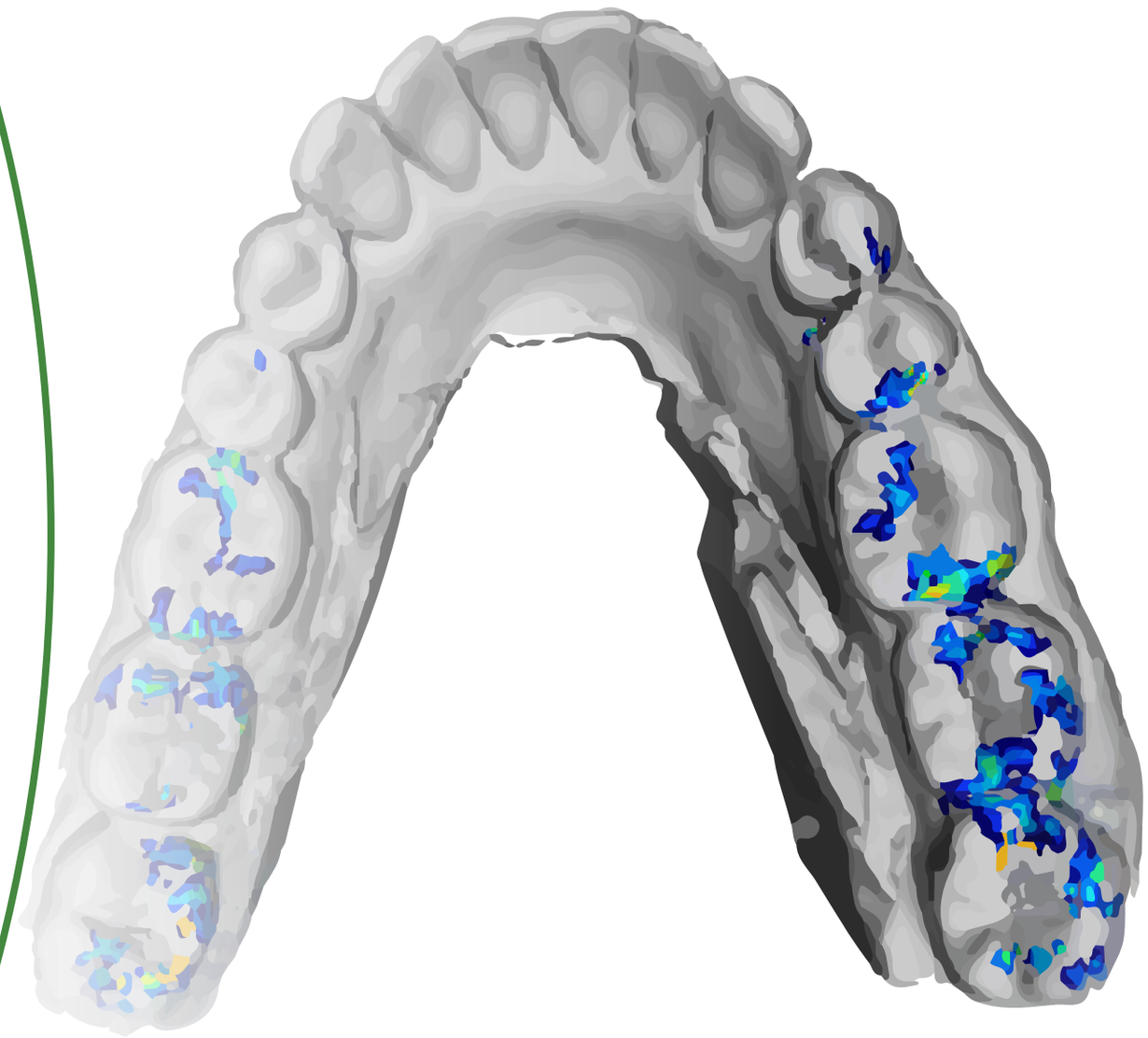
Tekscan™

Clinical Chronicles of TMD Resolution with Digital Occlusion

How to Use a Digital Protocol to Balance an Anatomical Splint

by Dr. Curtis Westersund

TABLE OF CONTENTS



PREFACE

The TMD universe is vast and ever-changing, just like the real thing. And while treatment approaches are as unique as the patient, there are some protocols in place to help guide your diagnosis and set the foundation for your treatment plan. One such case was illustrated by Dr. Curtis Westersund, from Alberta, Canada, who uses digital tools to assess his patients' symptoms so that he can apply the right treatment modality.

He's found success in a digital approach to TMD symptoms and shares his protocol on how to balance an anatomical splint. Based on his webinar case presentation, he outlines all the considerations, steps, and tools required to successfully balance a splint for TMD treatment.

