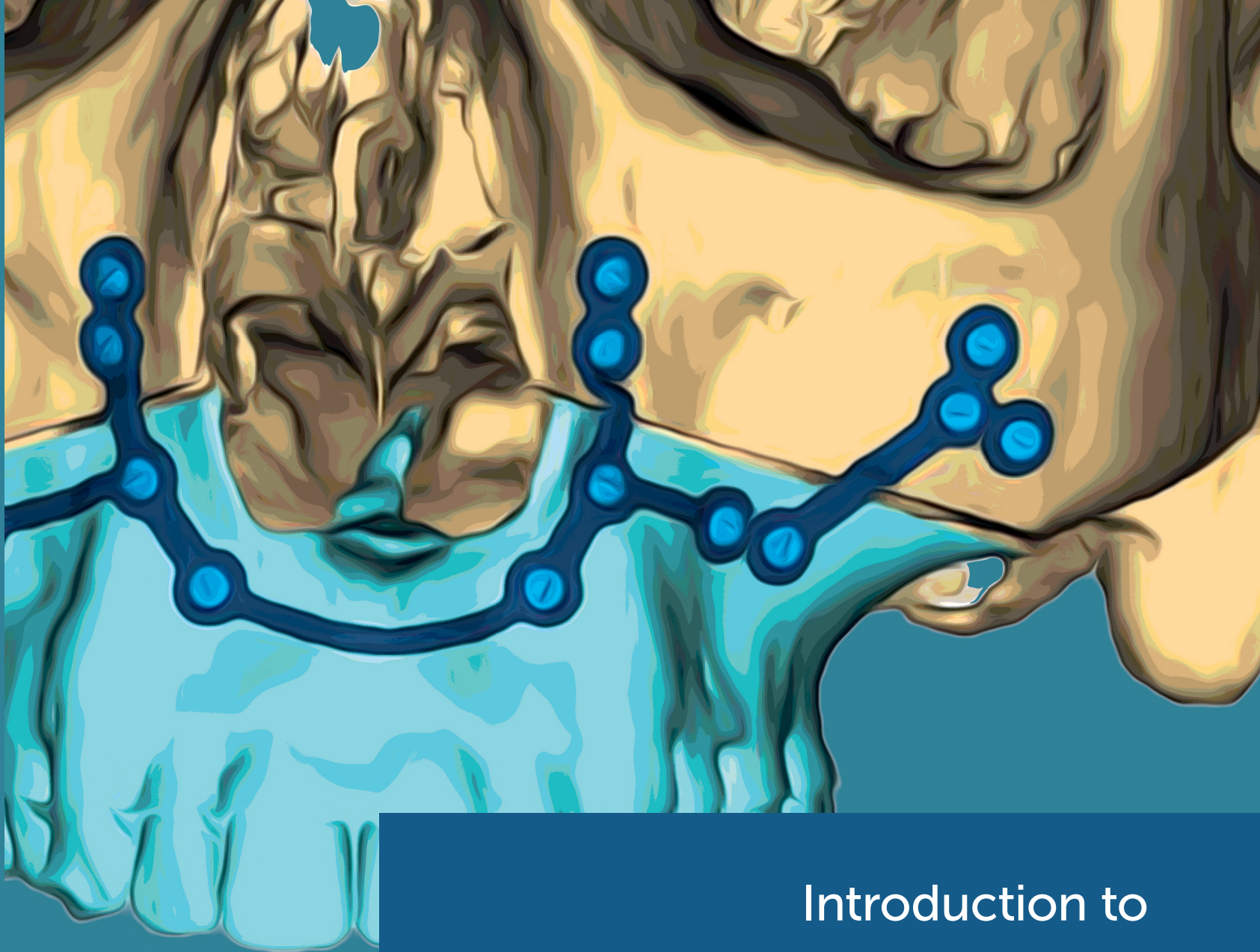
