

Alyssa Smith:

Hello, everyone. This is Alyssa Smith, one of the hosts of ENT in a Nutshell. If you've enjoyed listening, please consider taking a second to rate and review this podcast. Now, on to the episode.

Dr. John Marinelli:

Hey, everybody. Welcome back for another episode of ENT in a Nutshell. My name is John Marinelli. Today, we're joined by a facial plastic surgeon, Dr. Scott Bevans, to discuss traumatic mandible fractures. Dr. Bevans, thanks so much for joining us today.

Dr. Scott Bevans:

Hi, John. Man, it's a pleasure to be with you. I'm really impressed with this resource you guys are building. I'm actually honored that you asked me to be involved.

Dr. John Marinelli:

Yeah. Of course, happy to have you. With mandible fractures, obviously, it's a bit intuitive how they present, but can we just start off by talking about how you typically see patients with mandible fractures presenting?

Dr. Scott Bevans:

Sure. Yeah. Just as a reminder, so mandible fractures are either the second or the third most common facial fractures behind nasal bone fractures and maybe zygomatic arch fractures depending on what article you read.

Dr. Scott Bevans:

In either case, they're two to three times more common than mid-face fractures. The mandible is the only large mobile bone in the face. We consider it as an arch or an incomplete ring. That means when a force is applied to one location, it's going to flex, and it's actually more common for the mandible to fracture in two locations than just one location.

Dr. Scott Bevans:

Practically speaking, that means that if we see one mandible fracture, we're always looking for the second. And depending on how urban the environment that you live in or work in, the most common mechanisms are either assault or motor vehicle accident.

Dr. Scott Bevans:

As you'd expect with those mechanisms, while mandible fractures can occur in any age patient, far and away, the most common demographic is the 18 to 30-year-old male. Those mechanisms that we spoke about, they dictate the location of the mandible fracture.

Dr. Scott Bevans:

A lot of patients in that age demographic, that 18 to 30-year-old demographic, they still have their third molars. What the third molar is doing in the angle of the mandibles is actually taking up space both cortical bone space as well as cancellous bone space. It weakens the bone slightly there.

Dr. Scott Bevans:

The angle is actually one of the most common locations if not the most common location for a mandible fracture. Angle fractures often present with a contralateral parasymphiseal fracture. It goes back to that incomplete arch concept. When there's a force applied, the angle is weak. It flexes and breaks, and the contralateral [inaudible 00:02:28] fracture will break at the same time. That's the super common combination from blunt force injury.

Dr. Scott Bevans:

In the pediatric age population, the most common etiologies are falls or motor vehicle accident, mostly anterior blows. Because kids are more flexible, that force from the anterior blow will be transmitted posteriorly back towards the condyle or the subcondylar segment. We more commonly see fractures in those locations in kids. In fact, I remember in residency, someone told me that a chin laceration from a significant fall in a child is a subcondylar fracture until proven otherwise.

Dr. Scott Bevans:

A couple of additional reminders, the vast majority of these anterior fractures like the ones that we see in adults, they're open fractures. By that, I mean they communicate with the teeth and the tooth roots and therefore with the oral cavity and have a route for saliva to enter the fracture site directly.

Dr. Scott Bevans:

Another reminder is when we see that blunt force pattern, an angle fracture with a contralateral symphyseal fracture in a female, these fractures occur so much more commonly in males than female that there are some authors that advocate we at least consider the possibility of domestic abuse.

Dr. Scott Bevans:

While I may not ask a patient about that, it's something that I'm mindful enough that if it's a female with that fracture pattern, I may mention it to the consulting physician.

Dr. John Marinelli:

All right. As a resident, I think a common scenario we encounter is the trauma team calling saying that there's a patient with a mandible fracture either on imaging or is obvious on their exam. When you're talking to them on the phone, what are the key questions you like to ask before you hang up?

Dr. Scott Bevans:

Yeah. You bring up an excellent point with this. The majority of the time, we are consulted. Patients already have imaging proving they have a facial fracture, in this case, a mandible fracture. However, as with any trauma patients, we have primary and secondary surveys algorithms to make sure that we don't miss things.

Dr. Scott Bevans:

I guess what I'm saying here is that the ABCs are still in play. When I get a phone call, one of my questions to the consulting physician needs to be, "Well, how are they breathing? How is their airway right now?" That can help communicate to me a lot of what their overall acuity might be.

Dr. Scott Bevans:

The other piece of understanding of the acuity is understanding the mechanism. It goes without saying a patient who suffers a gunshot wound to the face and has a bullet lodged next to the carotid artery actively hemorrhaging out of their mouth, they're treated totally different than someone who is kicked in the face by a horse or hit by a train or assaulted.

Dr. Scott Bevans:

Once I have an idea of the acuity, well, that guides the urgency of my intervention. Pragmatically speaking, I'm also trying to assess on the phone, well, what kind of other injuries do they have? Are they operative. This is important too. I didn't mention it before, but patients with multiple facial fractures, there are a couple of publications that suggest if there are multiple facial fractures that include the mandible, there's between a five and 10% rate of cervical spine injury.

Dr. Scott Bevans:

That's something that I try to ask about. In the setting of multiple facial fractures, has the patient's cervical spine been cleared? That'll also have significant influence on what surgical approach I might be able to use if they have an operative facial fracture.

Dr. Scott Bevans:

In addition, I'm always trying to find out will they have other facial lacerations? What's the disposition of the patient? Are they headed to the ICU? Are they going to the OR now? I try to remember to ask about the NPO status on the phone if they're not a high acuity patient because as much to remind, the consulting service that we need to leave them NPO as it is important for me to be able to plan an operative intervention.

Dr. John Marinelli:

Okay. Let's say now you know the patient has a mandible fracture that you have to go see, would you mind describing the key features on physical exam that you like to look for when you see the patient?