It's TMD treatment made predictable

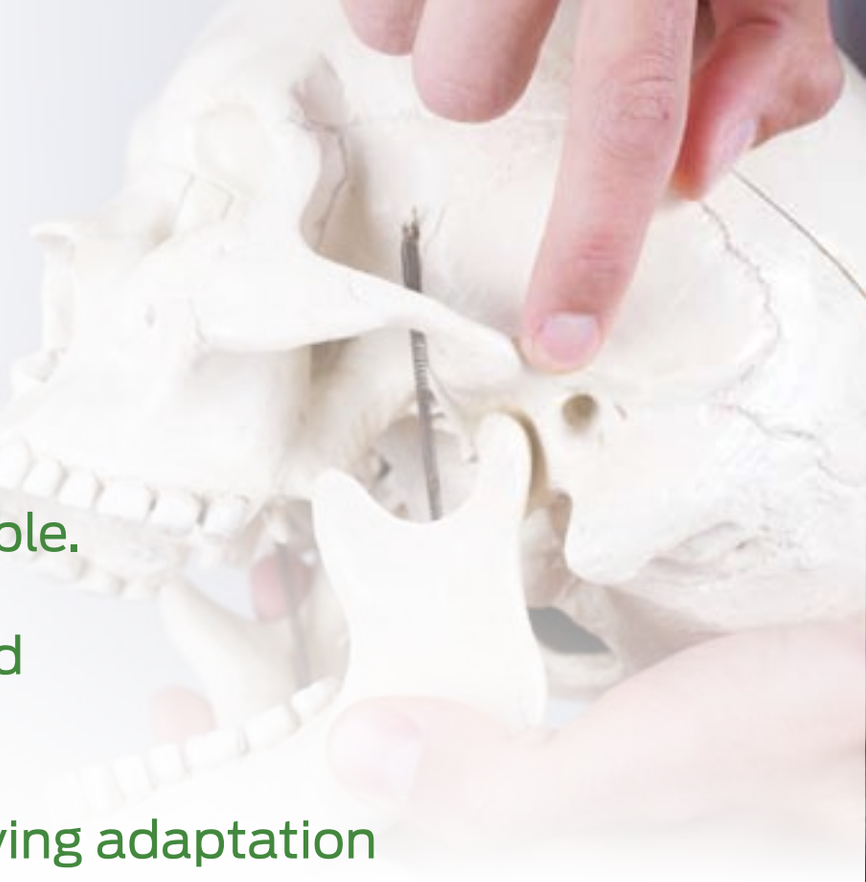
INTRODUCTION

Successful TMD treatment depends on many factors. The key, of course, is finding the correct diagnosis with the best treatment. In order to do so, we have to be able to see what's going on with our patient's physiology that is causing problems. We take photos of the patient, we assess their postural balance and flexibility, and we examine:

- Muscle tension
- Muscle balance
- Airway patency
- TMJ mobility
- Inflammation
- Function
- Functionality of the patient's occlusion

With that information we can develop the various coordinated treatments that will be the most successful to achieve symptom resolution. These treatments may include Health Care Professionals (HCPs) that will extend the process beyond the care of a dentist. With the gradual resolution of our patient's structural strain and maladaptive accommodation, we need to continue to support the changes in their physiology of occlusion over time. All this has to be done with effective, timely service. Happy patients and timely service build your practice's brand and generate profits.

PHYSIOLOGIC FUNCTION



Our goal for treating the TMD is to help restore an improved physiologic balance to our patient's body. As a dentist, I see three problems that my patients present with:

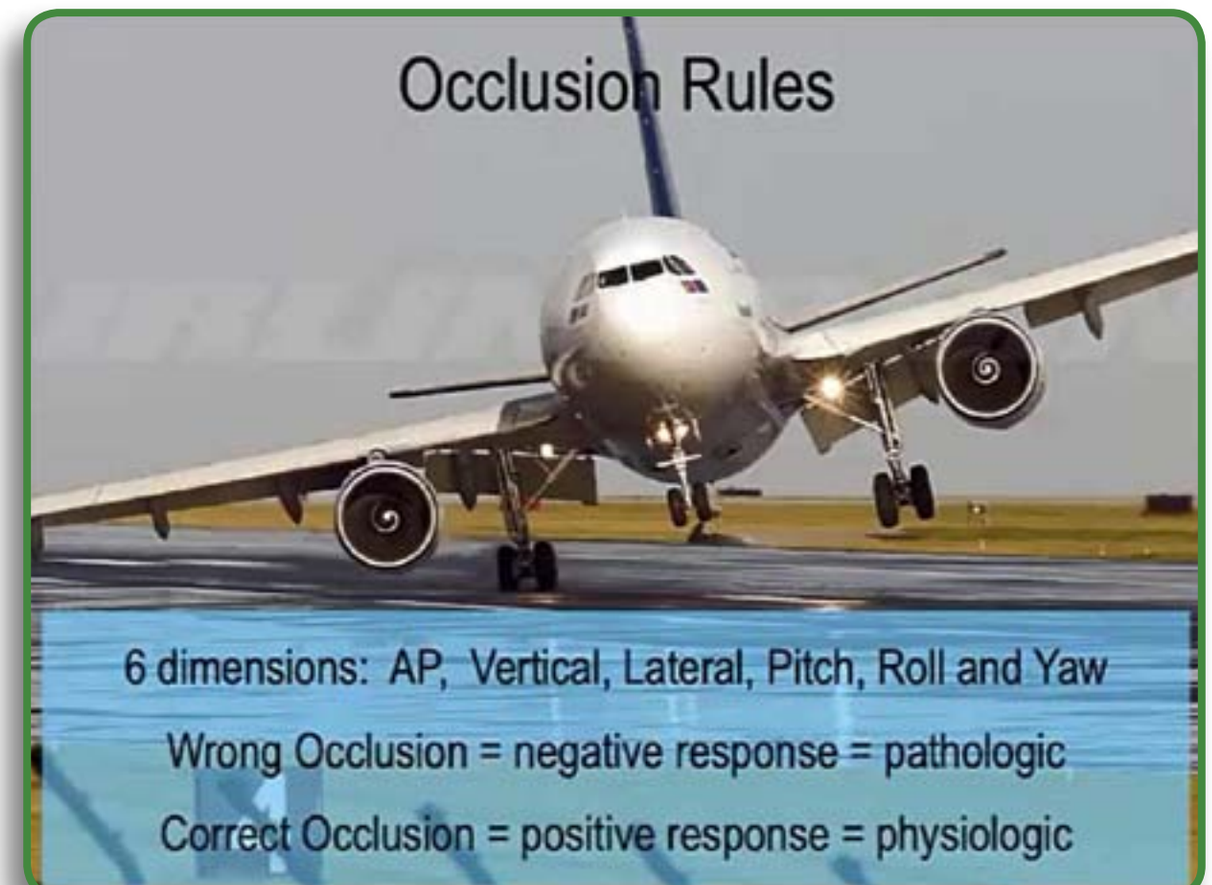
1. They have an unbalanced occlusion seen in biting into MIP and/or in the functional movements of the mandible.
2. Their mandible closes into the maxilla in a strained and damaging relationship.
3. Both of these first two problems create an accompanying adaptation within the patients' entire body from teeth to toes.

