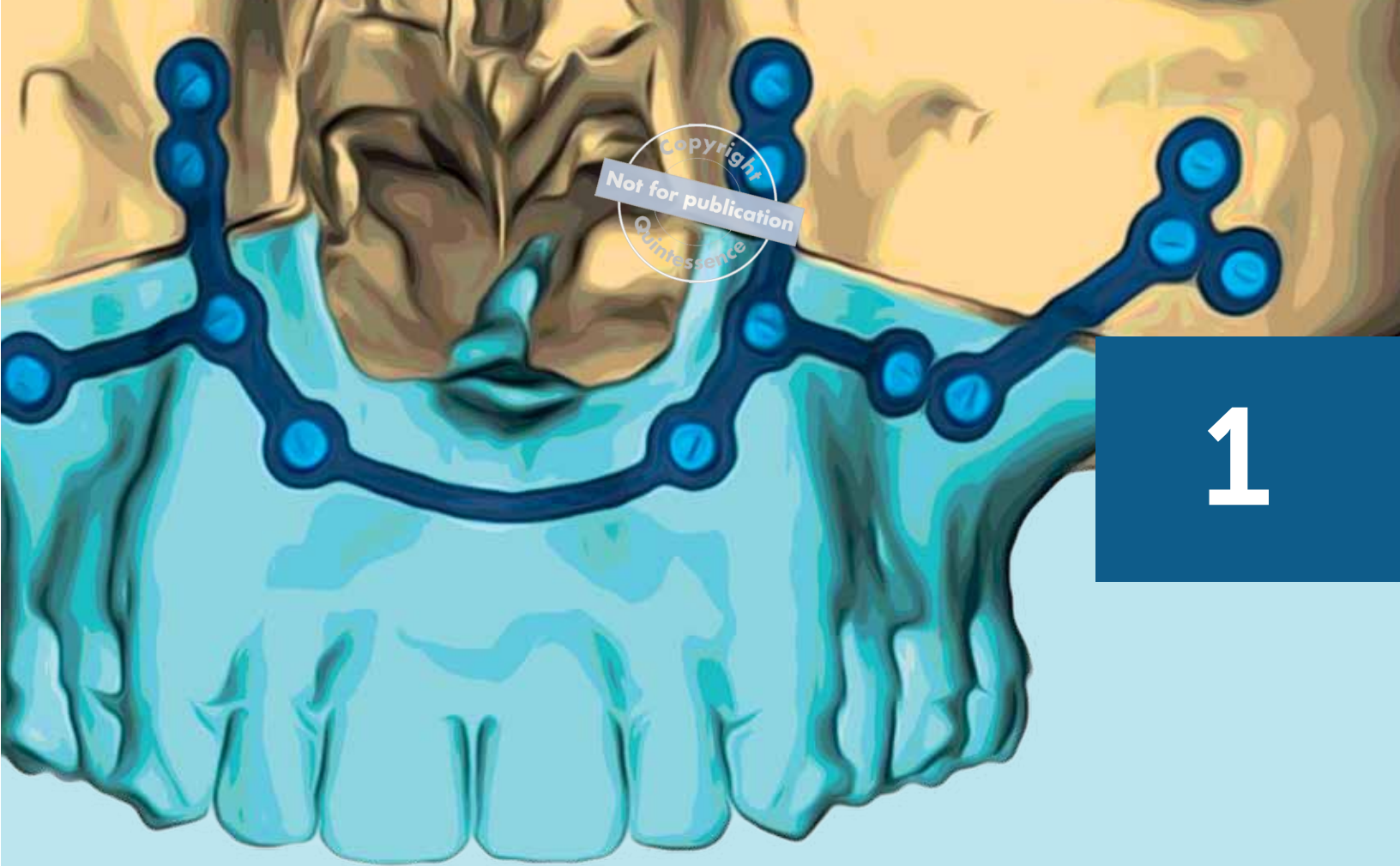
To my colleagues and residents who I have worked with over the past decade. To my patients who have honored me by trusting me with their care. For my wife and children who saw me through residency, fellowship, three tours in Afghanistan, and hours spent in the hospital. Knowing you were always there, ready to receive me when I came home, is the fire that drove me to succeed. And most of all to my Lord and Savior Jesus Christ, who saved me from my sins, gave me new life, and brought me safely through every danger. His steadfast love endures forever.

*Joseph W. Ivory*

To those who have dedicated themselves selflessly to the profession of oral and maxillofacial surgery and to those who are striving to join those ranks. To my wife, Rachel, and my parents, Les and Debra, for their steadfast love and support.

*Jonathan L. Czerepak*





## THE EVALUATION APPOINTMENT

*Andrew C. Jenzer*

The goal of this chapter is to clearly explain how to do an orthognathic workup with the patient in your chair, covering the subjective and objective sections, measurements, photographs, models, and bite registration. There are many ways to accomplish this; I will present you with how I do things. Like surgery, there are many ways to do something, and you should always strive to stay away from a cookbook mentality, but when you are learning for the first time, a template can be helpful (see the final section of this chapter for a customizable orthognathic evaluation template). Then, as you develop, you can alter how you do things to fit your style. I always tell my residents that the most important thing is to think critically about why you are doing something and understand the reasons behind it. I will strive to do that in this text to allow you a window into my thought process and explain how I structure my workups.

The goals of a good workup are (1) to gather the information that will allow you to make a correct diagnosis, which leads to an excellent surgical plan; (2) to

spend time with the patient explaining the procedures, risks, and complications associated with them and go over the timeline and process of surgery; and (3) to build rapport and trust with your patient to help them feel as comfortable as possible. A poor workup will lead to a flawed surgical plan. I always strive for predictability in surgery; the more predictable you can make your surgeries, the more you minimize all the factors that could contribute to a bad outcome or complication. **Never forget: Predictability equates to efficiency.**

There are two main types of workup: an initial workup and a final workup. An initial workup is when you see a patient who is not yet in orthodontics or has at least 6 to 12 months of orthodontic treatment left before surgery. A final workup is when a patient is referred from an orthodontist ready for surgery. Though most patients generally fall into the latter category (depending on your practice or residency), the initial workup is a critical skill because it emphasizes communication with the orthodontist and the orthodontic setup of the case. You must be able to understand and be a part of the treatment planning from the beginning, as many of the decisions about extractions, how to set up the teeth, etc, play a significant role in what surgery you will do. (Chapter 3 focuses on this aspect of treatment planning and communication—that is, how to speak orthodontics.) There are several differences between an initial and final workup. For example, the surgical plan is generally set in a final workup, and extra impressions are required to facilitate the virtual surgical plan (if an occlusal scanning technique is not used). The photographs and evaluation process, however, are the same for both.

## Workup and Examination

I always start by meeting the patient and asking what brings them to my office. The response could be “I want jaw surgery” or “my bite has always been off, and I want it fixed” or something to that effect. This naturally leads to a discussion of the history of present illness. You want to explore how long the problem has been present and any inciting events, like trauma. The main reason I dig into this is to see if something else might be going on besides a hypoplastic or hyperplastic jaw, namely something with the temporomandibular joint (TMJ). For example, I have seen plenty of patients who suffered an injury in childhood leading to a hypoplastic condyle and then insufficient development on one side, leading to both jaws being severely canted. Conversely, a hyperplastic and growing condyle can also manifest with facial asymmetry. Other considerations should include any syndromes and hemifacial microsomia, which can lead to numerous problems depending on the etiology and severity.<sup>1-3</sup>

I always ask them if they have had previous orthodontic therapy. Often patients who undergo multiple rounds of orthodontics end up with moderate to severe root resorption, so elucidating and documenting that in the history, and commenting

on it in your notes, is imperative. **Remember: Good documentation is your best friend; a preexisting problem becomes your fault if you do not document it.**

I then do a complete medical history review, covering past medical and surgical history, medications, allergies, and family and social history. Of particular importance is any history or problems with the TMJ and cervical spine. This then transitions into our limited physical examination. Any pertinent positives get a closer look, but otherwise the examination is generally limited to the head and neck.

I perform a full head and neck examination, which I will not detail here, but I will emphasize certain elements that are pertinent to orthognathic surgery. A portion of the workup and diagnosis will occur later using the photographs and radiographs you will obtain, but certain things need to be examined and measured clinically. A thorough TMJ examination is necessary, and any problems should be considered and addressed. This is a very detailed and controversial subtopic that is beyond the scope of this introductory text, but combination joint replacement with orthognathic surgery is discussed in chapter 10. I do a careful intraoral examination where I look at the hard and soft tissues, noting things like missing teeth, hygiene, and classification and characterization of the malocclusion using the Angle system (Class I, II, or III).<sup>4,5</sup> More detailed analysis regarding crowding, overbite and overjet, and shapes of the arches is postponed until later when I have photographs and models. Note that for any final workups before I bring a patient into the operating room, I perform all other necessary examinations and documentation needed, including a review of systems, an examination of other systems, and assigning an ASA classification to the patient.

### ***Tooth show in repose***

A few things are critical to measure clinically with the patient in the chair. The first is tooth show in repose (TSIR). TSIR will drive your surgical plan later because it will dictate the final position of the maxilla. It is the main driver behind figuring out the ideal positions of the jaws. TSIR is the relationship of the maxillary teeth to the upper lip in a relaxed position, or more simply, how much tooth structure shows at rest. I have found that the easiest way to get the patient into this relaxed position is to have them maintain their head in an upright and neutral position and simply ask them to open halfway while breathing through their mouth and keeping their face relaxed. The lips will naturally fall into the natural relaxed position, and then I use a Boley gauge to measure how much central incisor display is present. **I triple-check this measurement because it is absolutely critical in the planning process.** As surgeons, we use TSIR as a reference point instead of tooth show in animation because it is a much more predictable variable. Tooth show in animation can be affected by many other factors like the gingiva, amount of animation, etc, and can be addressed after surgery with tools like gingivectomy, botulinum toxin, or reverse vestibuloplasty.

Depending on age, a young to middle-aged person will show 1 to 4 mm of TSIR.<sup>6</sup> As we age and our tissues get more lax, we have less TSIR because the upper lip thins and hangs down more, obscuring more of the dentition. A common mistake among residents is estimating this measurement based on patient photographs. Do NOT do this; it is such a critical measurement because it dictates the final position of the maxilla, and you should not leave this up to a guess.