Dr. Scott Bevans:

I'll tell you that if I have the chance, I like to cheat. I like to look at the imaging ahead of time. If I can get to a computer and pull it up, I'll definitely do that. I'll talk a little bit later about full radiographic assessment, but one of the things that I'm trying to identify now is whether or not I have 3D reconstructions especially for a significant mechanism of injury.

Dr. Scott Bevans:

Those are really helpful to me both in the operating room and to explain to patients where their fractures are and how we're going to treat them. If we don't have those 3D reconstructions, I'll stop now, and I'll call the Radiology Department, and I'll ask them to burn them from the raw data on the CT scanner which they usually only keep for about a day. That's important.

Dr. Scott Bevans:

Now, to really address your question, when I'm going down to the ER or to the ICU to assess the patient again, I'm trying to be systematic and do the same exam on everybody. I'll tell you even before the COVID pandemic started, I put gloves on before I start the examination. I go from the top of the head all

the way down to the collarbones. There's so often blood or saliva. I don't want to miss something or pick something up that's unintended because I wasn't using gloves or the right PPE.

Dr. Scott Bevans:

But, specifically, when I get to the oral cavity exam, I'm looking for several things. Externally, I'm looking for a lip or facial lacerations. Even if they're partial thickness, they're important to note because patients are going to swell, and I'm likely going to stretch their lips particularly if I need to intervene operatively.

Dr. Scott Bevans:

Then, when I get intraorally, I'm looking to see whether or not fractures are grossly open and how much soft tissue trauma is present. I want to assess the floor of mouth whether or not there's hematoma, whether there's active bleeding. In general, what is their airway posture like? Are they retrognathic from having bilateral subchondral fractures, for instance?

Dr. Scott Bevans:

Although teeth aren't super sexy, they are super important. I need to have a really solid assessment of what the patient's dentition and occlusion look like.

Dr. John Marinelli:

Yeah. Actually going off of that, sir, would you mind just briefly touching on the angle classification for occlusion?

Dr. Scott Bevans:

Yeah. I'd be happy to. The angle classification is really a tool to describe the anterior posterior relationship between the maxilla and the mandible. Now, everybody knows that typically the maxilla is in front of the mandible and the angle classification defines that based on the position of the first molars which presumably are erupting in a more stable location than the rest of the dentition.

Dr. Scott Bevans:

The angle classification is defined as the mesial buccal cusp of the maxillary first molar and its articulation with the buccal groove of the mandibular first molar. The standard angle classification is class one. That's normal. That means that the mesial buccal cusp, the anterior lateral cusp of the maxillary first molar is fitting into the buccal groove, the cleft in the middle of the mandibular first molar.

Dr. Scott Bevans:

Class two angle classification means that this relationship is displaced posteriorly meaning the mandible is relatively retrognathic to that normal position of the mesial buccal cusp of the maxillary first molar. Class three is prognathic meaning that mandibular first molar is going to be anterior to the mesiobuccal cusp of the maxillary first molar.

Dr. Scott Bevans:

But remember that the angle classification only gives us the anterior posterior relationship. Just like it's important to document the angle classification, it's also maybe even more important to document

whether or not the patient has a crossbite. This is a super useful thing to recognize preoperatively, but we rarely talk about it.

Dr. Scott Bevans:

In general, from a medial lateral relationship, we expect that maxillary arch of dentition to be outside, to be lateral and anterior to the mandibular arch. If it's not, then that's abnormal. It's really useful to know this ahead of time because one of the things intraoperatively that we have to control for is mandibular splay. If one side of the mandibular arch is outside of the maxillary arch, then we need to know that.

Dr. Scott Bevans:

I'm watching a patient as they're opening and closing their mouth, and I'll try to assist them passively. Then I'll have them actively get into occlusion. I'll be asking them, "Does that occlusion feel normal to you?" I'll tell you that the periodontal ligament, which is the sensory organ that feeds the teeth, is super sensitive.

Dr. Scott Bevans:

Patients will tell you, "No, that occlusion does not feel normal to me." Sometimes, that can happen even the absence of frank mandibular fracture, but the other important question that I'm asking them is well can you slide into a normal occlusion? Can you get into a normal occlusion? How does that feel to you?

Dr. Scott Bevans:

At the same time, I'm looking to see whether or not there's early contact on the molars. You remember that a unilateral subcondylar fracture will have early contact on that side. If you have early contact from say a left subcondylar fracture, it's going to create a contralateral open bite meaning that early molar contact on the left is going to leave the anterior right side in an open bite, mandibular drift chin deviation.

Dr. Scott Bevans:

That usually occurs ipsilateral to the side of fracture. It's more common when you have a body fracture or more anterior mandibular fracture. That's because the muscles of mastication during occlusion are going to create excessive pull on that highly mobilized side, and it's going to drift the chin over to that side.

Dr. Scott Bevans:

Finally, intraorally, I'm also looking for these wear facets. The wear facets are just these very specific areas of two contact that occur from normal occlusion over time. They can be great landmarks for me to understand like, for instance, where the canines fit back together.

Dr. Scott Bevans:

Lastly, sensory innervation is important. Almost all mandibular fractures in some way are adjacent to the inferior alveolar nerve. We want to know ahead of time what their sensation is like on the lower lip. I'm careful to assess that before I inject any local.

Dr. John Marinelli:

Okay. What about the radiographic evaluation? Would you mind just walking us through how you like to think about that?

Dr. Scott Bevans:

Again a reminder to us, we need to be algorithmic. The radiologist may only see one fracture, but we're going to be careful to look for two which we always anticipate that we're going to have two fractures on the mandible again. There are several site-specific concerns.

Dr. Scott Bevans:

With subcondylar fractures, I'm evaluating the degree and location of displacement of the condylar head. I believe we'll probably talk in a minute about the Kent and Zide criteria. I'm going through that algorithm in my mind. I'm also cognizant of how much proximal bone remains outside of the condylar head. That gives me an idea whether or not I have proximal bone to surgically fixate.