Understanding the global effect on the body from occlusion may be a new way of thinking about our profession's scope of care. Our patients are well aware of the connected nature of their bodies and how changes in one area create far-reaching consequences to the rest of their body. They want support from their HCPs as well as their dentists. It is time we also became aware of this.

The physiology of occlusion is not limited to the teeth and TMJs. The terminal endpoint of occlusion, our 'bite', cannot happen without the support of the head, neck, and shoulders. The physiologic dance of nerves, muscles, ligaments, and bony structures is what we learn as babies and children to survive. To survive, we must be able to swallow, breathe, eat, communicate, and balance. All of these functions happen at the lowest level of our brain, the Pons or brain stem, and do not require our conscious thought. Perhaps because these basic survival needs happen at this basic level, we often fail to consider our basic survival instincts can cause chronic strain in our bodies.

A malocclusion creates structural strain and contributes to most of the signs and symptoms patients have, which are related to the head and neck. How does this happen in the first place? How do we lose our ideal form and function? Genetics play a factor but, perhaps, only a small part. The most common cause of a malocclusion is from an altered development we call “epigenetics,” meaning “on top of genetics.” It is a function of nasal vs. mouth breathing. Initial developmental problems often become exacerbated with chronic strain, some form of injuries or accidents, or even iatrogenic dentistry.

OCCLUSION RULES



In my world, occlusion rules. A mandible closing up into maxilla is like a plane landing on a runway. This airplane must manage speed, height, pitch, roll, and yaw, to land smoothly on the runway. The neurology and muscular structures of the occlusion must perform the same trick. We have anteroposterior (AP), vertical dimension, and lateral side to side. We also have to look at pitch, roll, and yaw of the mandible as it engages the maxilla. The act of occluding carefully is also survival. More on that later.

A malocclusion is pathologic to the body. If we have a correct occlusion, it is physiologic to the body. Our goal is to improve the occlusion to support the physiologic side of function.