### **Midlines**

The other thing that I always measure is where the midlines of the maxilla and mandible are related to the midsagittal plane and to each other. An effective way to do this is to have an assistant hold a piece of dental floss vertically in the middle of the patient's face while you measure how far off the midlines are on either side. Remember to think about the nose; if it is off to one side, it can change your findings if you ignore it, so try to use a midline down the center of the face. It can be helpful to measure the upper lip length both at rest and in animation.

### **Canting**

Another thing to mention here is measuring a cant. A cant is a sideways tipping of a jaw, usually with reference to the maxilla, though the mandible will often cant to compensate. A good rule is that a cant of 2 mm or less is not evident to the untrained eye. With virtual surgical planning (VSP), measuring and correcting cants has become much easier and more predictable than model surgery. If a patient has a pronounced cant over 2 mm, I generally measure it clinically. To do this, I measure from the top of each orthodontic bracket (or cusp tips if no brackets are present) for the maxillary anterior teeth to the medial canthus of each eye. For the maxillary right canine, lateral incisor, and central incisor, I measure to the right medial canthus. For the maxillary left central incisor, lateral incisor, and canine, I measure to the left medial canthus. This is not a consistent measurement because you are estimating the position of each medial canthus and trying to duplicate that on the other eye, which introduces error. Also, any component of vertical dystopia (ie, one eye being higher or lower than the other) can make this measurement unreliable. Generally, this becomes more important in patients with either hemifacial microsomia or a hyperplastic or hypoplastic condyle, leading to a marked facial asymmetry. These patients tend to present with cants of 5 mm or more.<sup>2</sup>

### **Photographs**

The next step is to take photographs. I will discuss some basics of photography here, but I encourage you to learn more about the basics of dental-related photography, because taking good photographs for workups and during surgery is

a necessary skill.<sup>7</sup> Generally, I use automatic settings for extraoral photographs and a custom manual setting for intraoral images.

Using your camera's portrait mode or automatic setting for extraoral photographs is sufficient. The f-stop is a crucial feature to understand; it determines the depth of the field of focus in a photograph and generally goes from low (around 3 to 5) to high (24 to 30). A low f-stop is fine in extraoral photographs and will allow good image capture. For intraoral photographs, you want to turn the f-stop up as high as possible, which is why I use a manual setting. If you are taking an intraoral center photograph of the patient in centric occlusion, for example, increasing the f-stop will allow all of the teeth to be in focus when you focus the camera on the canine and take the shot. If you have a low f-stop for this photograph, the anterior teeth and molars will blur and be out of focus.

For intraoral photos, I use a standard lens with a ring flash and my manual settings configured to a high f-stop and a low ISO. ISO is the camera setting that dictates how long the aperture is open and capturing light. A standard ISO is often set to 800, whereas a high ISO can be 3,200 or more. Here, I like an ISO of 200. This will provide you with a crisper photo with less noise and granularity, but it does require a good light source, like a ring flash. Changing other variables can have different effects, but that discussion is beyond the scope of this chapter.

### **Extraoral photographs**

For extraoral photographs, you want an environment where you can consistently obtain high-quality images. I use a room with a dark photo backdrop and a tall standing ring light. If you do not have this available, using blue towels to create a backdrop can work. I take two or three photos in each position, which allows for mistakes and optimization during editing. A discussion on how to take each specific photograph follows here, with an analytical description later. Note that all of the photographs in this chapter are of me, so I reserve the right to make fun of the patient as we go through this process.

There are three critical extraoral photographs and a few optional ones. The first is the frontal repose photograph (Fig 1-1), which allows evaluation of the face at rest and a demonstration of the TSIR. You want to approach this the same way you evaluate the TSIR in the chair. I simply ask the patient to breathe through their mouth and open their mouth a little until I can see the maxillary teeth, and then I ask them to open or close it slightly to get it where I want it. You want to achieve a relaxed soft tissue drape to find the proper relationship of the upper lip to the maxillary teeth. The camera should be at a height that puts it level with the patient's face.

The second critical photograph is the frontal animation (smiling) photograph (Fig 1-2). You want to achieve a realistic animation, so I usually make a terrible joke here to get the patient to smile. This photograph allows for evaluation of the

## 1 \* THE EVALUATION APPOINTMENT

**FIG 1-1 (left)**

Frontal repose. Note the slightly open mouth and maxillary incisor display. Here I am showing minimal TSIR, about 1 to 2 mm.



**FIG 1-2 (right)**

Frontal animation. Find your favorite bad joke to put the patient at ease and capture a real smile.

**FIG 1-3 (left)**

Lateral profile with Frankfort horizontal (FH) plane marked. The FH plane (inferior of the orbit and superior aspect of the ear canal) should be parallel with the floor.



**FIG 1-4 (right)**

Patients generally lift their chins, exaggerated here, so positioning the FH parallel to the floor is critical.

**FIG 1-5 (left)**

Example of a right three-quarter view. Try to line up the tip of the nose with the contralateral malar area. The photograph is repeated on the left side as well.



**FIG 1-6 (right)**

Fox plane photograph to look for any canting. The Fox plane is placed against the maxillary teeth and held in place by the patient using their thumbs. Adjust the patient's head up or down so the photograph is directly in line with the metal edge of the plane. Minimal to no canting is seen here with my maxilla. You can also instruct the patient to smile so you can evaluate the teeth and contact with the Fox plane, especially in a multiplanar occlusion.



tissues of the face and balance of structures in animation as well as assessment of the dentition in animation (ie, the buccal corridors, gingival display, etc).

The last photograph you must capture is the lateral profile shot (Fig 1-3). This photograph can be tricky to obtain because nearly all patients lift their chin up when asked to pose for this shot (Fig 1-4). People intrinsically understand that by doing this, they make their necks look better and hide any retrognathia or adipose tissue, and in the setting of the photoshoot, it is a natural reaction. You want the Frankfort horizontal plane, which is from porion (the superior point on the bony external auditory meatus) to orbitale (the inferiormost part of the bony orbit) parallel to the floor, which you can see marked on Fig 1-3 for reference. You also must ensure they are biting in centric occlusion and not posturing their mandible forward. If they are retrognathic, they will often stick their mandible forward to hide this. I tell the patient to bite on their back teeth and hold that bite while I take this photograph. This allows an accurate evaluation of the face from the lateral view and helps determine the relationship between the maxilla and mandible.

The optional photographs here are the three-quarter views and the Fox plane photograph. Three-quarter photographs (Fig 1-5) are not ones I typically take during orthognathic workups, but they are standard as part of my cosmetic workup and really highlight the malar areas. The key to these photographs is lining up the tip of the nose with the soft tissue of the cheek behind it. The Fox plane photograph is taken to help determine whether there is any canting of the maxillary plane (Fig 1-6). The sterilized piece of metal (the Fox plane) is taken out of the package, and the patient is instructed to use their thumbs to press it gently against their maxillary teeth while making fists with their hands. You must ensure that the patient understands that they need to keep it flat against the teeth; if they rock it, the photograph will be invalid. The patient is then manipulated until the Fox plane edge is flat toward the photographer; you want to see light reflecting off the metal edge in the photograph. With VSP being widely used, the measurement, assessment, and correction of any cant is much easier, making this a somewhat outdated photograph. However, consider it during your evaluation process in cases with severe cants.

### ***Intraoral photographs***

Once the extraoral photographs are taken, I bring the patient back to the evaluation room and take the intraoral photographs. I have learned and tried many methods for this, and the following is what I have found works best for me. I use a pair of metal cheek retractors and a dental mirror as well as a ring flash on my camera and as high an f-stop as possible, as discussed earlier. Have your assistant place the mirror in a bowl of warm to hot water as you start this process; it makes the mirror less likely to fog and gives better photographs.

The first photograph is the intraoral center view. I have the patient sit in the dental chair and recline it until it is parallel with the floor, all the way back. I

## 1 \* THE EVALUATION APPOINTMENT

**FIG 1-7 (left)**

Intraoral center photograph. Note that the anterior and posterior teeth are in focus.

**FIG 1-8 (right)**

Intraoral left view. The camera is focused on the premolar areas. Ideally, the retractor is pulled back to allow visualization of the second molars without changing the angle of the camera, but in small mouths (like mine) this can be difficult.



give them the metal cheek retractors, generally making a joke about Wolverine (of the comic book *X-Men*) claws, and instruct them to place the bigger ends inside their cheeks. I then stand over the patient and take the photographs directly down and into their mouth. Getting an excellent intraoral photograph is tricky, mainly because it is hard to keep the entire field of view in focus. Often junior resident photographs will have some teeth in focus with others blurry and out of focus. The trick to this is to use autofocus on the canines, then move the center of the shot back to the middle and take the photograph (Fig 1-7). This will position the middle of the field of focus at the anteroposterior position of canines and extend your depth of field forward to capture the anterior teeth and posteriorly to capture the molars.

I then sit on my office chair, keeping the patient in the same reclined position, and move on to the intraoral left and right photographs (Fig 1-8). For the right intraoral photograph, I have the patient hold the left retractor very loosely, near the midline, simply to keep the soft tissues off the anterior teeth. I then take control of the right-sided retractor and tell them that I will briefly pull hard to get the photo and remind them to keep biting down. Getting this photograph is a balance because ideally you are coming directly perpendicular to the teeth on that side. But often the soft tissue is in the way, even with aggressive pulling. So you want to focus this shot on the premolar segment and cheat forward slightly so that your camera lens looks backward into the mouth a little. In an excellent intraoral left or right photograph, you can see the anterior part of the second molar. (We all know that providers make awful patients, and despite many attempts by my coauthor Dr Czerepak, my small lips were unable to pull back far enough to demonstrate this well in these photos, but hopefully you get the idea.) Another trick is to change out the metal cheek retractor you are using to pull the patient's lip back for a curved plastic one; I can more predictably and more easily get the shot I need using this.

Another technique to consider is using mirrors to obtain these shots (Fig 1-9). You can sometimes get a good photograph by placing a unique mirror into the side of the mouth and levering it out. This is an acceptable technique; I simply



**FIG 1-9 (left)**  
Alternative technique of using a mirror to take the intraoral left photograph.

**FIG 1-10 (right)**  
Maxillary arch photograph. The key is good mirror positioning, effective use of the retractor, and prevention of fogging.

don't routinely use it as I have found my methods give me quick and predictable photographs, and I find mirror photographs somewhat fickle due to fogging.