Dr. Scott Bevans:

There's other site-specific fracture patterns. Angle fractures can commonly have this what's called basal trigone fracture pattern. You've got two fracture, one that extends through the ramus horizontally and then one that extends inferiorly at the junction of the body in the ramus. It creates this mobile triangle of bone down by the angle which can be easily displaced.

Dr. Scott Bevans:

With symphyseal and parasymphyseal fractures, I'm evaluating whether or not bone stock is involved, whether or not the inferior which is the load-bearing portion of the mandible or the alveolar bone are fractured. I'm also evaluating the lingual cortex to see whether or not there's splay which can happen from widening of the mandible.

Dr. Scott Bevans:

Okay. This leads us into the discussion of horizontal and vertical favorability. Favorability just talks about whether or not the muscles that attach to the mandible are going to reduce or distract the fracture when they contract. We can put these muscles into two categories, depressors and elevators

Dr. Scott Bevans:

The depressor is generally attached to the inferior aspect of the mandible, the muscles like the mylohyoid or the digastric. When they contract, they're going to pull the anterior portion of the mandible down and back. The elevators conversely attach more posteriorly to the mandible.

Dr. Scott Bevans:

These are the muscles like the temporalis, the masseter, the pterygoid muscles. When they contract, they're going to pull the angle of the mandible up and forward, anterior, superior. The lateral pterygoid usually gets this little asterisk because it can also pull the condyle forward when it attaches. That pushes the mandible anteriorly and can actually open it a little.

Dr. Scott Bevans:

The horizontal favorability is a horizontal assessment meaning that we're looking at the mandible from a sagittal view. The assessment of vertical favorability looks in the axial plane at the fracture. To be

honest, it used to be that every time I saw a mandible fracture, I would try to reason through the muscular attachments and try to figure out what's going on. When this contracts, is it going to slide? Is it going to reduce or distract?

Dr. Scott Bevans:

Then a friend of mine, Travis Newberry, taught me this easy memory aid. He said if a fracture points to the nose, it stinks. It's unfavorable. That turns out to be true both in horizontal and vertical favorability assessments. It's important for us to recognize that are things vertically or horizontally unfavorable. That doesn't always translate to a difference in our surgical approach however.

Dr. Scott Bevans:

Another important factor is to be able to describe the fracture as complete. Is it incomplete? What's the degree of displacement? What's the degree of comminution of the fracture? Those things will have influence on our surgical approach.

Dr. John Marinelli:

Okay. Now, we've talked about disease presentation, as well as the initial evaluation. Can you walk us through how you think about deciding which patients need intervention?

Dr. Scott Bevans:

Well, the primary goal of evaluating these patients and seeing them through this process is re-establishing native occlusion. If I see a patient and they're able to get in native occlusion and their fractures are minimally displaced or non-displaced and stable, then in theory, there's nothing that needs to be done. We can let a limited diet guide their treatment plan, but for the vast majority of patients, that's not the case.

Dr. Scott Bevans:

There's also this misnomer of closed techniques. Closed techniques, and by that, we're usually talking about establishing maximum mandibular fixation to help guide our treatment, even that, often requires some sort of operative intervention.

Dr. John Marinelli:

Okay. Let's say we've determined that the patient can't get into their native occlusion or their fractures unstable and they require operative intervention. Would you mind now touching on how to conceptually think about operative intervention and specifically the different options available to us?

Dr. Scott Bevans:

Yeah. I'm going to take a patient to the operating room for anything more than something minimally invasive. I need to be mindful of the airway plan. Goal number one is to make sure that we have a safe airway plan for this patient. If they've got a whole bunch of dentition and won't allow me to sneak and end a small endotracheal tube into the retromolar trigone, by the way, I know this because if a patient closes their mouth and I can slide my finger into the retromolar trigone, then usually, I can get away with an oral intubation.

Dr. Scott Bevans:

But with that exception, it's easiest to have a nasotracheal intubation or to convert an oral intubation into a submental or tracheostomy approach. After we've established an airway, that primary dictum is to re-establish occlusion. We do that through this technique of what we call MMF, maximum mandibular fixation. I'll tell you that often I throw this around like, "Oh, we'll put them in MMF."

Dr. Scott Bevans:

But this is a critical portion of the surgery. Often, it can take a lot longer than you think. Consider Erich arch bars. They're the gold standard. Those are the braces with the lugs. They do a great job of stabilizing and ultimately can move teeth. They're like a poor man's braces, but they can loosen over time. Patients don't love them. While they act like a tension band, essentially a plate that's right on the teeth, you can't totally tighten them right around the fracture until you have the fracture fully reduced.

Dr. Scott Bevans:

Additionally, they take between 60 and 90 minutes to apply. Interestingly, there's been studies on the rates of surgeons puncturing their gloves and presumably their skin. It's relatively high like upwards of 25 to 30%. But for a minimally displaced or alveolar fracture that doesn't involve the inferior portion of the mandible, an Erich arch bar alone can be the primary treatment.

Dr. Scott Bevans:

A more minimally invasive approach is using IMF screws, intermaxillary fixation screws. We don't need to change the position of the teeth, but we need rigid fixation either during the surgery or postoperatively. We want some mechanism post-operatively for retraining, something that we can put, for instance, an elastic band on.

Dr. Scott Bevans:

The keys here for placing IMF screws is that we have to put them at the junction of the attached and the loose gingiva. If you're looking intraorally, this is about where the color change occurs on the alveolar tissue and obviously the attached gingiva. The attached alveolar tissue is far less mobile.

Dr. Scott Bevans:

If we put them at that junction and not higher, then it lowers the rate of mucosal overgrowth which makes our access to the screws easier down the line. Now, when we keep the screws inferior right at that junction between the attached and loose gingiva, we're closer to the tooth roots, but if you don't pre-drill the holes, it decreases the rate of tooth root injury by over 80%.