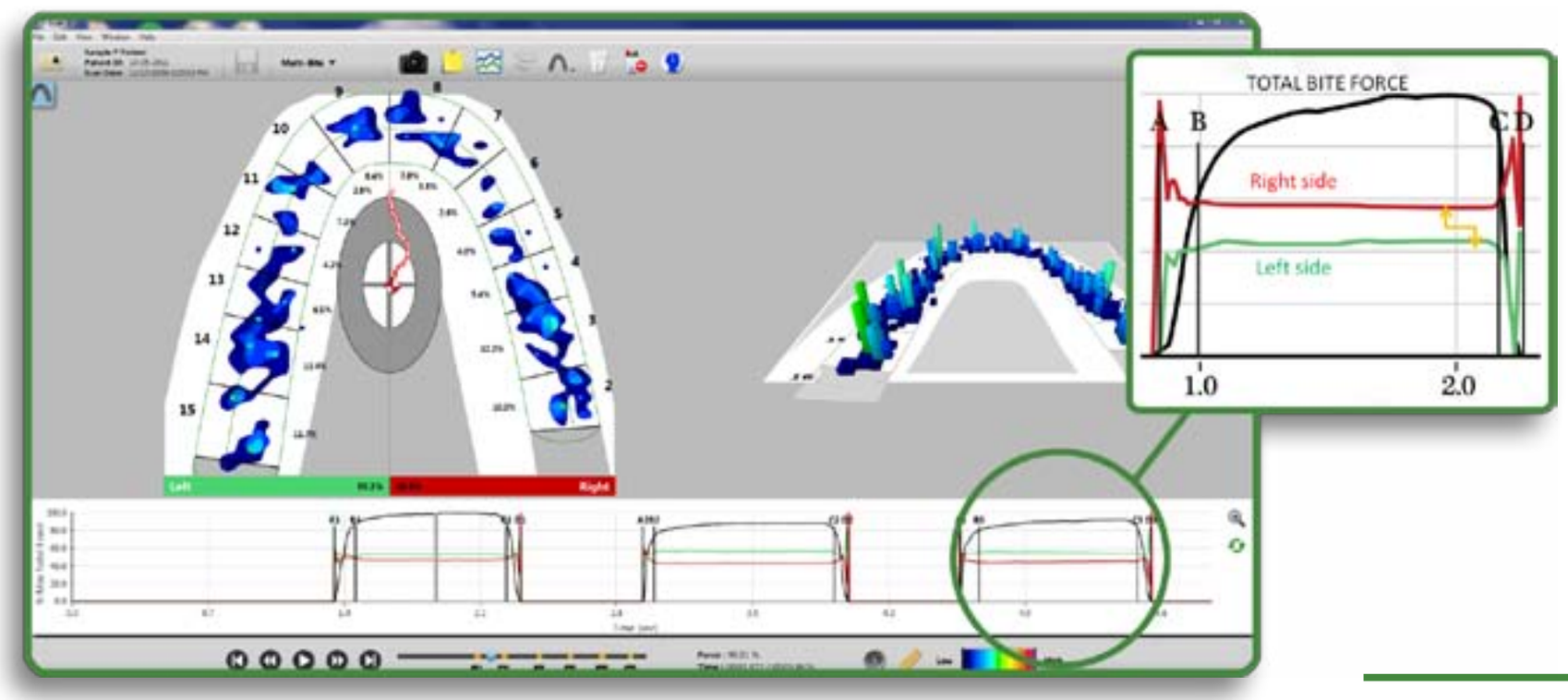
Let us discuss the first of the three problems I mentioned earlier:

PROBLEM 1:

How do we make the teeth meet and function with balanced force and movement?

One of the most efficient ways to treat an imbalanced occlusal scheme is to use the T-Scan™. T-Scan is a valuable tool to allow us to figure out which of the teeth are touching first and which have the most force placed on them. The sensor is placed in the mouth, the T-Scan is turned on with a button on the handle, and the patient is asked to bite on to the sensor hard, hold it for three seconds and then open. This creates a “movie” of the bite process. We can do this two or three times to create a consensus of the occluding event. Rarely does someone bite exactly the same from one movie to the next. However, there are patterns that usually show up on multiple movies.

We have two graphics: 1. A 2D image on the left, and 2. A 3D graphic on the right. We show the various movies we took with that scan at the bottom.



‘A’ marks the first occlusal contact

‘B’ marks entrance into the full clench

‘C’ marks leaving maximum clench

‘D’ marks no contact

— shows strength of the clench during that test

— shows the accumulative force from the midline to the left

— shows the accumulative force from the midline to the right

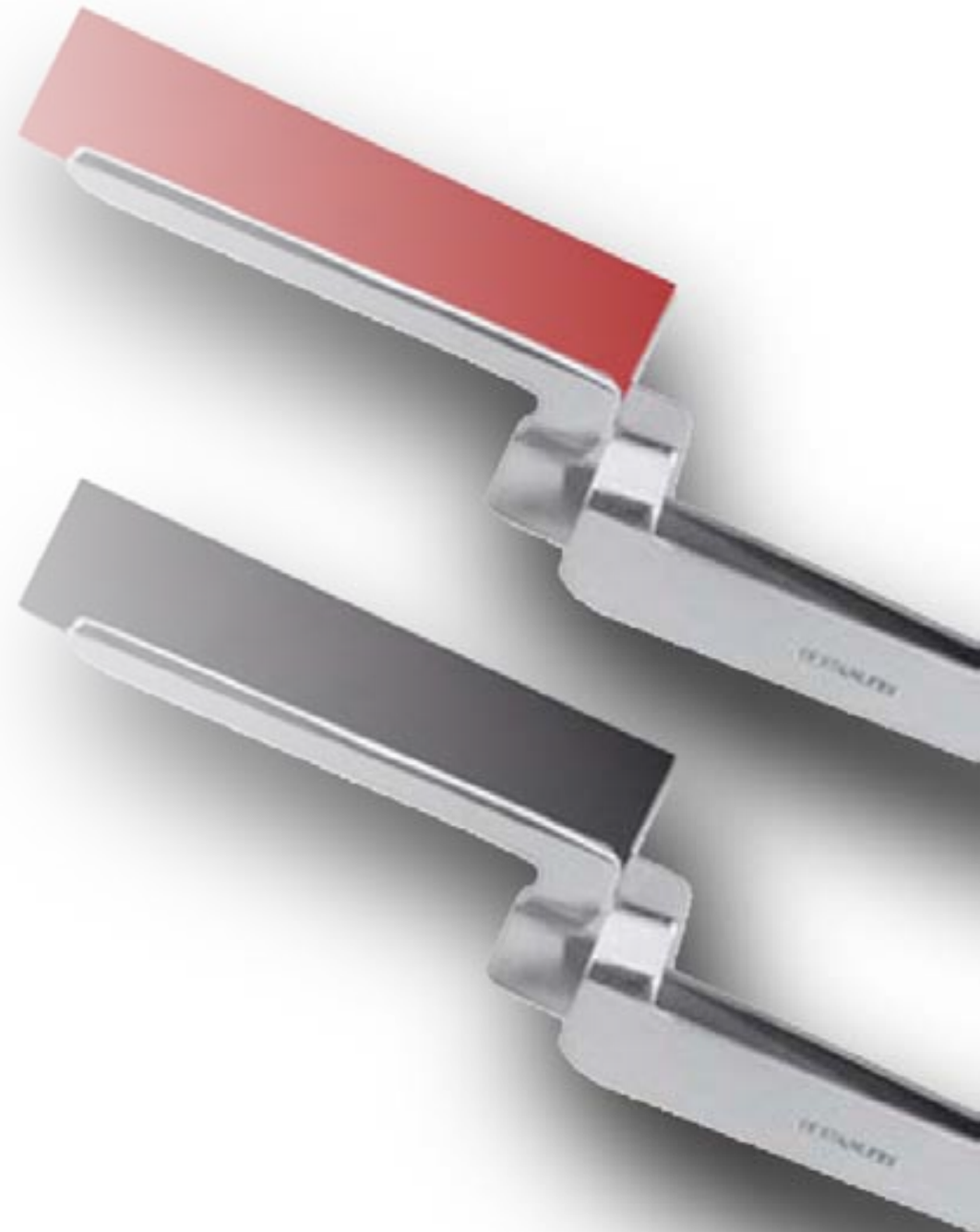
T-Scan is really helpful because you're going to actually see all of the tooth contacts. You can then compare the inked articulating marks on either the teeth or on a dental orthotic. The marks left by ink from articulating paper may show you a location on the tooth, but it cannot tell you which mark has the most force. It also can't tell you the timing of that ink mark (coming into occlusion) in functional movements. Articulating paper is simply not digital. It does not provide a record of how your therapy is improving the bite. Having digital data and a digital record is key to treating TMD in an effective and timely manner.