The last two intraoral photographs are the maxillary and mandibular arch shots. Still keeping the patient reclined all the way back, I explain to them what's going to happen—that I will place a big mirror in their mouth that fogs easily and ask them to hold their breath for 5 seconds when it goes in. I then get the maxillary shot first (Fig 1-10). I have the patient use the metal cheek retractors to hold their upper lip out of the way, have them open as wide as possible, and then have my assistant remove the mirror from the warm water bath, quickly dry it, and place it in the patient's mouth. The mirror needs to be as far back as possible, ideally behind the second molars and tilted away from the maxillary teeth as far as possible to get a good shot. I stand behind the patient to get a good photograph of the mirror, shooting down into the patient's mouth. This process is repeated for the mandible, with the assistant and I trading places to get a good photograph of the mandible in the mirror. The mandibular arch is often trickier because of the tongue. You can instruct the patient to pull their tongue back as far as possible, which usually works to keep it out of the way, or have them lift it up, and then the assistant can place the mirror under it, effectively pushing it back and out of the way.

Using the above methods, I can get a complete set of high-quality photographs in 5 to 10 minutes. It takes practice, and I would encourage you to try different angles and techniques to find what works best in your hands.

## Models and Bite Registration

An excellent set of models is imperative for a good workup. Minor problems become magnified later in the process, so you should accept nothing less than perfect. A single set should be fine if you are doing an initial workup because you are simply evaluating things. If you are completing a final workup, it is worth thinking through how many sets you need, which depends on your workflow for surgical planning. If you are doing VSP, you need a complete set to send off

for planning. If you are doing model surgery, of which I have done hundreds, you need multiple casts for redundant mountings to verify cross-mounts (very time-consuming and not enjoyable). If the maxillary surgery involves a multipiece surgery, then sending an uncut and a cut maxilla to the VSP company is wise. I generally get one extra set to pick the best one and compare for problems like distortion, blebs, or deviations when evaluating. For example, when I do a two-jaw surgery with a two-piece Le Fort, I will get two mandibular models and three maxillary models for the reasons mentioned above.

I make a caveat here that many surgeons have a completely digital workflow where they scan the occlusion and then set it virtually. Though this can be an excellent method in a skilled practitioner's hands, there are a lot of details in the process that demand understanding, so it remains important to learn both ways of navigating the process. Though I have found that virtually setting the occlusion generally produces excellent results, I always invite my orthodontist to join on the call to verify they are happy with the set occlusion to ensure I have their buy-in. I also know surgeons who practice with a hybrid system, taking their own impressions, modifying the occlusion as needed, then scanning that and sending it to a VSP company. There are many ways of hybridizing these systems, and I am sure they will continue to evolve (discussed in more detail later).

So how can you take excellent models on patients in braces? Several techniques are worth trying. Consider what we are trying to achieve with these models: Capturing the cusp tip relationship and translating that into a splint for use in surgery is the most important goal. With these models, I care much more about the occlusal half of the teeth and less about the rest. One technique is applying rope wax underneath the orthodontic wires and around and under the brackets to act as a blockout mechanism. Personally, after experimenting with this, I moved away from it and found that by simply pulling out the impression about 5 to 10 seconds before I usually would, the alginate would be at a perfect set. Too early and it will deform. Too late and it locks in and then rips or tears from the impression tray. I routinely use tray adhesive to help prevent this as well.

One tip my mentor gave me that I teach my residents is that you should take the impressions for a final workup yourself. So much of your surgical plan hinges on excellent impressions that you owe it to your patient to do that. A slightly less than ideal impression can translate to an incorrect surgical plan, and the downstream effect could be you in the operating room, trying to figure out why your splint doesn't fit. In all of this, I believe that you can increase the speed and predictability of your surgery in the operating room by optimizing the workup and preparation.

The bite registration has changed with the evolution of the workflow. For model surgery, you needed a bite registration trimmed to just the cusp tips to set the occlusion. However, for VSP, the company just scans the bite registration. So you can simply obtain a full bite registration, not trim it at all, and send it with the

models, or scan it if you are using a digital workhorse. I prefer using what we all know as a “blue moose” product for this. If you use something else, it is always a good idea to check with the VSP company first to make sure they can use it. If you are doing a multipiece maxilla, you should send the clinical bite registration as well as a bite registration of a cut and set maxilla in the final position.

## Radiographs

Radiology will be somewhat dictated by what the patient already has. Even a new patient will often bring in radiographs from their orthodontist if they have them. For a new patient, consider a panoramic radiograph and a lateral cephalometric radiograph or a CBCT scan to reconstruct these images. For a patient ready for surgery, a CBCT or medical-grade CT scan is necessary with a minimum slice thickness of 1 mm; either is acceptable for VSP. For multipiece Le Forts, ensure a way of measuring between the teeth where the cuts are proposed, either by measuring the CBCT or taking a separate dental periapical radiograph.

## Surgical Discussion

With all the information and data collected, I then sit down with the patient (and their family if present), and we have a detailed discussion about the surgery. If the patient is just starting or has not yet started orthodontics, I first discuss the basics and goals of presurgical orthodontics. I explain how our teeth compensate for skeletal abnormalities and that the teeth often strive to touch. I use my hands to demonstrate a Class II (retrognathic) patient as an example and explain how the upper teeth tend to tip in and back and how the lower teeth tip out to try to touch. I then explain that one of the major goals of braces is to decompensate this problem by positioning the teeth correctly within each jaw relative to the alveolar bone. I emphasize that this will make their bite worse but that we must first unmask the problem to optimize surgical correction and harmonization of the facial structure.

If the patient is in the initial phase of treatment, a surgical plan is usually not finalized, or it may change during the orthodontic decompensation, so I describe both a Le Fort and a bilateral sagittal split osteotomy (BSSO) to the patient and explain that we will not know the final plan until they are closer to being ready for surgery. I use skull models to explain the approaches, the bony cuts, and how the bone is fixed with titanium plates. I also explain that the hardware generally will stay there for the rest of their lives and that it won't set off metal detectors.

Next, I describe the positions of the second and third divisions of the trigeminal nerve and how they are exposed and protected during surgery. I go into detail about the expected numbness (paresthesia) after surgery. I try to use simple analogies that everyone can understand and relate to, so I explain that it feels the way your arm does when it falls asleep and starts waking back up (tingly). I find that is the most relatable sensation most people understand. I explain

that it does not affect the way the nerves recover, and that even though we do these procedures very carefully to protect them, the nerves are incredibly sensitive and even operating near and around them can cause altered sensation. I tell them that normal sensation usually returns but can take weeks to months and even up to 1 year or more to fully recover. There is a chance, especially with the BSSO, that there will be an element of permanent paresthesia, up to full loss of sensation, though this is uncommon. I spend considerable time discussing the risk of paresthesia in detail because the patient will have altered sensation after surgery, and I want to ensure they understand, especially with a BSSO, that it is possible they will have permanent paresthesia or anesthesia.

I then describe what the time leading up to surgery will look like; the basics of VSP and how that process works; and the importance of high-quality models, scans, and photos. We then review recovery and the postsurgical phase, and I let them know that they may go home the day of surgery or spend (generally) one night in the hospital.

If I am doing a final workup with a referred patient who is ready for surgery, I spend more time discussing their proposed surgical plan and the VSP process, as well as what they can expect after surgery. When discussing expectations for postoperative pain, I like to set the bar low and then try to exceed it, which I have found tends to make patients happy. When high expectations don't match reality, it creates conflict. So I ask patients if they have ever had the flu and felt pretty miserable for a week or so. When they inevitably answer yes, I tell them they can expect to feel like that for about 2 weeks—tired and uncomfortable, even with pain medications. I have had patients recover from upper and lower jaw surgery without requiring any home narcotic medications, as well as some who experienced substantial discomfort for a prolonged period, so I try to set the expectations low (and then hopefully exceed them).

This brings us to one of the single most important points that I repeatedly emphasize before surgery, after surgery at the time of discharge, and at every postoperative visit: chewing. I first explain that there is a very small chance I will wire them together after surgery (maxillomandibular fixation) and that my preference is simply to have them in guiding elastics (discussed in later chapters). However, I tell them that if they chew anything between their teeth, they can break their jaws and then we must do surgery again (I have had this happen, so I can tell you it is real!). I then describe a 6-week, nonchewing diet. My favorite analogy for this is to tell them to pretend that they are an old person with no teeth. Anything they can smush using their tongue and roof of their mouth is okay to eat but only if they are extremely careful not to chew. Out of all the information we give patients, this is one of the most critical instructions, so I try to hammer the point home each visit to ensure as much compliance as possible.

Future chapters delineate more postoperative discussions, including exercises, specific medications, etc, so after reading those and becoming familiar

with them, you can blend in any more tailored discussion that suites your style. Remember, patients will judge your competence as a surgeon based on their interaction with you, so do everything you can to establish a good relationship and make them feel comfortable and supported in their care. I spend a little more time with folks than average during these visits to build a good relationship and make sure I answer all their questions. I believe it goes a long way in helping to create that special patient-doctor relationship.

## Orthognathic Workup Template

The following template can be used for performing orthognathic evaluations. It is meant to be customized. Remove things you don't like, add things you do like, and make it yours. This is not a comprehensive list, but it should help guide you in performing an excellent workup.



An electronic copy of this template can be found here.