Dr. Scott Bevans:

As a practical tip, I've never had to use an IMF screw longer than eight millimeters. There's some people that advocate for using longer screws, but I found eight millimeter screws work quite well. They're quick. They only take between eight and 15 minutes in published assessments.

Dr. Scott Bevans:

Hybrid systems are kind of... Well, they're hybrids between IMF screws and air guards bars. There's an arch bar. Then, there's an attached screw hole. This does give you sort of a broader length, a broader arch of stabilization, but it's still screw based. You've got the risks of mucosal overgrowth of loosening over time and of tooth root damage.



Dr. Scott Bevans:

The last one is interdental fixation or embrasure wires. I'll tell you that I love this technique because it only takes a couple of minutes. You put a couple of wires on each side of the fracture, but patients have to have good dentition. I'm also presuming this is when we pass wires from the lingual surface to the buccal surface of the mandible. We'll pass two wires on either side of the fracture. Then, we'll twist them all down while we're holding the patient into occlusion.

Dr. Scott Bevans:

I'm presuming that at the end of the case, I'm going to be able to cut these wires and take them out, and the patient is going to ride without guiding elastics. I used to be a big fan whenever I put a patient in maximum mandibular fixation and I was going to leave some mechanism of retraining or rigid fixation post-operatively. I used to be a big fan of just using rubber bands, using heavy elastics.

Dr. Scott Bevans:

But I'll tell you that wires often turn out to be easier to care for than rubber bands. And at least in the hospitals that I work at, they've often switched to the non-latex rubber bands. They tend to be a little bit less rigid. They break more frequently. I've had several patients tell me that it's harder to do the rubber band maintenance than it is to do the wire maintenance as a result.

Dr. Scott Bevans:

Generally speaking, we need to re-establish occlusion and then figure out whether or not each fracture needs additional fixation which leads into our open reduction internal fixation concept.

Dr. Scott Bevans:

I should say before we get much further that, ideally, we want to intervene on these fractures sooner rather than later within the first 48 to 72 hours, but there are some situations in which we're just not going to have the opportunity to do that. I'm a big advocate of at least putting patients in some sort of minimal MMF. What I'm really referring to here is creation of an IV loop. That's a loop of wire that goes two teeth on either side of the fracture. Then, as we cinch that wire down, it's going to reduce that fracture and hold it in place.

Dr. Scott Bevans:

I think this helps a lot both with pain and I suspect also with the amount of saliva that's penetrating into the wound. That's a minimally invasive concept, things you can use in the emergency room if you know you're not going to be able to perform definitive fixation on this patient in the near term.

Dr. John Marinelli:

Okay. What about open reduction and internal fixation? Would you mind commenting on that as well?

Dr. Scott Bevans:

Yeah. I'd be happy to. The open reduction internal fixation, the name is actually self-explanatory. First, you have to open. To do that, we'll have to figure out our approach either we're going to go across the mucosa transorally or external approaches either transcervically or more commonly to the periparotid region.

Dr. Scott Bevans:

After we open, then we're going to reduce. When we reduce a fracture, this often requires debridement of the granulation tissue at the fracture site and because that granulation will prevent reduction. We often talk about what do you do with teeth that are in the fracture line. And the answer is if they're not preventing reduction or not actively infected, then we leave them there.

Dr. Scott Bevans:

Then, the last step is internal fixation. This is where it comes down to using either load bearing or load sharing techniques. Let me mention for a moment the difference between those. A load bearing technique isn't relying on direct apposition of the bone edges. That hardware is taking the entire load of occlusion.

Dr. Scott Bevans:

In the case of a mandible fracture, we're talking mostly about reconstruction bars greater than two millimeter plates often with locking screws and the locking screws and that reconstruction bar are able to articulate with enough strength that it resists the distraction force under bite.

Dr. Scott Bevans:

Practically, any comminuted fractures or segmental defects, they all require load bearing techniques. Locking screws in a recon bar using bicortical screw purchase. Load sharing techniques usually use non-locking screws in a smaller bar or even lag screws or even the Champy plate technique.

Dr. Scott Bevans:

The Champy plate technique is a great example of a load sharing technique. I love this concept. It's totally minimally invasive. Consider an angle fracture and using a retromandibular incision to expose the oblique ridge. The oblique ridge is one of Champy's lines of osteosynthesis which is the reason why it's called the Champy technique.

Dr. Scott Bevans:

There's even a pre-bent bar. I will tell you that unfortunately I think often the pre-bent bars are too small and a lot of sets. It's a 1.8 or 2-millimeter plate. While I love that concept, there's a few potential problems here. These are usually unfavorable fractures, horizontally unfavorable fractures. They are pointing towards the nose.

Dr. Scott Bevans:

The degree of motion here is relatively high. Also, one of the keys to using the Champy technique is to not elevate the pterygomasseteric sling. However, if we're not elevating the pterygomasseteric sling, that means that we're not evaluating the reduction of the more posterior inferior aspect of an angle fracture.

Dr. Scott Bevans:

There's a few potential complications here. I remember I was talking with Ed Ellis. He's published extensively on this Champy plate technique. I had been using these 2.0 or smaller pre-bent plates. I'd seen a couple of non-union, patients with non-union, a few more patients that had plate exposures. I was asking him.

Dr. Scott Bevans:

"When I read your literature, you get such good results, sites greater than 95% healing, low, low complications." I said do you really keep these patients in MMF because I had started doing that using a Champy technique and then leaving him locked in rigid fixation for two weeks?"

Dr. Scott Bevans:

To paraphrase, he said, "Well, plate exposure probably happens about a third of the time, but we just remove it in clinic. It's not a big deal. So not really a complication." A few years ago, I met a comprehensive otolaryngologist in West Texas. We were talking about this topic. He told me, "Yeah. I just use a 2.3-millimeter plate. I bend it myself. That seems to do a lot better."