T-Scan lets you use articulating papers in a whole new manner, taking the guesswork out of occlusal coronoplasty.

Typically, dentists will use thin 50 microns articulating paper called AccuFilm. It was thought that thin articulating paper would not interfere with occlusal function and, therefore, give you the most accurate data. It turns out that it does not give *all* of the data. You miss contacts on hard to reach areas, shiny surfaces like gold crowns, and areas of avoidance. Likewise, there is no location, timing, duration, or force comparison with articulating paper or Shimstock foil strips.

Prior to T-Scan I always used two colors of Accufilm: one was black/black and one was red/red. However, with a “digital articulating paper” like the versatile T-Scan sensor, I can measure the data of occlusion at as little as three microns of contact. This means that I am not relying on the Accufilm to find my contacts, and I now have a digital data set that is so much more accurate and useful. Therefore, to leave ink on the actual contacts on the teeth, I can use a much thicker paper film (called Mynol) that is seventy microns thick. I often place double strips of the Mynol into my ultra-light articulating paper holder and have the patient bite or move their jaw in order to find all the tooth contacts that I can see on the computer screen. I can easily sort out light force contacts from heavy force contacts, and adjust the occlusion accordingly.

With accurate digital data of occlusal contacts and function, I can then use appropriate micro-coronoplasty protocols to adjust and shape the patient’s teeth as needed, to improve the occlusion and the physiologic balance throughout their body. The “dance” of neuromuscular occlusal function happens with smooth motions that are free of tooth contact interferences. Often, the coronoplasty at this level is reducing tooth structure on the scale of talcum powder dust, or somewhere around fifty microns. Muscles calm, nerves calm, teeth calm, and the balance of the physiologic occlusion is immediately felt by the patient.



PROBLEM 2:

The mandible closes into the maxilla in a strained position.

What does this mean? Well, when the teeth occlude, the resulting position of the mandible creates muscle strain, ligament strain, TMJ capsular compression, a decrease in pharyngeal airway volume, cervical vertebrae misalignments with the cranial base, tooth wear, and a variety of pain symptoms[1].