### Orthognathic Workup Evaluation

Chief complaint: \_\_\_\_\_

Referring provider: \_\_\_\_\_

History of present illness: \_\_\_\_\_

#### MEDICAL HISTORY

Past medical history: \_\_\_\_\_

Past surgical history: \_\_\_\_\_

Medications: \_\_\_\_\_

Allergies: \_\_\_\_\_

Social history: \_\_\_\_\_

Family history: \_\_\_\_\_

#### OTHER QUESTIONS TO ASK

Any history of previous orthodontics? \_\_\_\_\_

Are third molars present? \_\_\_\_\_

Is obstructive sleep apnea a concern? \_\_\_\_\_

Is this the final evaluation? Are the orthodontic appliances passive? How long have they been passive?  
\_\_\_\_\_

#### CRITICAL INFORMATION (TRIPLE CHECK!)

Tooth show in repose: \_\_\_\_\_

Maxillary midline relative to midsagittal plane: \_\_\_\_\_

Mandibular midline relative to midsagittal plane: \_\_\_\_\_





**MEASUREMENTS**

**Frontal view**

- 1. Facial fifths: \_\_\_\_\_
- 2. Brow position: \_\_\_\_\_
- 3. Brow-tip esthetic line: \_\_\_\_\_
- 4. Scleral show? \_\_\_\_\_
- 5. Nasal deviation (deviation, twist): \_\_\_\_\_
- 6. Tooth show in repose: \_\_\_\_\_
- 7. Tooth show in animation: \_\_\_\_\_
- 8. Gingival exposure while smiling: \_\_\_\_\_
- 9. Apertognathia: \_\_\_\_\_
- 10. Upper lip length: \_\_\_\_\_
- 11. Interlabial gap (lip incompetence): \_\_\_\_\_
- 12. Midlines relative to midsagittal plane
  - a. Maxillary: \_\_\_\_\_
  - b. Mandibular: \_\_\_\_\_
- 13. Buccal corridor fill (empty, full, narrow, etc): \_\_\_\_\_
- 14. Chin point relative to midsagittal plane: \_\_\_\_\_
- Other notes: \_\_\_\_\_

**Profile**

- 1. Profile (concave, flat/straight, convex): \_\_\_\_\_
- 2. Facial thirds: \_\_\_\_\_
- 3. Cheekbone, nasal base, lip curvature line: \_\_\_\_\_
- 4. Midface hypoplasia (infraorbital soft tissue relative to globe): \_\_\_\_\_
- 5. Malar region: \_\_\_\_\_
- 6. Radix take-off point (high/low and shallow/deep): \_\_\_\_\_
- 7. Dorsal hump (absent, present, pseudohump): \_\_\_\_\_
- 8. Nasal projection (anterior/posterior, over- or underprojected): \_\_\_\_\_
- 9. Nasal tip rotation (superior/inferior, over- or underrotated): \_\_\_\_\_
- 10. Columellar show (minimal, normal, excessive): \_\_\_\_\_
- 11. Nasolabial angle (acute, normal, obtuse): \_\_\_\_\_
- 12. Labiomental fold (normal, deep/exaggerated, flattened/obliterated): \_\_\_\_\_
- 13. Lip strain: \_\_\_\_\_
- 14. Chin projection (balanced, macrogenia, microgenia): \_\_\_\_\_
- 15. Neck-throat point (well-defined, flattened, obfuscated): \_\_\_\_\_
- 16. Submental lipomatosis: \_\_\_\_\_
- Other notes: \_\_\_\_\_







**Intraoral**

1. Maxillary and mandibular arch form (wide, narrow, U-shaped, V-shaped, omega-shaped): \_\_\_\_\_
  2. Spaces: \_\_\_\_\_
  3. Missing teeth: \_\_\_\_\_
  4. Crossbite: \_\_\_\_\_
  5. Third molars (present or extraction date): \_\_\_\_\_
  6. Molar class
    - a. Right: \_\_\_\_\_
    - b. Left: \_\_\_\_\_
  7. Canine class
    - a. Right: \_\_\_\_\_
    - b. Left: \_\_\_\_\_
  8. CR/CO shift: \_\_\_\_\_
  9. Overbite: \_\_\_\_\_
  10. Overjet: \_\_\_\_\_
  11. Cant (if so, consider measuring and Fox plane photo): \_\_\_\_\_
  12. Maximum incisal opening: \_\_\_\_\_
  13. Curve of Spee (flat, normal, steep): \_\_\_\_\_
  14. Intraoral pathology or concerns: \_\_\_\_\_
  15. Oral hygiene: \_\_\_\_\_
  16. Intraoral appliances (active, final surgical wire, powerchains, etc): \_\_\_\_\_
  17. TMJ issues (if so, do a full TMJ exam): \_\_\_\_\_
- Other notes: \_\_\_\_\_

**Nasal**

1. Cottle: \_\_\_\_\_
  2. Septal deviation: \_\_\_\_\_
  3. Inferior turbinate enlargement: \_\_\_\_\_
  4. Dorsal hump (absent, present, pseudohump): \_\_\_\_\_
  5. Projection (anterior/posterior): \_\_\_\_\_
  6. Rotation of the tip (superior or inferior): \_\_\_\_\_
  7. Alar base width: \_\_\_\_\_
- Other notes: \_\_\_\_\_





**BRIEF CLINICAL ASSESSMENT TO AID IN PLANNING**

Maxilla	Mandible	Dental	Soft tissue
<ul style="list-style-type: none"> <li>• AP deficiency</li> <li>• AP excess</li> <li>• Transverse excess</li> <li>• Transverse deficiency</li> <li>• Vertical maxillary excess</li> <li>• Vertical maxillary deficiency</li> <li>• Asymmetry</li> </ul>	<ul style="list-style-type: none"> <li>• AP deficiency</li> <li>• AP excess</li> <li>• Transverse excess</li> <li>• Transverse deficiency</li> <li>• Asymmetry</li> </ul>	<ul style="list-style-type: none"> <li>• Class I/II/III malocclusion</li> <li>• Midline discrepancy</li> <li>• Impacted teeth</li> </ul>	<ul style="list-style-type: none"> <li>• Normal</li> <li>• Abnormal</li> </ul>

## References

1. Steinbacher DM, Gougoutas A, Bartlett SP. An analysis of mandibular volume in hemifacial microsomia. *Plast Reconstr Surg* 2011;127:2407–2412.
2. Tahiri Y, Birgfeld C, Bartlett SP. Craniofacial microsomia. In: Rodriguez ED, Losee JE (eds). *Plastic Surgery, Volume 3: Craniofacial, Head and Neck Surgery and Pediatric Plastic Surgery*. Elsevier, 2018:744–800.
3. Wink JD, Paliga JT, Tahiri Y, et al. Maxillary involvement in hemifacial microsomia: An objective three-dimensional analysis of the craniofacial skeleton. *J Craniofac Surg* 2014;25:1236–1240.
4. Angle EH. Classification of malocclusion. *Dent Cosmos* 1899;41:350–357.
5. Proffit WR, White RP, Sarver DM. *Contemporary Treatment of Dentofacial Deformities*. Mosby, 2002.
6. Reyneke JP. *Essentials of Orthognathic Surgery*. Chicago: Quintessence, 2003.
7. Aschhiem KW, Wright FD. Esthetics and oral photography. In: Aschhiem KW (ed). *Esthetic Dentistry: A Clinical Approach to Techniques and Materials*, ed 3. Mosby, 2015:455–478.

# INDEX



Page numbers followed by “t” denote tables, those followed by “f” denote figures, and those followed by “b” denote boxes.

## A

Abdominal fat grafts, 269  
Absolute transverse discrepancy, 28, 29f, 68  
Aerophagia, 264  
AHI. *See* Apnea-hypopnea index.  
Airway  
    CBCT of, 318–319  
    Fujita classification of, 319, 319f  
    upper, 313f, 314  
Ala, 25–26  
Alar cinch suture, 148  
Allis clamp, 196, 196f  
Alphanumeric tooth numbering system, 42, 43f  
Amoxicillin-clavulanic acid, 302  
ANB angle, 37t, 38, 43–44, 226, 227f  
Anesthesia team, 108  
Angle classification of malocclusion, 30f  
Anterior nasal spine, 129f  
Anterior osteotomy, 180–184, 181f–186f  
Antibiotics  
    preoperative use of, 119  
    prophylactic use of, 301, 366  
Apertognathia, 27  
Apnea. *See* Central sleep apnea; Obstructive sleep apnea.  
Apnea-hypopnea index, 266, 278, 324b, 330, 338  
Appliances. *See* Orthodontic appliances.  
Arch length discrepancies  
    crowding caused by, 58  
    premolar extractions for, 57  
Arthroscopic graspers, 256, 256f  
Ascending ramus, 175  
Aufritsch retractor, 235  
Autologous fat grafts, 276

## B

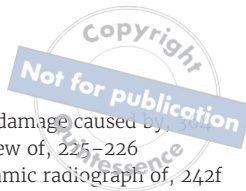
Bands  
    description of, 46, 46f, 58  
    failure of, 366, 367f  
    postsurgical removal of, 70  
Bauer retractors, 215, 216f, 362  
Berlin questionnaire, 315  
Bicortical screws, 206, 207f  
Bilateral sagittal split osteotomy  
    advantages of, 168  
    bone reduction, 192–194  
    complications of  
        bony interferences, 359–360  
        buccal plate fractures, 355, 355f–357f  
        condylar malpositioning, 359–360  
        condylar neck fractures, 356, 357f  
        distal segment fractures, 356  
        healing-related, 361–362  
        incorrect screw length, 360, 360f  
        lingual nerve damage, 358, 359f  
        nerve damage, 357–359, 358f–359f  
        types of, 354  
        unfavorable fractures, 354–357, 355f–357f  
    condylar seating in, 359–360  
    custom plates for, 109f  
    description of, 11–12, 24, 31, 58  
    dissection for, 172–173  
    elastics, 211f–212f  
    fracture in, 186–192, 187f–192f  
    healing after, 361–362  
    history of, 168  
    incision of, 171, 172f  
    indications for, 168  
    inferior alveolar nerve in  
        damage to, 357–359, 358f  
        description of, 173, 221f  
        freeing of, 191–192, 192f  
    intermediate splint in, 195, 195f  
    lingual plate fracture in, 192–193, 193f  
    local anesthesia for, 170  
    low and short technique, 219–222, 220f–221f  
    maxillomandibular fixation  
        bicortical screws, 206, 207f  
        description of, 194–195  
        miniplates, 206  
        plates for, 206–207, 207f  
        proximal segment, 197, 197f  
        removing patients from, 208  
        rigid internal fixation, 196–205, 196f–206f  
        screws for, 206  
        three-screw technique, 206  
    mucosal incision of, 171  
    neurosensory dysfunction caused by, 168  
    osteotomies in  
        anterior, 180–184, 181f–186f  
        assistant's role in, 179  
        medial, 176–178, 177f–179f  
        oblique ridge, 178–180, 179f  
    patient positioning for, 169–170  
    postoperative care, 210–213  
    recovery from, 208–210  
    screw depth analysis for, 93f

     setback distance, 194, 194f  
    soft tissue dissection, 170–175, 171f–176f  
    subperiosteal dissection for, 172  
    surgical setup for, 169–170  
    tripod, 75, 76f  
    virtual surgical planning for, 203f  
    wound closure of, 208–210  
Bipolar electrosurgical device, 117  
Bispectral index monitor, 321  
Bite registration, 10  
Bleeding  
    intraoral vertical ramus osteotomy-related, 362–363, 363f  
    maxillary surgery-related, 344–345, 345f  
Boley gauge, 3  
Bolton discrepancy, 32  
Bone loss, 34  
Bone reduction  
    in bilateral sagittal split osteotomy, 192–194  
    in maxillary surgery, 143–144  
Bone-borne distraction devices, 163  
Bovie, 117, 170  
Braces, 10  
Brackets  
    description of, 45–46  
    18-slot, 46  
    lingual, 46  
    self-ligating, 47, 47f  
    22-slot, 46  
Breathing tube placement, 110  
BSSO. *See* Bilateral sagittal split osteotomy.  
Buccal cheek pressure, 61  
Buccal corridors, 3  
Buccal plate fractures, 355, 355f–357f  
Bumpers, 30  
Bupivacaine, 117–118, 208, 237, 295  
Buttonholing, 233