Dr. Scott Bevans:

I started reading literature on this. Sure enough, there's actually a randomized control trial from 2012 by an oral surgeon at Emory that compared the results of using smaller plates meaning 2.0 millimeter or less and larger plates, usually a 2.3 or larger. It showed that the 2.3-millimeter plate does hold the load more effectively.

Dr. Scott Bevans:

Now, the data here wasn't totally transparent because a lot more of the small plate patients were excluded, but the physiologic proof of concept was fairly convincing to me because even the patients who had non-union, radiographic non-union didn't have as much mobility because the plate was performing the load-bearing function. In my own unpublished experience since I've started using a little bit larger plate, my complication rate has also gone down.

Dr. Scott Bevans:

That said, rigid fixation is really, really helpful to prevent early motion and therefore hardware complications at the surgical site. I have a low threshold to leave patients in rigid fixation for two weeks afterward.

Dr. Scott Bevans:

Using lag screws is another load sharing technique. You're trying to perfectly reduce this fracture and create tight bone apposition. You need these two really long titanium screws to hold the fracture in that position. You bore out the more proximal side. Then, you're trying to get it to bite into the distal bone.

Dr. Scott Bevans:

To achieve that, you really have to be able to access the fracture at a perpendicular angle to the plane of the fracture. They're most applicable for fixating symphyseal fractures. As you can imagine because you're putting this horizontally along the base of the tooth roots, you have to stay really low.

Dr. Scott Bevans:

Maybe as a word of caution, I've seen good surgeons using intraoral approaches think that they're low enough, but because we have to stretch like crazy on that lip, it can be difficult to get those screws all the way at the inferior border of the mandible. They end up putting the more superior screw through the base of the anterior sextant of teeth. That causes some significant morbidity.

Dr. Scott Bevans:

It's also worth highlighting, we talk a lot about with the open reduction internal fixation, we talk a lot about when we're using smaller plates, usually anteriorly on parasymphyseal or symphyseal fractures, this idea of compression and tension. The reason why we describe this two plate system as tension and compression is because they're fighting the natural tendencies of the bone where they're placed.

Dr. Scott Bevans:

Imagine when you're biting down, on the superior aspect of the mandibular bone really the alveolar segment, it's creating a tension load. It's trying to pull that apart. When we put a plate here to reinforce against that motion, it's called a tension band. Similarly, at the inferior border of the mandible when you bite down, it creates a compression force. Our plate inferiorly stabilizes against that. Usually, that's a stronger force. We place a larger plate with bicortical screws because it's really that cortical bone screw interface which provides a lot of stability.

Dr. John Marinelli:

Dr. Bevans, you just mentioned bicortical screws. That was another topic I want to ask you about. Would you mind just touching on when we typically use bicortical screws?

Dr. Scott Bevans:

Yeah. In general, anytime that I'm using a load-bearing technique, I want the screw purchase into the mandible to be as strong as possible. That articulation between a screw and a plate and native bone, most of the strength there is housed in the cortical portion of the bone.

Dr. Scott Bevans:

In fact, think about the largest load-bearing bones in the body like the femur. If you look at a cross-section of the femur, the amount of cortical bone to cancellous or marrow ratio, there's a lot of cortical bone there because that's where all the strength of the bone lies.

Dr. Scott Bevans:

On the load-bearing portion of the mandible which tends to be the inferior portion of the mandible, not the alveolar portion, that's where the cortical bone is the strongest. When you think about where that cortical bone is thickest, it's anteriorly where all the tongue muscles attach to the back of the mandible. That's where we use the longest screws.

Dr. Scott Bevans:

Anytime I'm putting a plate on the inferior border of the mandible, in general, anytime I'm putting a plate on the inferior board of the mandible, I want to use as much as possible bicortical screws to recreate a load-bearing technique.

Dr. Scott Bevans:

Now, this isn't always true. Sometimes, we'll use mini plates and monocortical screws when we're trying to reduce fragments. There's some data to suggest that results can be just as good, but I would say if we're anticipating that our hardware is going to be performing a load-bearing function, then we need to have bicortical screws. Both the lingual and the buccal aspect of the mandible need to be involved.

Dr. John Marinelli:

Okay. We've touched on this topic a little bit already, but would you mind just going through the different approaches that we can use for ORIF? Broadly, it's broken down between transoral and external or transcervical approaches, but how do you think about the different approaches and when to use them?

Dr. Scott Bevans:

I mean in general, we all like transoral approaches because they save patients a visible incision. But sometimes, the quality of the reduction in the fixation is better using a transcervical approach. How do I decide when? Well, if I'm doing a relatively anterior fracture and there's already an intraoral opening, then it's really reasonable to do to transoral approach here.

Dr. Scott Bevans:

There, I'm going to make a gingival buccal sulcus incision likely and a tip here. When I make that incision, I need to make sure that I leave plenty of mucosa and maybe some muscle to sew to. When you think about exposing a parasymphiseal or symphiseal fracture, you're going to have to elevate the mentalis muscle off. It's really important to resuspend that.

Dr. Scott Bevans:

If you don't, well you can Google witch's chin and see how that mentalis contracts down. If I'm not able to leave a generous cuff of tissue when I'm making an intraoral approach and often this is as I work more posterior in the oral cavity, then, I'll do a gingival release. That means I'm going to release the tissue right up against the teeth.

Dr. Scott Bevans:

When I'm doing this, I usually use a long knife handle on a 15 blade which makes it easy to articulate right around the papilla and release that alveolar mucosa. Then, when you sew that, up you can use circumdental sutures.

Dr. Scott Bevans:

My head and neck fellowship director always said that this alveolar tissue was the strongest tissue in the body. I don't know if that's been proven, but the bottom line is that that attached alveolar tissue holds a suture really well and even better if you can anchor it around a tooth.