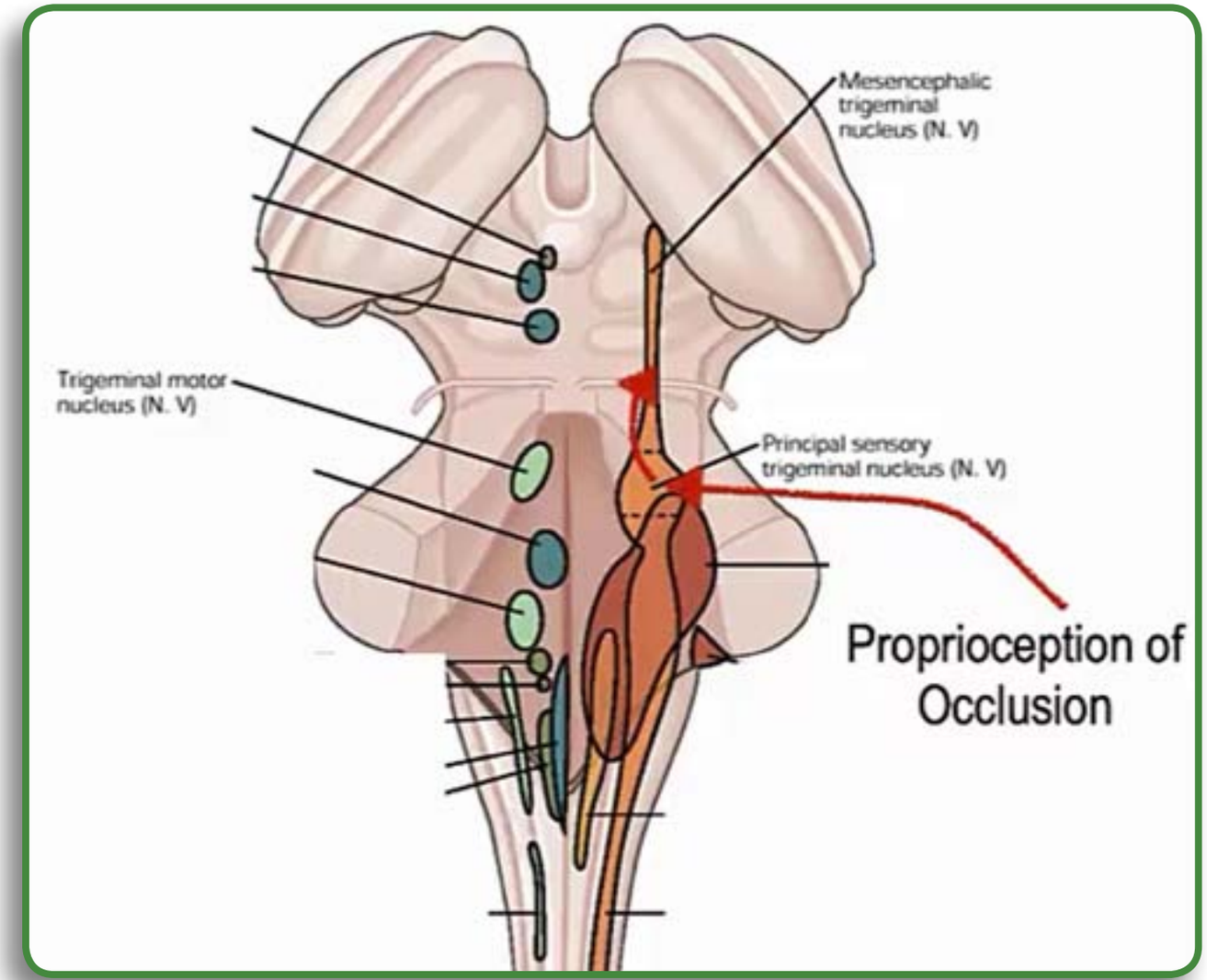
To solve the mandible/maxilla strained relationship, I first want a therapy that is non-invasive, potentially long-term, and readily accepted by the patient. To accomplish this, I will construct a lower removable anatomical dental orthotic made of acetyl resin. It is called the “Natural Fit Orthotic” and it is made by The Aurum Group dental laboratory out of Calgary, Alberta, Canada. This orthotic is tooth colored, shaped like teeth, and is so thin that patients can talk, laugh, eat, and function with it in their mouths. No one will know they are wearing it. The Natural Fit Orthotic can last for three to five years and they are very resistant to fracturing. It also lets me adjust its occlusal surface to accommodate the healing of the patient’s physiologic system that happens over time. I wear one myself!

The Natural Fit Orthotic solves the problem of correcting the mandibular position and still let me balance the occlusion. We see this is the same patient’s photo—one with the orthotic in, and one with the orthotic out. Again, we use a removable orthotic, not a bonded orthotic. Bonded orthotics are more prone to fracture or breaking off, and do not allow for proper hygiene while in place.

1: Curtis D. Westersund, Jeffrey Scholten & Raymond J. Turner, 2016
http://www.tandfonline.com/doi/full/10.1080/08869634.2016.1235254

Why an anatomical orthotic?

Why do we make something that's not a flat plane orthotic or, say, something like an NTI? We have to understand something about the proprioception of tooth contact and the way our body balances the forces of biting. Teeth cannot bang together with abandon. If there were no protective mechanisms when occluding, the stomatognathic system would fracture and break teeth. That is why there is a proprioceptive neural feedback system surrounding the root structures of each tooth. It provides a guide into occlusion. This prevents tooth fracture and, in pre-historic man, the chance of a life-taking tooth infection.



Our neural muscular loop from tooth contact to activation of jaw and neck muscles is very fast and very sensitive. We can sense tooth contact at roughly 30 microns—the size of dust mites floating in a sunbeam. So, when your mandible comes up and it touches the maxilla, proprioceptive fibers send a signal back to the brain stem. Once it gets to the brain stem, unlike any other nerve fiber into the PONS, the cell body is directly in the trigeminal nucleus. From there, it goes to the mesencephalic trigeminal nucleus through a hard-wired connection, and then directly to the trigeminal motor nucleus, and finally to the muscles of mastication. This is very fast, and because it is so fast, it protects us from chipping and breaking our teeth.