## C

Canines, 75f  
Cant/canting, 4, 84  
CBCT  
    in chin analysis, 226  
    description of, 11  
    for midline setting, 83  
    in obstructive sleep apnea evaluation, 318–319  
Central sleep apnea, 314  
Cephalometric radiographs, 35–39, 36f–37f, 45  
Cephalometrics, 43–45

- Cephalosporins, 302  
 Cervicomentral angle, 250  
 Chewing, 12  
 Chin  
   advancement of, 241  
   analysis of, 226–230  
   asymmetry of, 228  
   downgrafting of, 238  
   height of, 226  
   ptosis of, 231, 364  
 Chin implants, 231  
 Chin point, 20  
 Chisel osteotome, 159f  
 Chlorhexidine, 237  
 Class I malocclusion, 30, 30f  
 Class II malocclusion  
   description of, 30f, 30–31, 44f, 50  
   division 1, 60  
   division 2, 60  
   mandibular incisor proclination and supereruption in, 61  
   maxillary incisor proclination in, 60  
 Class III malocclusion  
   description of, 30, 30f, 50  
   Le Fort I osteotomy for, 331  
   maxillary incisor proclination in, 60  
 Clear aligners, 48–49  
 Clear convex facial profile, 24, 24f  
 Cleft lip/palate, 110  
 Clindamycin, 301  
 Columella, 25–26  
 Communication, 108, 110–111  
 Complications  
   foreign body, 367–368  
   hardware failure, 366–368  
   infection, 365–366  
   mandibular  
     bilateral sagittal split osteotomy. *See* Bilateral sagittal split osteotomy, complications of.  
     bony interferences, 359–360  
     condylar malpositioning, 359–360  
     genioplasty, 363–365  
     healing-related, 361–362  
     inferior alveolar nerve damage, 357–358, 358f  
     intraoral vertical ramus osteotomy, 362–363  
     lingual nerve damage, 358–359, 359f  
     parafunctional habits, 360–361  
     reciprocating saw, 363  
   maxillary  
     bleeding, 344–346  
     bony healing compromises, 347–350  
     malocclusion and relapse, 351–352  
     movement predictability, 353–354  
     poor treatment planning, 351  
     soft tissue devascularization, 347–350, 348f–349f  
     unfavorable fractures, 346–347  
     SARPE, 352f, 352–353  
     segmentation of, 62–64  
 Dental casts  
   mounting of, 101, 102f  
   preparation of, 101, 103  
 Dental compensation, 59–60  
 Dentofacial deformities  
   description of, 225  
   in obstructive sleep apnea, 328–329, 331  
   orthognathic surgery for, 264, 304  
   temporomandibular disorders and, 265  
 Dermal fillers, 248–249  
 Descending palatine artery, 133, 135–137, 138f  
 Diagnoses, 18, 18b  
 Differential impaction, 85  
 Direct lipectomy, 253  
 DISE. *See* Drug-induced sleep endoscopy.  
 Distraction osteogenesis, 68, 98–100, 99f  
 Documentation, 3  
 Double-guarded osteotome, 131, 132f  
 Double-jaw surgery  
   mandible correction during, 87f  
   mandible-first approach to, 88–89  
   maxilla-first approach to, 89  
   maxillary advancement in, 86  
   moves for, 84–86  
   order of surgery for, 88–89  
   splints for, 90, 141  
   tooth show in repose, 84–86  
   workup for, 88  
 Downfracture of maxilla, 135–140, 135f–140f, 151, 336f  
 Downgraft, 236f, 237–238  
 Drug-induced sleep endoscopy, 267, 320–322, 321b, 327
- ## E
- EABs. *See* Erich arch bars.  
 18-slot brackets, 46  
 Elastics  
   in bilateral sagittal split osteotomy, 211f–212f  
   interarch, 69  
 Elastometric ligatures, 47  
 Electrosurgical units, 110, 117  
 Enameloplasty, 64–65, 71, 76, 80–81  
 Envelope of tooth discrepancy, 50, 50f  
 Epworth Sleepiness Scale, 315, 316b, 338  
 Erb's point, 252  
 Erich arch bars, 334  
 Esmarch maneuver, 322  
 ESS. *See* Epworth Sleepiness Scale.  
 Esthetics  
   genioplasty complications involving, 364–365  
   in maxillomandibular advancement, 331–332  
   in orthognathic surgery, 51–52, 56, 325  
 Exparel, 108, 117–118, 124  
 Extraction of teeth. *See* Tooth extractions.  
 Extraoral photographs



description of, 5–7, 6f, 19f–23f, 19–28  
 Fox plane, 6f, 7, 28, 28f  
 frontal animation, 5–7, 6f, 19f, 21–24  
 frontal repose, 5, 6f, 19–21, 19f–21f, 229f  
 lateral profile, 6f, 7, 24f, 24–28

## F

Facial asymmetry, temporomandibular joint replacement and maxillofacial osteotomy for, 290, 291f–294f  
 Facial fifths, 19–21, 20f  
 Facial nerve weakness, 302  
 Facial proportions, 248  
 FALL. *See* Forehead anterior limit line.  
 Fat grafting, 276f, 276–277  
 Fillers, dermal, 248–249  
 Final workup, 2, 12  
 Financial costs, 55  
 Finishing, 71  
 Fire risks, 110  
 Fish loops, 195  
 Fitzpatrick classification of skin type, 22, 22f, 23t  
 Flag spreader, 189–190, 190f  
 Footplate, 26  
 Forehead anterior limit line, 85  
 Foreign body, 367–368  
 Foreign body giant cell reaction, 268  
 Fox plane photographs, 6f, 7, 28, 28f  
 Frankfort horizontal, 227, 227f  
 Frankfort horizontal plane, 7  
 Friedman tongue position score, 317  
 Frontal animation photograph, 5–7, 6f, 19f, 21–24  
 Frontal repose photographs, 5, 6f, 19–21, 19f–21f, 229f  
 f-stop, 5  
 Fujita classification, 319, 319f  
 Full buccal corridor, 3  
 Full-thickness graft, 349f  
 Functional matrix hypothesis, 353

## G

Galetti articulator, 81  
 Genial bone advancement, 337  
 Genial tubercle  
 advancement of, 241  
 definition of, 239–240  
 Genioplasty  
 chin analysis before, 226–230  
 closure of, 364f  
 complications of, 363–365  
 contraindications for, 229  
 diagnosis before, 230  
 esthetic complications of, 364–365  
 history of, 225  
 infection after, 365  
 maxillomandibular advancement with, 337

nerve damage caused by, 226  
 overview of, 225–226  
 panoramic radiograph of, 242f  
 relapses after, 242  
 rhinoplasty and, 230f  
 sliding. *See* Sliding genioplasty.  
 stair-step, 238  
 surgical planning for, 97f, 97–98  
 sutures for, 119  
 telescoping, 238  
 temporomandibular joint replacement  
 and maxillomandibular advancement with, 281–282, 282f–285f  
 trapezoid-shaped, 240f, 241  
 treatment planning for, 230–232  
 variations in, 238–242  
 virtual surgical planning of, 289f  
 wound dehiscence after, 365  
 Gingiva, 22  
 Global impaction, 85  
 Glogau classification of photoaging, 22, 23t  
 Goldenhar syndrome, 304  
 Greenstick fracture, of lingual plate, 192

## H

Hand-articulated models, 53–54, 56  
 Hanging columella, 26  
 Hardware, 95f–96f, 95–97  
 Hardware failure, 366–368  
 Hargus medial ramus retractor, 173–174, 174f  
 Hemifacial microsomia, 2, 100f, 239f, 304  
 Hemorrhage, 299–300  
 Hemostat, 199, 200f  
 History of present illness, 2  
 History-taking, 2–3  
 Holdaway analysis, 227f  
 Holdaway ratio, 38  
 Hooks  
 description of, 47–48, 48f  
 placement of, 67–68  
 Horizontal vestibular incision, 150  
 Hourglass arches, 32  
 HPI. *See* History of present illness.  
 Hyaluronic acid dermal injections, 231  
 Hygiene, 28  
 Hyperbaric oxygen therapy, 347, 350  
 Hyperplastic condyle, 2  
 Hypopharynx, 313–314  
 Hypoplastic condyle, 2  
 Hyrax expander, 99f, 160f

## I

IMPA, 39  
 Implants  
 chin, 231  
 infraorbital, 261f  
 midface. *See* Midface implants.  
 Infection, 365–366

Inferior alveolar nerve  
 in bilateral sagittal split osteotomy  
 damage to, 357–359, 358f  
 description of, 173, 221f  
 freeing of, 191–192, 192f  
 damage to, 357–358, 358f, 362  
 in intraoral vertical ramus osteotomy, 168, 362  
 mapping of, 92, 94f  
 Inferior border cut, 181f, 181–182, 185  
 Inferior border retractor, 180, 181f, 185  
 Inferior turbinoectomy, 337  
 Infraorbital implants, 261f  
 Initial evaluation, 54–55  
 Initial workup, 2  
 Interarch elastics, 69  
 Intermediate splint, 90, 90f, 195, 195f  
 Interpositional bone graft, 236f, 237  
 Interproximal reduction, 30  
 Intraoral examination, 3  
 Intraoral photographs  
 center, 28–29, 28f–29f  
 description of, 7–9, 8f–9f, 53  
 left, 29–31, 30f  
 mandibular arch, 9, 31–33, 32f  
 maxillary arch, 9, 31–33, 32f  
 right, 29–31, 30f  
 Intraoral vertical ramus osteotomy  
 bleeding during, 362–363, 363f  
 complications of, 362–363  
 computed tomography of, 217, 217f  
 description of, 167–168, 214  
 endoscopic view during, 215f  
 history of, 168  
 inferior alveolar nerve and, 168, 362  
 mandibular setbacks treated with, 168  
 maxillomandibular fixation for, 217  
 nerve damage caused by, 362  
 oscillating saw for, 216  
 presurgical preparation for, 214  
 proximal segment in, 216, 217f  
 reciprocating saw accidents during, 363  
 retractors used in, 215, 215f  
 technique for, 214–218, 214f–218f  
 Inverted L osteotomy, 218, 218f–219f  
 Invisalign, 48  
 Iowa space, 62, 63f  
 IPR. *See* Interproximal reduction.  
 IVRO. *See* Intraoral vertical ramus osteotomy.