Dr. Scott Bevans:

I will say that often even when we do transoral approaches as we move more posterior to fixate these plates and screws, we often need a percutaneous trocar port. The percutaneous port, of course, you're going to make a small incision in parallel to relax contention line.

Dr. Scott Bevans:

Then, once you're through the skin, you're going to dissect bluntly through the subcutaneous tissue and then pop into the subperiosteal dissection that you've done intraorally. Then, you can use this cheek retractor that allows you to get perpendicular access to the bone in that location.

Dr. Scott Bevans:

It's not always possible, but you'll have a lot more mobility and be able to move a single port around to access lots of screw holes if you can keep that trocar out of the masseteric fascia. You'll want to be just the anterior to the border of the mandible. You can imagine that sometimes all this business about making an intraoral incision and then having this percutaneous trocar ports, sometimes, it's easier just to do a transcervical approach

Dr. Scott Bevans:

Generally speaking, if I know that I'm going to have to reconstruct more than a third of a mandible or there's significant comminution or a segmental defect in the mandible, I'm going to take a transcervical approach. I do a similar approach to how I would approach a submandibular gland.

Dr. Scott Bevans:

I'm two finger breaths below the border of the mandible. I try to use relaxed contention line. I'll dissect directly down to the inferior border of the mandible or, excuse me, the inferior border the submandibular gland. Then, I'll essentially use a Hayes Martin approach where I'm skinning up the lateral surface of the submandibular gland.

Dr. Scott Bevans:

I don't usually ligate the facial vein or the facial arteries because I want to preserve all that blood flow to the face if I can. Then, I'll come right up on the inferior border the mandible and release the periosteum in that location. That can give me really broad exposure. It can also allow me to see from an inferior aspect and ensure that I'm not getting a lot of mandibular display.

Dr. John Marinelli:

All right. There's obviously numerous different topics we could talk about within ORIF. But one topic I wanted to make sure we address that I think is particularly relevant or helpful to understand as residents is the indications for open reduction of condylar and subcondylar fractures. Would you mind commenting on that?

Dr. Scott Bevans:

Yeah. In fact, subcondylar fractures probably deserve their own hour. Classically, we talk about the Kent and Zide criteria published in the early '90s. There's these four criteria that dictate when we should when we should try to do open reduction internal fixation on subcondylar and condylar fractures.

Dr. Scott Bevans:

The first one is classically a foreign body in the temporomandibular joint like a bullet. The second is significant lateral extracapsular joint displacement. That's rotation of the condylar head laterally. Third would be intrusion into the middle cranial fossa or external auditory canal. And the last one is the inability to achieve a satisfactory occlusal result through closed techniques which is a very broad topic in and of itself.

Dr. Scott Bevans:

But if you look at the AO website or any recent literature on this, there's actually a ton of additional considerations. The exact location of the fracture and a really critical component is the amount of vertical reduction and the height of the ramus. That can be dictated by the degree of angulation or the

degree of subluxation of the condylar head either into or out of the glenoid fossa, the association of other mandibular injuries, their dental status including specifically how much posterior dentition they have and what the [inaudible 00:36:23] of their posterior dentition is as those factors can be protective against having a prolonged anterior open bite or loss of the height of the ramus.

Dr. Scott Bevans:

These patients have other facial bone injuries, other facial fractures that are going to need to be fixated. You can imagine if they have a mobile mid face, well, then it's much more complex to treat a subcondylar fracture and retain good occlusion if we're also going to be mobilizing and attempting to fixate the maxilla.

Dr. Scott Bevans:

Similarly, if they have other systemic injuries or comorbidities that would lead towards or away from operative intervention, then those are factors as well. I'll tell you that this is a super hotly contested topic when to perform open reduction internal fixation versus closed techniques using maximum mandibular fixation.

Dr. Scott Bevans:

I will say that there's good data to suggest that on many patients, early open reduction internal fixation gets them back to normal function sooner, but it is not without risk, risk of nerve injury, for instance. I am doing more of these open, but there's a lot of subtlety to the specifics about how we approach these fractures from a transparotid or retroparotid or even transcervical approach.

Dr. John Marinelli:

Thanks, sir. I think that's helpful. Another specific topic or subtopic that I wanted to ask you about was management of edentulous patients. I know they often deserve some special considerations just given the fact that they often have atrophic mandibles and whatnot. Could you comment on them?

Dr. Scott Bevans:

Yeah. When we think about the pathophysiology, as they've lost teeth, then the alveolar segment which used to be the tooth bearing portion of the mandible often dissolves. What that leaves is the more atrophic and smaller inferior cortical region on the mandible. That means the strength is also reduced, and our bone stock is reduced.

Dr. Scott Bevans:

That means that sometimes these fractures can be more comminuted. We need more exposure. We need bigger plates that span a longer distance. In these patients, I'm always using a load-bearing technique, locking screws with a recon bar because I'm less confident in the cortical strength of the residual mandible.

Dr. Scott Bevans:

On the flip side, often, our reduction here is not based on occlusion but anatomic reduction. When there are no teeth to articulate, the occlusion no longer seems to be as influential. But a tip, if a patient does have dentures, those can be used essentially as splints. And sometimes, we'll screw those in to the

residual mandible and maxilla in order to create a stable platform to reduce motion after an open reduction internal fixation.

Dr. John Marinelli:

Okay, sir. I think that's helpful. Just changing gears, shifting more towards follow-up and complications and whatnot, the first question I wanted to ask you was if you've done ORIF and you've got established a good occlusion for the patient, how do you determine which patients should have post-operative continued rigid fix fixation and which ones don't need it?

Dr. Scott Bevans:

Yeah. Well, obviously, if the rigid fixation is the primary method that we're using to stabilize a mandible fracture, then they need to stay in rigid fixation for some period of time. Even that's debatable. For a subcondylar fracture most of the time, you need rigid fixation for two weeks. If you're using MFF primarily to treat a body or angle fracture, then up to six weeks in published reports.