PROBLEM 3:

The first two problems create an accompanying adaptation within the patients' entire body.

It is important to know that we bring our teeth into contact not only for eating, but also to provide stability to our jaw, our head, and our cranio-cervical complex. Our bite, as stated in the cited work mentioned before, helps stabilize our head and neck. Think of it this way: If you are under stress, you clench. If you were about to have a collision, you do not flap your mouth open and stick your tongue out. You clench in preparation for the impact. Physical stress, emotional stress, and mental stress, all have the same effect on our body. We brace and bring tension to our entire body. With the jaw, that means we clench automatically.

So, if we have an imbalance in our bite relationship, then that clenching is causing structural strain. Reduce that, and the effects on the patient are global throughout their body. If your approach is only to treat a symptom, it will be less effective than providing better overall structural balance.

A dental malocclusion is like a thorn in your foot. You don't walk on a thorn; you walk around the thorn by twisting your foot or changing your gait. The same thing happens with a tooth contact. You avoid that noxious contact by twisting your jaw and utilizing uneven muscle recruitment in your closing and in your chewing functions, and it is very automatic.

YOUR TOOLKIT

If you are a dentist that focuses on physiology, you may be delivering an orthotic like the Natural Fit Orthotic. You would first provide some physiologic therapy by relaxing muscles. For that, I use the ULF TENS.

What is ULF TENS?

ULF TENS stands for Ultra Low Frequency Transcutaneous Electro-Neural Stimulation. And there are two basic types of TENS:

- **The medical TENS** that provides rapid strong pulses (hundreds per second) to an area that blocks afferent or sensory nerve signals to the brain. This blocks pain from a damaged or stressed part of the body from reaching the brain.

- **The ULF TENS** is a slow light pulse that stimulates efferent or motor nerves that make the muscles contract. The ULF TENS helps to relax the muscle by giving a slow (1 pulse very 1.5 seconds) rhythmic contracture of the muscle. For dental purposes, we pulse 3 cranial nerves: Trigeminal, Facial, and Accessory nerves (CN V, CN VII, and CN XI).

ULF TENS pulsing over time will:

1. Lengthen muscle spindles
2. Pump oxygen, ATP, and Ca+ into the muscle
3. Allow muscle physiology to move from contracted to rested
4. Break up muscle memory

"TENS provides physical therapy to restore the muscle function and wipes out muscle memory to allow us to find a bite position for our orthotic. TENS must be used to balance the imperfections in that occlusal scheme of the orthotic."

-Dr. Konstantin Ronkin

We use the ULF TENS to help us find a bite and deliver a more balanced dental orthotic. The TENS helps us find a better physiologic bite position by finding a less strained starting point. (Note: I use a Kinesiograph called the K-7 to provide data that shows the strain of a bite before TENS and after TENS).

Of course, you have to use the right laboratory. As I said, I use Aurum Ceramic Dental Lab in Calgary, and they are experts at the acetyl resin “Natural Fit” orthotic. But even though they deliver a well-fitting orthotic, there’s a problem. You can use any neuromuscular dental lab and they will create this fantastic anatomical orthotic, but no lab can reproduce the complex stomatognathic function of the jaws perfectly. You are going to have to make some adjustments to the occlusion of the orthotic on delivery, and also after delivery, as the patient’s physiology improves and the TMD condition heals.

Bonus: With the ULF TENS and the T-Scan tools in place, this treatment is fast and predictable.

Prior to using TENS and T-Scan, depending on the case, return visits used to take up to six to twelve hours of chair time to find stability in the occlusion. I may have had to have the patient back four to six times just to get a stable, comfortable bite. With the combination of the ULF TENS and T-Scan on delivery, my orthotic delivery is TENS for forty-five minutes and then thirty minutes’ of balancing of the orthotic.

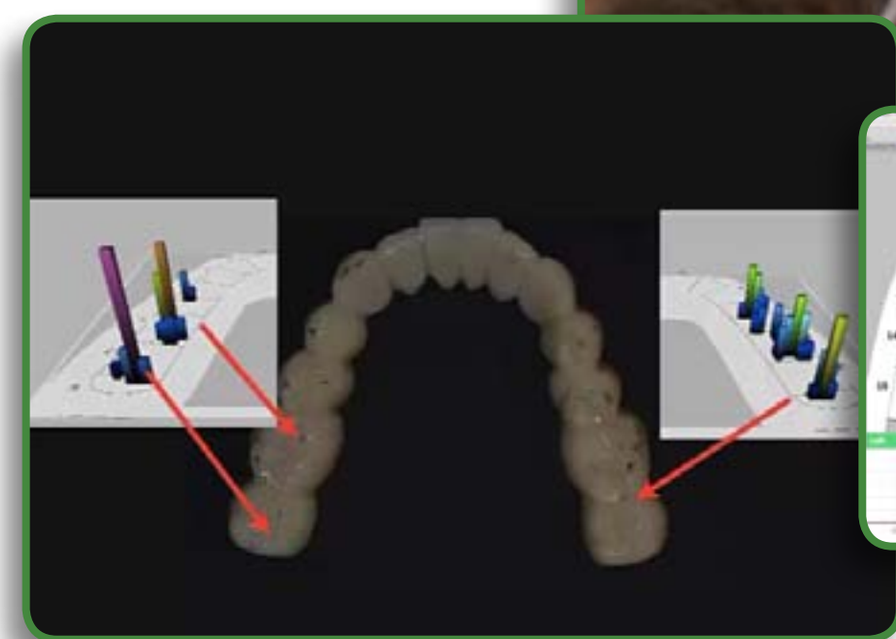
Return visits have dropped from 4–6 down to 0-2, and the results are better. Patients are resolving symptoms further and faster.