## J

J split, 182–183  
 Jaw thrust, 322  
 Jefferson Protocol, 327  
 Juvenile idiopathic arthritis, 278, 279f–281f

## K

K wire, 124



**L**

- Labiomental fold, 26–27
- Lateral cephalometric radiographs
  - description of, 35–39, 36f–37f, 37t
  - in obstructive sleep apnea evaluation, 318, 319f
- Lateral nasal wall osteotomy, 132–133
- Lateral profile photograph, 6f, 7, 24f, 24–28
- Le Fort osteotomy
  - blood loss during, 110
  - for Class III skeletal malocclusion, 331
  - complications of
    - nasal septum buckling or deviation, 350
    - soft tissue devascularization, 347–350, 348f–349f
    - unfavorable fractures, 346–347
  - description of, 11, 21
  - downfracture of, 336, 336f
  - guides for, 95, 96f
  - horizontal, 128
  - midface deficiency and, 260
  - multi-piece. *See* Multipiece Le Fort.
  - rhinoplasty and, 145
  - segmental, 277f, 347
  - three-piece. *See* Three-piece Le Fort osteotomy.
  - tooth extractions in, 164
  - two-piece, 63, 156f–157f
- Lehman analysis, 227f
- Lidocaine, 108, 118, 123, 234, 319, 321
- Ligation, 47, 47f
- Lighted LeVasseur–Merrill retractor, 215, 362
- Lingual brackets, 46
- Lingual buildup, 92
- Lingual nerve injury, 358, 359f
- Lingual plate fracture, 192–193, 193f, 356
- Lingual ramping, 90–91
- Lingual split, 87
- Lingula, 174, 175f
- Lip competency, 264
- Lip entrapment, 60
- Lip incompetence, 60
- Lip ptosis, 230
- Lipodissectors, 255
- Local anesthesia
  - for bilateral sagittal split osteotomy, 170
  - for maxillary surgery, 123–124
- Low and short technique, 219–222, 220f–221f
- Lower airway, 313
- Lower lip–chin prominence angle, 228
- L-style osteotomy, 88, 100
- Lugs, surgical
  - description of, 47–48, 48f
  - placement of, 67–68

**M**

- Macrogenia, 230
- Mallampati score, 317
- Malocclusion
  - Angle classification of, 30f
  - Class I, 30, 30f
  - Class II. *See* Class II malocclusion.
  - Class III. *See* Class III malocclusion.
  - dental compensation associated with, 59–60
  - growth modification appliances for, 50
  - after orthognathic surgery, 351–352
  - tooth movements to correct, 50
- Mandible
  - extraoral approach to, 88
  - hypoplasia of, 24, 27, 38, 331
  - midline of, 4, 28
  - posterior, 87
  - retrognathia of, 44, 60
- Mandibular arch
  - decompensation of, 58
  - photograph of, 9, 31–33, 32f
  - premolar extractions for leveling of, 57
- Mandibular foramen
  - in bilateral sagittal sinus osteotomy, 174
  - mapping of, 94, 95f
- Mandibular incisors
  - proclination of, 61, 229
  - retroclination of, 61
  - supererupted, 61
  - upright, 61
- Mandibular plane angle, 37, 37f, 89
- Mandibular surgery
  - bilateral sagittal split osteotomy in. *See* Bilateral sagittal split osteotomy.
  - intraoral vertical ramus osteotomy in. *See* Intraoral vertical ramus osteotomy.
  - inverted L osteotomy, 218, 218f–219f
  - low and short technique, 219–222, 220f–221f
  - modified condylotomy, 214
  - types of, 354
- MAP. *See* Mean arterial pressure.
- Maxilla
  - differential impaction of, 85
  - downfracture of, 135–140, 135f–140f, 151, 277, 336f
  - expansion of, 70
  - global impaction of, 85
  - heat mapping of, 93f
  - hyperplastic, 85
  - hypoplasia of, 84
  - midline of, 4, 28
  - postsurgical width stabilization of, 49, 49f
  - segmentation of, 62, 77–79, 77f–79f
  - superior repositioning of, 353
  - transverse discrepancy of, 29f, 68
  - transverse expansion of, 152
- Maxillary arch
  - hyrax expander in, 99f
  - photograph of, 9, 31–33, 32f
  - posterior, narrowing of, 61–62
  - segmentation of, 63
- Maxillary casts, 77–80, 77f–80f
- Maxillary incisors
  - anteroposterior position of, 52
  - central
    - final position of, 82
    - retroclination of, 36, 36f
  - decompensation of, 60
  - flared, 60
  - pitch position of, 52
  - proclination of, 57–58, 58f, 60
  - upright, 60
- Maxillary surgery
  - bleeding after, 344–345, 345f
  - bone reduction in, 143–144
  - closure of, 148–150, 149f–150f
  - complications of. *See* Complications, maxillary.
  - custom guides and plates in, 150–152
  - dissection in, 126–128
  - grafting considerations, 147–148
  - incision for, 125, 125f–126f
  - K wire for, 124
  - lateral nasal wall osteotomy, 132–133
  - local anesthesia for, 123–124
  - maxilla in
    - bony reduction of, 139–140, 140f
    - bony separation of, 128–134, 129f–134f
    - downfracture of, 135–140, 135f–140f, 151
    - plating of, 146–148, 147f
  - multi-piece Le Forts, 152–160, 153f–157f
  - nasal complex evaluation, 144–145
  - nasal mucosa, 128
  - occlusal adjustment, 124
  - patient preparations for, 122–123
  - presurgical preparations for, 121–124
  - pterygoid plate separation, 132–133
  - reciprocating saw in, 128, 130–131, 131f
  - rhinoplasty and, 145
  - SARPE in, 160–164, 160f–164f
  - smiley retractor for, 125f
  - subperiosteal dissection in, 127f
  - surgical splints for, 141–143, 141f–143f
  - suture closure in, 148–149
  - throat pack placement, 123
  - tooth extraction in, 164
  - tooth show in repose evaluation, 143f, 143–144
  - types of, 344
  - V–Y closure in, 149, 150f
- Maxillary third molars, 34, 57
- Maxillary tooth show in repose, 20
- Maxillomandibular advancement
  - adjunctive procedures, 336–337, 336f–337f
  - counterclockwise rotation in, 332
  - esthetic considerations, 331–332
  - extent of, 330–331



- genioplasty with, 337  
hemorrhage after, 299  
inferior turbinoplasty with, 337  
intubation for, 332  
mandible–first approach, 332–333  
maxillomandibular fixation in, 333–334  
modified septoplasty with, 336  
movement fixation and stability, 335–336  
for obstructive sleep apnea  
  comorbidities, 329–330  
  counterclockwise rotation, 332  
  definition of, 328  
  dentofacial deformities associated with, 328–329, 331  
  description of, 139  
  esthetic considerations, 331–332  
  extent of advancement, 330–331  
  genial tubercle advancement in, 240  
  indications for, 326  
  intubation, 332, 333f  
  movement fixation and stability, 335–336  
  orthodontic consultation in, 328–329  
  patient satisfaction after, 339  
  results, 338–339  
  treatment planning, 328–330  
open septorhinoplasty with, 336  
in orthognathic surgery, 328  
pain management after, 295  
patient satisfaction after, 339  
piriform rim widening in, 337  
results of, 338–339  
total airway volume after, 330–331, 338
- Maxillomandibular fixation  
for bilateral sagittal split osteotomy  
  bicortical screws, 206, 207f  
  description of, 194–195  
  miniplates, 206  
  plates for, 206–207, 207f  
  proximal segment, 197, 197f  
  removing patients from, 208  
  rigid internal fixation, 196–205, 196f–206f  
  screws for, 206  
  three-screw technique, 206  
description of, 88, 142f, 168  
for intraoral vertical ramus osteotomy, 217  
for maxillomandibular advancement, 333–334  
methods of, 334  
Minne Ties for, 334, 335f  
screws for, 206, 207f, 334  
for unfavorable fractures, 346
- Mean arterial pressure, 110  
Medial osteotomy, 176–178, 177f–179f  
Medical history, 3  
Megamomma wire, 49, 70  
Microgenia, 27, 230–231  
Midface deficiency, 21, 260
- Midface implants  
  description of, 260–262  
  surgical planning for, 97f, 97–98  
  virtual surgical planning of, 261
- Midline platysmectomy, 253
- Midlines  
  description of, 4, 28, 75, 81  
  setting of, 82–83
- Midsagittal plane, 21
- Miniplates, 206
- Minne Ties, 334, 335f
- MMA. *See* Maxillomandibular advancement.
- MMF. *See* Maxillomandibular fixation.
- Mobile orthognathic cart, 119
- Models  
  occlusion fit on, 64–65  
  stone, 74, 75f  
  in workup, 9–11, 53
- Modified condylotomy, 214
- Modified septoplasty, 336
- Molar Class I relationship, 51
- Molars  
  maxillary third, 34, 57  
  relationship among, 30
- MSP. *See* Midsagittal plane.
- Multipiece Le Fort  
  chisel osteotome for, 159f  
  instruments for, 158  
  in maxillary surgery, 152–160, 153f–157f  
  reciprocating saw for, 159f  
  single-piece Le Fort versus, 153  
  technique for, 152–160, 153f–157f
- Myofascial tissue, 267
- N**
- Nasal complex, 144–145
- Nasal dorsum, 25
- Nasal packing, 346
- Nasal septum  
  anatomy of, 145f  
  buckling of, 350
- Nasion, 37
- Nasolabial angle, 26
- Nasopharyngoscopy, 319
- Nasopharynx, 313
- Nasotracheal intubation, 110, 112, 112f, 273f
- Nausea and vomiting, postoperative, 118–119
- Neck  
  Dedo classification of, 27, 27t  
  throat point of, 27
- Nerve damage. *See also* Inferior alveolar nerve.  
  bilateral sagittal split osteotomy as cause of, 357–359, 358f–359f  
  genioplasty as cause of, 364  
  intraoral vertical ramus osteotomy as cause of, 362  
  temporomandibular joint replacement and maxillofacial osteotomy as cause of, 302–303
- Nerve hook, 174, 175f
- Nickel–titanium wires, 47
- Non-rapid eye movement sleep, 312
- Nose  
  ala of, 25–26  
  columella of, 25–26  
  deviation of, 20, 21f  
  dorsum of, 25  
  evaluation of, 267  
  in frontal repose photograph, 20  
  importance of, 26  
  inferior turbinates of, 145  
  overrotation of, 26  
  projection of, 26  
  pseudohump on, 25  
  radix of, 25  
  rotation of, 26  
  supratip break of, 25  
  twist deformity of, 20, 21f  
  underrotation of, 26
- NREM sleep. *See* Non-rapid eye movement sleep.
- O**
- Obesity, 325
- Oblique ridge osteotomy, 178–180, 179f
- Obstructive sleep apnea  
  anatomy of, 313f, 313–314, 318  
  central sleep apnea versus, 314  
  comorbidities in, 329–330, 365  
  conditions associated with, 314  
  depressants and, 325  
  diagnosis of  
  Berlin questionnaire for, 315  
  CBCT in, 318–319  
  drug-induced sleep endoscopy in, 320–322, 321b, 327  
  Epworth Sleepiness Scale for, 315, 316b  
  imaging in, 318–319, 319f  
  lateral cephalometry, 318, 319f  
  nasopharyngoscopy for, 319  
  polysomnography, 323–325, 324t  
  questionnaires for, 314–315, 316b–317b  
  STOP-BANG questionnaire for, 315, 317b  
  tongue examination in, 317, 318f  
  health problems associated with, 315f  
  obesity and, 325  
  physical examination in, 317  
  prevalence of, 265, 313  
  Revised Stanford Protocol for, 327, 327f  
  temporomandibular disease and, 265  
  treatment of  
  continuous positive airway pressure, 325  
  maxillomandibular advancement.  
  *See* Maxillomandibular