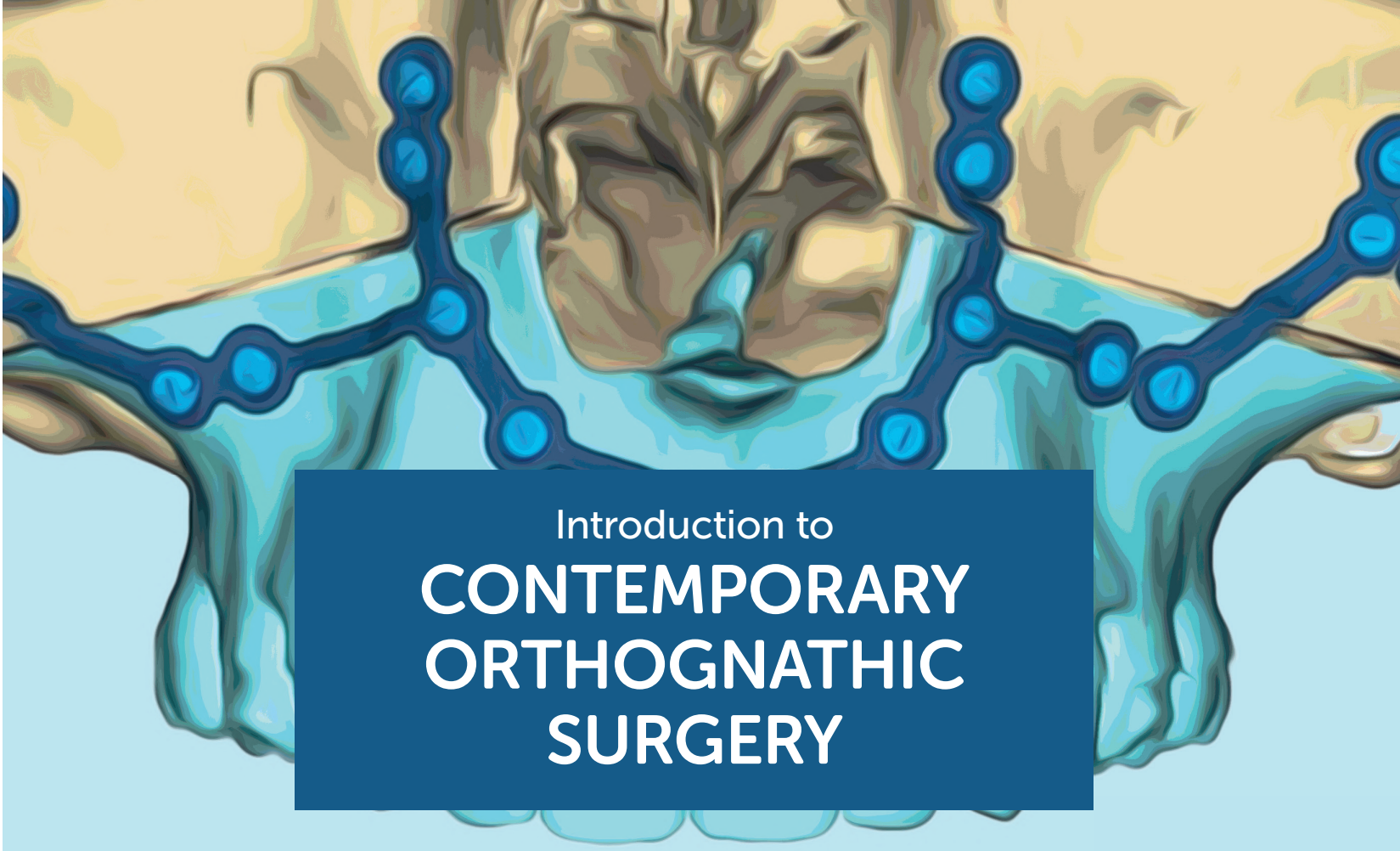