Dr. Scott Bevans:

But if you've got a load-bearing plate, then theoretically, we no longer need rigid fixation. I'm only using rigid fixation in these patients when there's an associated significant alveolar fracture that I need to stabilize the mandibular teeth against the maxillary teeth or even to move the mandibular teeth. Pull them a little bit into occlusion with the maxillary teeth after a surgical intervention.

Dr. Scott Bevans:

The vast majority of time postoperatively, we're trying to move to early elastics, so semi-rigid fixation or non-rigid fixation. A lot of that is to guide early muscular retraining. Generally, I approach these patients in two-week blocks. If I'm going to leave them in rigid fixation, for instance, I only do that for two weeks. Cut them out. Transition to elastics.

Dr. Scott Bevans:

As soon as I have patients using elastics, these elastics need to be changed out relatively frequently. It seems like now in most hospitals we've gone away from latex-based rubber bands, and the strength of the rubber bands is not as good as probably it once was. Patients are going to need to replace these.

Dr. Scott Bevans:

I ask them when they're replacing them during that interval do maximal incisive opening and mandibular excursion exercises to prevent ankylosis postoperatively.

Dr. John Marinelli:

That's actually a perfect segue. Speaking of ankylosis, TMJ ankylosis, would you mind just describing some of the complications that we need to be aware of when treating these patients?

Dr. Scott Bevans:

Yeah. I think one of the main complications is just the inability to get pre-morbid occlusion. I can't tell you the number of times during a surgery that I've said or I've heard, "Oh, they probably had this cross bite pre-operatively." Then, they wake up. You ask them, "Are you getting a good occlusion?" They say no. It's easy to fool ourselves into thinking that we have good reduction when we don't.



Dr. Scott Bevans:

I think this is also one of the values. I pre-routinely perform some kind of post-operative imaging either a Panorex and a simple fracture or a CT and a complex comminuted or segmental defect fracture. I think that's consistent across the surgical fields. Orthopedic surgeons, neurosurgeons are all getting some sort of imaging to assess their hardware location.

Dr. Scott Bevans:

But aside from that complication of just not getting pre-morbid occlusion, there's the tendency for parasymphseal and symphyseal fractures to splay. We've under bent that anterior plate or we've got some widening of the angles of the mandible.

Dr. Scott Bevans:

You can combat this during the surgery as by having someone squeezing on the angles of the mandible or even using a big orthopedics clamp called a Weber clamp that you just plant on both angles of the mandible and you tighten that thing down and helps hold the angles of the mandible in as you're bending your plates and putting them on.

Dr. Scott Bevans:

Another big risk, common risk or complication after surgery is wound dehiscence. The rate of wound dehiscence for intraoral incisions is relatively high even with layered closures. We've talked about the importance of having an adequate cuff, but this can sometimes then expose hardware. That leads to a debate about how to manage hardware.

Dr. Scott Bevans:

Generally speaking, my perspective is I remove hardware when it's loose when there's evidence of bone loss or when it's chronically exposed to saliva, but if I had limited exposure and well-anchored hardware, I can sort of limp those patients along through the first couple of months to achieve cortical healing. That means I can take the hardware off and not have to replace it.

Dr. Scott Bevans:

But anytime there's pain, inflammation, or mobility, I'm at minimum interrogating that hardware and preparing to replace it or put them in rigid fixation using MMF or external fixation or even replace the plate if I have good soft tissue coverage.

Dr. Scott Bevans:

When patients come back and they're reporting pain and mobility or changes in occlusion or sometimes they say, "I heard this popping noise," I take these complaints pretty seriously. I know it's difficult to assess sometimes because you consider with an angle fracture you've released the masseter muscle. That alone can create some muscular dysfunction and pain, but usually one of the key symptoms of a non-union is pain.

Dr. Scott Bevans:

I have a low threshold to get post-operative imaging on these folks. If I'm concerned about infection, I'll get imaging with contrast. I'm careful to evaluate all the teeth around the fracture as those are often as a source of seeding infections. While having a tooth infection postoperatively or a lot of these

complications sound pretty innocuous, I'll tell you that I've seen total disasters following mandibular fracture repair, significant bone loss and resorption, abscesses, even necrotizing fasciitis. The bottom line is that we really have to take these patients seriously or they can get pretty sick.

Dr. Scott Bevans:

The other category of iatrogenic injury is really the injury to the inferior alveolar nerve. I think that at least temporary sensory deficit is a lot more common than we think. Consider that for every fracture that's posterior to the mental foramen, we're going to be mobilizing the mandible. We're debriding that fracture and then moving it around to reduce it.

Dr. Scott Bevans:

That alone can damage the nerve if it wasn't damaged preoperatively by the fracture itself. Even more, when transoral approaches, we put a lot of tension on that mental nerve. I usually actually dissect the periosteum off adjacent to the mental nerve in order to provide more mobility, but I'll tell you that at least on one occasion, I have avulsed a nerve. It's weakened by a fracture. Then I'm pulling hard on. It comes right out.

Dr. Scott Bevans:

That requires drilling out the nerve, performing a neuroorrhaphy. That adds a solid 45 minutes and some noticeable morbidity for patients. If you have choice, I'd recommend against avulsing nerves. It's also easy to put screws in nerves. One of the main reasons that I like to get that post-operative imaging so I can evaluate every screw position, and you'll notice on that imaging that the mental nerve, the inferior alveolar nerve usually runs more inferior to inside the mandible prior to rising superiorly and then exiting in the mental foramen.

Dr. Scott Bevans:

That's one of the reasons why we have to be so careful to put our plates right along the inferior border of the mandible when we're fixating parasymphyseal body fractures.

Dr. John Marinelli:

You touched a little bit on post-operative infections. Are you typically putting your patients on antibiotics post-operatively or what are your thoughts on that?