- advancement, for obstructive sleep apnea.  
 noninvasive modalities, 325  
 soft tissue procedures, 326f–327f, 326–328
- Obturator, 199
- Occlusal plane angle, 88
- Occlusion
- adjustments to, 76, 76f
  - assessment of, 64
  - final, setting of, 71, 74–81, 77f
  - orthognathic surgery goals for, 50–51
  - virtual surgical planning of, 82
- Occlusion fit on models, 64–65
- Oculocardiac reflex, 330
- Open septorhinoplasty, 336
- Operating room preparations, 107–108
- Opiates, 295
- Oropharynx, 317, 322
- Orthodontic appliances
- bands, 46, 46f, 58, 70
  - brackets, 45–46
  - clear aligners, 48–49
  - debonding of, 71–72
  - elastometric ligatures, 47
  - ligation, 47, 47f
  - retention after removal of, 71–72
  - surgical lugs/hooks, 47–48, 48f, 67–68
  - transpalatal arches, 49, 49f
  - wires, 46–47
- Orthodontists
- cephalometrics, 43–45
  - tooth numbering used by, 42–43, 43f
- Orthognathic surgery
- antibiotic prophylaxis, 366
  - complications of. *See* Complications.
  - definition of, 167
  - dentofacial deformities treated with, 264, 304
  - description of, 69
  - esthetic goals of, 51–52, 56, 245
  - goals of, 51–52, 56, 245, 247
  - objectives of, 49–53
  - occlusion goals of, 50–51
  - presentation for. *See* Presentation.
  - single-jaw, 81
  - stability goals of, 51
- OSA. *See* Obstructive sleep apnea.
- Osteotome, 187, 188f
- Osteotomies
- in bilateral sagittal split osteotomy. *See* Bilateral sagittal split osteotomy, osteotomies in.
  - description of, 176
  - intraoral vertical ramus. *See* Intraoral vertical ramus osteotomy.
  - inverted L, 218, 218f–219f
  - Le Fort. *See* Le Fort osteotomy.
  - medial, 176–178, 177f–179f
  - oblique ridge, 178–180, 179f
  - sagittal split. *See* Sagittal split osteotomy.
- for sliding genioplasty, 235, 235f  
 Overrotation, of nose, 226  
 Oxymetazoline, 124
- P**
- Pain management, in postoperative period, 117–118
- Palatal splint, 277
- Palmer tooth numbering system, 42, 43f
- Panoramic radiograph, 33–35, 34f
- Parafunctional habits, 360f, 360–361
- Paresthesia, 12
- Passive plating, 147
- Patient(s)
- breathing tube placement in, 110
  - eye protection for, 111
  - headwrap on, 111–117, 112f–116f
  - initial discussion with, 2
  - sign-in by, 111
  - surgical discussion with, 11–13
- Patient positioning
- description of, 108, 110–117
  - for maxillary surgery, 122
- Periapical radiographs, 35
- Perineural fat, 174
- Photoaging, Glogau classification of, 22, 23t
- Photographs
- extraoral
    - description of, 5–7, 6f, 19f–23f, 19–28
    - Fox plane, 6f, 7, 28, 28f
    - frontal animation, 5–7, 6f, 19f, 21–24
    - frontal repose, 5, 6f, 19–21, 19f–21f, 229f
    - lateral profile, 6f, 7, 24f, 24–28
  - intraoral
    - center, 28–29, 28f–29f
    - description of, 7–9, 8f–9f
    - left, 29–31, 30f
    - mandibular arch, 9, 31–33, 32f
    - maxillary arch, 9, 31–33, 32f
    - right, 29–31, 30f
  - overview of, 4–5
  - selection of, 18
  - three-quarter, 6f, 7
- Physical examination
- canting, 4
  - midlines, 4
  - overview of, 2–3
  - tooth show in repose, 3–4
- Piriform rim widening, 337
- Plate fixation, 206, 207f, 236, 236f
- Platelet-rich fibrin, 348
- Platelet-rich plasma, 208, 256
- Plating, in maxillary surgery, 146–148, 147f
- Platysmaplasty, 254f, 258
- Polysomnography, 323–325, 324t
- Posterior maxillary arch narrowing, 61–62
- Postoperative period
- nausea and vomiting in, 118–119
  - pain management in, 117–118, 124
- Postsurgical phase
- overview of, 69–70
  - splints, 70
  - surgical wire removal, 70
- Powerchain, 195, 195f
- Predictability, 2
- Premolar extractions, 57–58
- Preoperative protocols
- antibiotics, 119
  - communication, 108, 110–111
  - electrosurgical units, 110, 117
  - Exparel, 117–118
  - final time-out process, 117
  - medications, 117–119
  - nasotracheal intubation, 110, 112, 112f
  - operating room preparations, 107–108
  - patients
    - eye protection for, 111
    - foam tape added to, 112–116
    - headwrap on, 111–117, 112f–116f
    - positioning of, 108, 110–117
    - sign-in by, 111
  - postoperative pain management, 117–118
  - team protocols, 108, 110–111
  - tranexamic acid, 118
- Presentation
- description of, 17
  - diagnoses, 18, 18b
  - finishing of, 39
  - photographs in. *See* Extraoral photographs; Intraoral photographs; Photographs.
  - preparing of, 18
  - radiographs in. *See* Radiographs.
- Presurgical orthodontics
- cut spaces preparation, 62–64
  - dental arch bonding, leveling, and aligning, 58–59
  - orthodontist's goal in, 55
  - overview of, 55–56
  - premolar extractions, 57–58
  - referral to surgeon for final approval, 65–67
  - SARPE, 68–69
  - segmentation preparation, 62–64
  - tooth extractions, 57–58
- Pretreatment evaluation and coordination, 53–55
- Proclination, of maxillary incisors, 57–58, 58f
- Progress models, 64
- Pseudohump, 25
- Pseudomacrognathia, 230
- PSG. *See* Polysomnography.
- Pterygoid plates
- description of, 85
  - separation of, in maxillary surgery, 132–133
- Pterygomasseteric junction, 275



Pterygomasseteric sling, 200f  
 Pterygomaxillary plate chisel, 133f  
 Pulmonary fibrosis, 330  
 Pulmonary hypertension, 330

## R

Radiographs  
 cephalometric, 35–39, 36f–37f, 37t, 45  
 description of, 11, 33  
 lateral cephalometric. *See* Lateral cephalometric radiographs.  
 panoramic, 33–35, 34f  
 periapical, 35  
 Radix, 25  
 Rainbow drill, 201f, 201–202  
 Rapid eye movement sleep, 312  
 RDI. *See* Respiratory distress index.  
 Ready-to-cut referral, 65–67  
 Reciprocating rasp, 192, 192f  
 Reciprocating saw, 128, 130–131, 131f, 234, 363  
 Referral, 54  
 Relative transverse discrepancy, 28, 29f  
 REM sleep. *See* Rapid eye movement sleep.  
 Respiratory distress index, 324, 324t  
 Resting lines of skin tension, 199  
 Retention, after orthodontic appliance removal, 71–72  
 Retracted ala, 26  
 Reverse J split, 182  
 Revised Stanford Protocol, 327, 327f  
 Rhinoplasty, 25–26, 145, 248f  
 Risdon's incision, 303  
 RLST. *See* Resting lines of skin tension.  
 Root resorption, 34  
 Round arches, 31  
 Rowe disimpaction forceps, 139