Introduction to CONTEMPORARY ORTHOGNATHIC SURGERY

Andrew C. Jenzer, DDS
Jonathan L. Czerepak, DMD
Joseph W. Ivory, DDS

QUINTESSENCE PUBLISHING

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://onetreeplanted.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

QUINTESSENCE PUBLISHING USA

Quintessence Publishing Co, Inc
411 N Raddant Rd
Batavia, IL 60510
www.quintessence-publishing.com

5 4 3 2 1

Editor: Kristen Clark
Design and production: Sue Zubek

Printed in Croatia

CONTENTS

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.

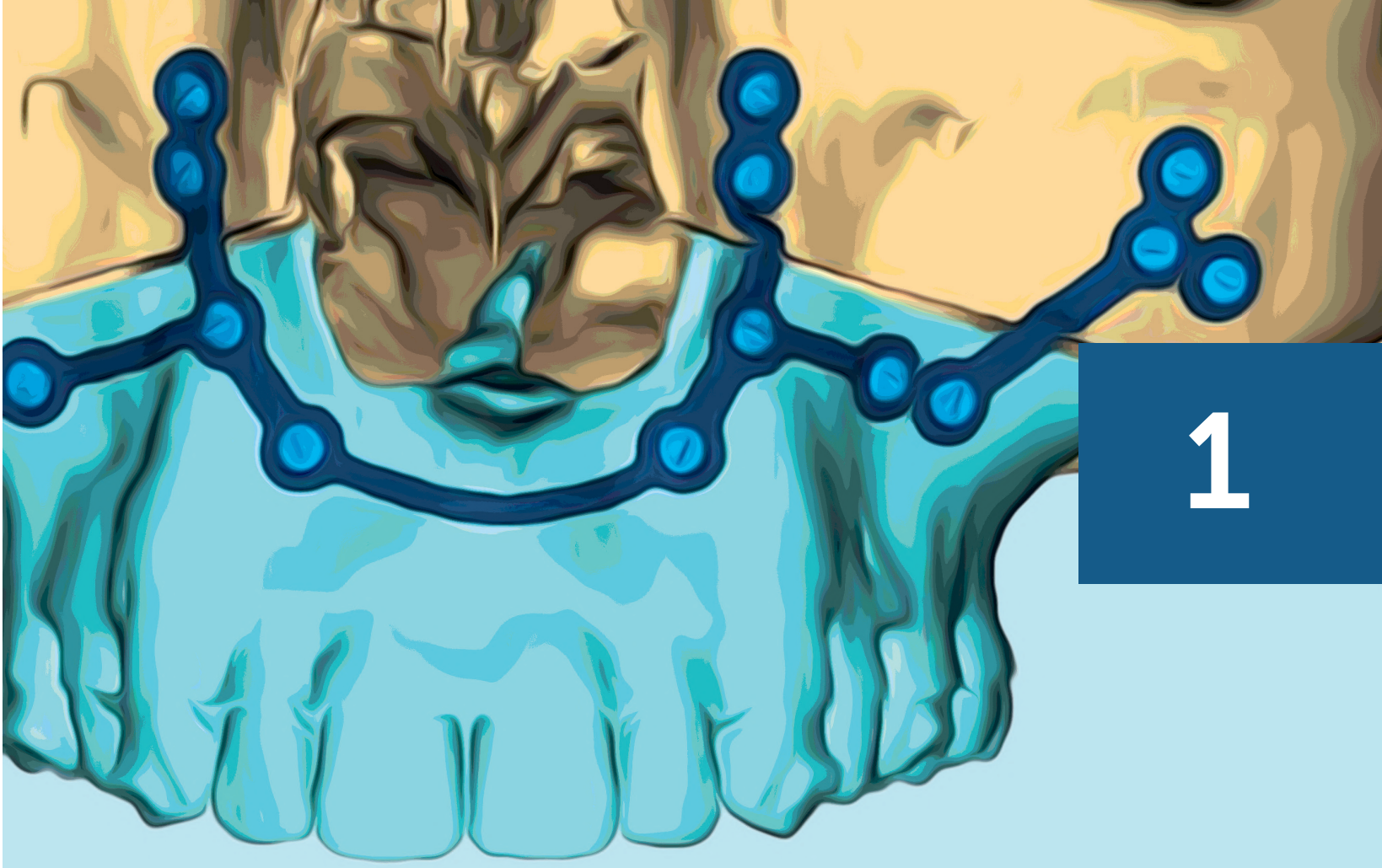
Andrew C. Jenzer

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



1

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.[1–3]

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).[4,5] 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.[6] 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.[2]

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.[7] 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

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.

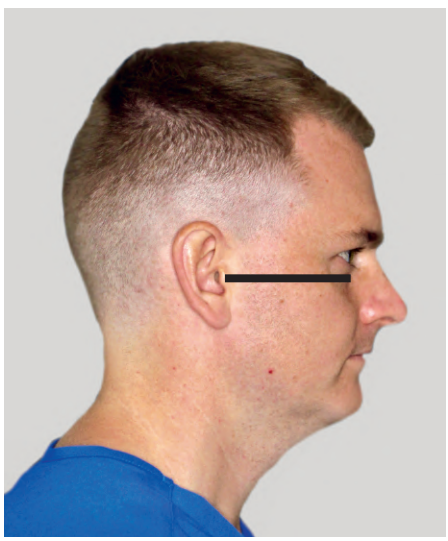


FIG 1-4 *(right)*
Patients generally lift their chins, exaggerated here, so positioning the FH parallel to the floor is critical.

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.