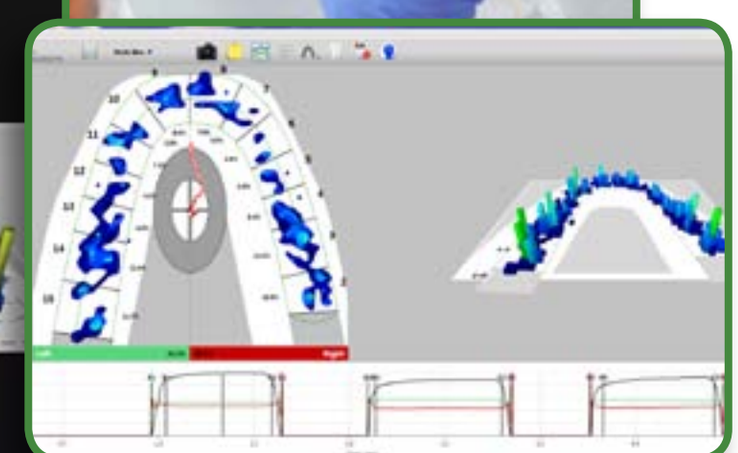
Adjusting the removable anatomical orthotic.

One of the tricks is to use the TENS and T-Scan together in a way that allows us to be able to speed up the entire process and make for a happier patient. We save chair time, we increase profit, patients are happier they don't have to come back all the time, and we get more referrals. That's our goal!

We have diagnosed a retruded mandibular position with the patient. We use the K-7 (Myotronics) equipment to find the improved physiologic starting point for our Natural Fit Orthotic. We have captured a snapshot of that myobite position with our Blu-Mousse bite registration material.

We take our digital models with the Itero digital system. Aurum Group then makes the orthotic to the specifications needed to provide a functional bite (limited anatomy occlusally, lingual cusps shortened, buccal surface of buccal cusps thin and not bulbous, canines able to engage in excursions).





At the delivery of the Natural Fit Orthotic, the patient undergoes TENS for 45 minutes. We then start to use TENS and T-Scan together.

1	In settings, make sure the T-Scan is set to “Turbo”
2	Turn up the T-Scan sensitivity to maximum
3	Place the T-Scan sensor in the patient’s mouth
4	Turn up the amplitude on the ULF TENS to allow the patient to have an involuntary, bilateral pulse into the T-Scan sensor (Hint: Listen for the Crinkle of the sensor film)
5	Once the patient is pulsing smoothly, record 4 or 5 pulses (Each pulse is 1.5 seconds apart)

The data you record will be the INITIAL OCCLUSAL CONTACT. This is the first contact into the orthotic. It is not a full clench. It is the start where all deflections will begin to occur. With this data, we place the thicker articulating paper in an ultra-light holder, and use the TENS in the same way to pulse the mandible up into contact. This allows us to capture ink marks on the orthotic. When we take the orthotic out of the mouth, the marks are visible, unlike an acrylic orthotic.

Use appropriate coronoplasty protocols to adjust the orthotic to be more balanced. Repeat the process until you have bilateral stability. Once you have this bilateral balance, you can turn off the J-5 TENS unit and turn down the sensitivity of the T-Scan. You can then begin recording the CLENCH BITE of the patient. This is the final balance of the bite into a forceful clench. The result is a well-balanced orthotic that can function smoothly without working or balancing interferences. The patient will be able to quickly become accustomed to the new bite, and the resolution of their structural strain can begin.

Are we forced to adopt technology?

Nowadays, patients are the moving forces for change in our profession. Social media makes worldwide news of both the positive and negative aspects of our dental profession. But do we need to be forced into changing? Do we need to have a social movement make us invest in technology?

I am sure if we could go back in time, G.V. Black would have loved the use of the TENS and T-Scan. He was a forward-thinking man of his time. Our profession now has tools that provide a more relaxed jaw position for the patient, like“digital articulating paper” to more accurately analyze the bite. We can measure pre-and-post results and record these results as important milestones in the patient’s healing. We can also see actual functional movements that were previously hidden behind lips and cheeks. Why would we not embrace these tools?

Everything is moving digital. We can no longer kid ourselves into thinking that we have some magic knowledge or magic hands that supersedes what is actually happening with our patient’s physiology. The amazing thing is that these tools make our treatments faster, less complicated, easier to communicate to patients, and easier to document. We save time, money, heart muscle, stomach lining, and produce better results. Why not embrace this?

For more information, contact me at curtis@cooltodrool.com or go to www.dentalife.com. Check out www.tekscan.com/dental, www.myotronics.com, and www.bioresearchinc.com. These great companies are here to help us up our game.

-Dr. Curtis Westersund