## S

Sagittal split osteotomy  
 bilateral. *See* Bilateral sagittal split osteotomy.  
 nerve damage during, 358  
 Sandwich splint, 92, 92f  
 SARPE  
 bone-borne distraction devices used in, 163  
 closure of, 163, 163f  
 complications of, 352f, 352–353  
 definition of, 160  
 description of, 31, 68–69, 99  
 distraction osteogenesis for, 99  
 gingival dissection in, 153f  
 Hyrax palatal expander for, 99f, 160, 160f  
 indications for, 99f  
 in maxillary surgery, 160–164, 160f–164f  
 technique for, 160–164, 160f–164f  
 Sayre elevator, 155f

Second molars, 30  
 Segmentation, 62–64  
 Self-ligating brackets, 47, 47f  
 Self-tapping, 147  
 Sigmoid notch, 175, 363f  
 Single-guarded osteotome, 134, 134f  
 Single-jaw surgery  
 description of, 81  
 movement predictability after, 353  
 splints for, 90  
 Skeletal malocclusion. *See* Malocclusion.  
 Skin type, Fitzpatrick classification of, 22, 22f, 23t  
 Sleep  
 function of, 312  
 non-rapid eye movement, 312  
 rapid eye movement, 312  
 stages of, 312b  
 Sleep apnea. *See* Central sleep apnea; Obstructive sleep apnea.  
 Sleep medicine, 311  
 Sleep-disordered breathing, 265  
 Sliding genioplasty  
 closure of, 237  
 fixation for, 235–237, 236f  
 grafting for, 237  
 incisions for, 232–233, 233f  
 measurements for, 232  
 osteotomy for, 234–235, 235f  
 planning of, 232  
 postoperative care for, 238  
 stair-stepped, 230  
 subperiosteal dissection, 234, 234f  
 Smile retractor, 125f  
 Smith spreader, 189–190  
 Smoking cessation, 365–366  
 SNA, 37–38  
 Snake bite articulator, 81  
 SNB, 37t, 37–38, 38  
 Snoring, 322  
 Soft palate, 322  
 Soft tissue devascularization, 347–350, 348f–349f  
 Spacing, 32  
 Spatula osteotome, 187, 188f  
 Splints  
 how to make, 101–106, 101f–106f  
 intermediate, 90, 90f  
 maxillary surgery use of, 141–143, 141f–143f  
 for maxillomandibular fixation, 88  
 postsurgical, 70  
 refining of, 106  
 sandwich, 92, 92f  
 smoothing of, 106  
 trimming of, 105, 105f  
 Sprung Allis clamp, 196, 199, 196f  
 SSI. *See* Surgical site infections.  
 SSO. *See* Sagittal split osteotomy.  
 Stability  
 maxillomandibular advancement, 335–336  
 orthognathic surgery goals for, 51

Stainless steel ligatures, 47  
 Stair-step genioplasty, 238  
 Stanford Protocol, 326, 327f  
 Stereolithographic model, 271  
 Stone models, 74, 75f  
 STOP-BANG questionnaire, 315, 317b  
 Straight impaction, 85  
 Stryker drill, 201–202  
 Submental crease, 252  
 Submental lipomatosis, 27  
 Submental pocket, 256  
 Submentoplasty  
 complications of, 259–262  
 hematoma after, 259, 259f  
 hemostasis for, 253, 258  
 indications for, 250f, 250–251  
 marking of, 251  
 overview of, 249–250  
 surgery for, 251–259  
 suspension neck lift with, 249  
 tips for success, 257–259  
 Subnasale, 24  
 Subperiosteal dissection, 127f, 172, 172f, 234, 234f  
 Supratip break, 25  
 Surgeon  
 ready-to-cut referral to, 65–67  
 responsibilities of, 82  
 Surgical discussion, 11–13  
 Surgical lugs  
 description of, 47–48, 48f  
 placement of, 67–68  
 Surgical planning  
 distraction osteogenesis, 98–100, 99f  
 genioplasty, 97f, 97–98  
 importance of, 167  
 midface implant, 97f, 97–98  
 overview of, 73–74  
 single-jaw surgery, 81  
 virtual. *See* Virtual surgical planning.  
 Surgical site infections, 300–302  
 Surgical wire removal, 70  
 Surgically assisted rapid palatal expansion. *See* SARPE.  
 Sutures, 119, 236

## T

TAV. *See* Total airway volume.  
 Team  
 communication among, 108, 110–111  
 protocols for, 108, 110–111  
 TeamSTEPPS, 108  
 Technetium-99m scan, 35  
 Telescoping genioplasty, 238  
 Template, workup, 13–16  
 Temporomandibular disease, 264–265  
 Temporomandibular joint  
 examination of, 3  
 history-taking about, 2–3  
 Temporomandibular joint replacement and maxillofacial osteotomy activity after, 297



case studies of, 278–295, 279f–295f  
 for chronic jaw/facial pain and  
     obstructive sleep apnea, 281–282,  
     282f–285f  
 clinical follow-up after, 296  
 complications of  
     chronic pain, 298–299  
     cranial nerve VII, 303  
     cranial nerve VII, 303  
     hemorrhage, 299–300  
     infection, 300–302  
     nerve damage, 302–303  
     prevalence of, 297–298, 298f  
     surgical site infections, 300–302  
 condylar neck in, 275  
 endaural approach, 273  
 in facial asymmetry patient, 290,  
     291f–294f  
 fat grafting for, 276f, 276–277  
 genioplasty and, 281–282, 282f–285f  
 in juvenile idiopathic arthritis patient,  
     278, 279f–281f  
 mandible–first surgery, 267–268  
 maxilla–first surgery, 267–268  
 nutrition after, 296  
 orthognathic surgery, 277–278  
 pain management after, 295  
 physical therapy after, 296–297  
 postoperative care, 295–297  
 preoperative assessment, 266–267  
 preparation for, 272–273  
 rationale for, 264–266  
 steps involved in, 273, 274f–275f  
 subperiosteal dissection in, 273, 274f  
 surgical techniques, 272b, 272–278  
 for TMJ pain and condylar resorption,  
     286–289, 286f–289f  
 total joint prosthesis systems for,  
     268–269  
 traction injuries after, 303  
 virtual surgical planning for  
     conventional planning versus,  
     269–271  
     imaging improvements with,  
     270–271  
     protocol, 271b, 271–272  
 Third molar extractions, 34, 57  
 3D printing, 269  
 3M Clarity Aligners, 48  
 Three-piece Le Fort osteotomy  
     complications of, 347–350, 348f–349f  
     description of, 62  
     maxillary cast sectioning, 77–80,  
     77f–80f  
     maxillary movements for, 85f  
     splint for, 91f  
 Three-quarter photographs, 6f, 7  
 TIVA. *See* Total intravenous anesthetic  
     technique.  
 TMD. *See* Temporomandibular disease.  
 Tongue, 317, 318f  
 Tooth discrepancy, envelope of, 50, 50f  
 Tooth extractions

    in Le Fort osteotomy,  
     in maxillary surgery, 164  
     presurgical, 57–58  
 Tooth movements, 50, 64  
 Tooth numbering, 42–43, 43f  
 Tooth show in animation, 3  
 Tooth show in repose  
     description of, 3–5, 84, 278, 331  
     maxillary, 20  
     in maxillary surgery, 143f, 143–144  
 Tooth size, 32  
 Tooth-borne custom positioning guide,  
     240f, 241, 242f  
 Total airway volume, 318, 331, 337–338  
 Total intravenous anesthetic technique,  
     118  
 Tranexamic acid, 118, 252, 345  
 Transfacial trocar, 199  
 Transpalatal arches, 49, 49f, 70  
 Transverse discrepancy, 28–29, 29f  
 Trapezoid-shaped genioplasty, 240f, 241  
 Treatment  
     final occlusal settling, 71  
     financial costs of, 55  
     finishing phase of, 71  
     initial evaluation phase of, 54–55  
     postsurgical phase of. *See* Postsurgical  
     phase.  
     presurgical phase of. *See* Presurgical  
     orthodontics.  
     pretreatment evaluation and  
     coordination phase of, 53–55  
     surgical phase of, 69  
 Trigone, 134  
 Tripod bilateral sagittal split osteotomy,  
     75, 76f  
 Tripod/tripoding, 31, 59  
 TSIR. *See* Tooth show in repose.  
 22-slot brackets, 46  
 Twist deformity, 20, 21f  
 Two-piece Le Fort osteotomy, 63  
 TXA. *See* Tranexamic acid.

**U**

Underrotation, of nose, 26  
 Unfavorable fractures  
     bilateral sagittal split osteotomy, 354–  
     357, 355f–357f  
     Le Fort osteotomy, 346–347  
 Universal tooth numbering system, 42,  
     43f  
 Upper airway, 313f, 314  
 U-shaped arches, 31  
 U1–SN angle, 44

**V**

VDO. *See* Vertical dimension of occlusion.  
 Vertical anterior osteotomy, 94  
 Vertical dimension of occlusion, 30  
 Vertical dystopia, 4  
 Vertical subcondylar ramus osteotomy.

*See* Intraoral vertical ramus  
     osteotomy.  
 Virtual surgical planning  
     advantages of, 86  
     bite registration for, 10  
     cant measurements, 4  
     inferior alveolar nerve, 173f  
     for maxillomandibular advancement,  
     328  
     midface implants, 261  
     models used in, 9–10  
     patient discussions about, 12  
     printouts from, in operating room,  
     108, 109f  
     steps involved in  
         cant correction, 84  
         centric relation of condyles, 82, 83f  
         final occlusion, 82  
         information gathering, 92–94  
         interference evaluation and  
         adjustments, 86–88  
         intermediate position, 89  
         mandible correction, 87f  
         midline, 82–83  
         moves, 84–86, 88–89  
         order of surgery, 88–89  
         preparation, 81–82  
         splints, 90–92, 90f–92f  
         tooth show in repose, 84–86  
 VOTE criteria, 321–322, 323f  
 V-shaped arches, 31  
 VSP. *See* Virtual surgical planning.  
 V–Y closure, 149, 150f

**W**

Wires, 46–47  
 “Witch’s chin” deformity, 231, 364  
 Wits appraisal, 38  
 Workup  
     final, 2, 12  
     goals of, 1–2  
     initial, 2  
     models in, 9–11, 53  
     patient discussions in, 2  
     photographs for. *See* Photographs.  
     radiographs in, 11  
     surgical discussion in, 11–13  
     template for, 13–16  
     types of, 2

**Y**

Yawing, 87

**Z**

Zygomaticomaxillary buttress, 126, 137,  
 148