Dr. Scott Bevans:

Outside of significant soft tissue loss with gross wound contamination or if we're performing a delayed intervention where the patient has active periodontal disease, I have not seen any good data to suggest that antibiotics are beneficial outside of that perioperative period.

Dr. Scott Bevans:

Now, the perioperative period is considered for about 48 to 72 hours of time surrounding surgery. However, there is good data to suggest that we may help preventing infection by using a good intraoral prep, so brushing the teeth with Peridex before we do any work in the mouth and then irrigating copiously any hardware that we put in irrigating copiously with sterile saline before closure.

Dr. Scott Bevans:

My personal practice has been I try to abide by that data set. I do keep patients on antibiotics for about 24 hours after surgery if they're staying in house. Then, I take them off. I use topical antibiotics or topical decolonization techniques like Peridex for instance, pretty heavily because we know that there's always some level of communication between the oral cavity and these fracture sites. We want to keep the bacterial load down.

Dr. Scott Bevans:

I do tell patients to stop using the full strength Peridex after three to four weeks because they can discolor the teeth. They should at least dilute it by 50%.

Dr. John Marinelli:

All right. The last component of complications that I just wanted to ask you about surrounds TMJ ankylosis and patient's long-term complications with that. Would you mind touching on that briefly?

Dr. Scott Bevans:

Yeah. This is one of the reasons why we've moved away from prolonged periods of rigid fixation. TMJ ankylosis is preventing patients from opening their mouth wide. We measure this using that MIO, that maximal incisive opening. One of the things that I mentioned before that I'm having patients do and this is standard across the industry is after patients come out of rigid fixation or even while they're using guiding elastics is multiple times a day having them open as wide as they can protrude their mandible and laterally mobilize their mandible to keep that temporomandibular joint, that jaw joint from ankylosing down, from scarring down.

Dr. Scott Bevans:

Once it's scarred down, it can be relatively difficult to treat, but preventing it is not very difficult. Often, postoperatively, so every time we have patients replacing rubber bands, we'll have them opening their mouth as wide as possible stopping when they reach the point of pain. There are also some over-the-counter and manufactured devices like a TheraBite Device and then some over-the-counter manufactured ones that are real similar that help passively push patients into a wider maximal incisive opening to prevent this ankylosis postoperatively

Dr. John Marinelli:

All right. What about post-operative follow-up? What do you like to do for that?

Dr. Scott Bevans:

My follow-up pattern for patients depends a little bit on whether or not I'm performing maximum mandibular fixation or open reduction internal fixation and what hardware they have left in their oral cavity. I will tell you that for patients that I'm treating purely with maximum mandibular fixation, that is a long-term relationship. I'm seeing those folks every two weeks for sometimes up to three months.

Dr. Scott Bevans:

But, generally speaking, I work in two-week blocks with patients. If they're in rigid fixation, I bring them back two weeks later and assess whether or not we can remove the rigid fixation and transition to guiding elastics.

Dr. Scott Bevans:

If they're in guiding elastics after surgery, then I'm bringing it back two weeks later to see whether or not we can remove the guiding elastics. Then, I want to leave whatever oral cavity hardware they have for two additional weeks after the use of guiding elastics to make sure that they don't relapse into an unfavorable occlusion. After I know they're healed from the acute phase of surgical intervention and there's no wound dehiscence but I'm usually seeing them back in about three months to ensure that the occlusal result has been stable.

Dr. Scott Bevans:

A common question throughout this is, "Doc, when can I get my teeth cleaned?" I usually say once oral cavity hardware is removed and your incisions are healed, then you're welcome to go get a good deep clean," and encourage them to do that.

Dr. John Marinelli:

Well, great, Dr. Bevans. I think we covered quite a bit of ground in a relatively short amount of time. I'm just going to provide a brief summary of what we talked about.

Dr. John Marinelli:

Mandible fractures are the second most common type of facial fracture behind nasal bone fractures. Typically, they present in the setting of an MVC or an assault. This helps to explain their epidemiologic predilection for younger males. When you're talking to the trauma team after they consult you, it's really good to get an idea of where is the patient headed. Are they intubated already? Are they going to the OR? Are there any lacerations that require suturing that you're going to have to deal with later?

Dr. John Marinelli:

When you go to evaluate the patient, being a careful student of their dentition and occlusion is key keeping in mind the importance of cross bite as well. Talked about different management options for these patients that chiefly surround getting the patient into their native occlusion and stabilizing any unstable fractures.

Dr. John Marinelli:

Talked about the importance of MMF as well as the importance for ORIF in the appropriate setting. Follow-up is largely dictated by what you did, obviously, but patients that are being primarily or exclusively treated with MMF are actually followed more frequently typically in two-week blocks over time to make sure that they're not having any complications or deviating from their good occlusion.

Dr. John Marinelli:

All right. Dr. Bevans, is there anything else you'd like to add before we close?

Dr. Scott Bevans:

Thanks, John. Well, maybe I could just make the summary statement also that trauma can be difficult, but also really rewarding especially for these patients. It can be very redemptive when trauma surgery is done well.

Dr. Scott Bevans:

Also, there are some great discussions on all of these topics in a really organized fashion available on the AOCMF website. You can just Google AOCMF. In fact, they have an AO surgical reference guide that helps me keep improving. I reference it not infrequently. It's a valuable resource. You can download it on your phone.

Dr. Scott Bevans:

You can remind yourself of several of these key concepts and see some pictures that do a nice job of demonstrating the surgical approaches. I should mention here as well that AO has recently published a guideline for operating on facial trauma patients during this COVID pandemic which we presume won't last forever, but these are thoughtful recommendations that have changed the way that we approach some patients with facial trauma during this period.

Dr. John Marinelli:

Yeah. I will definitely second the utility of that AO website, but either way, thanks so much for being here, Dr. Bevans. We really appreciate it.

Dr. Scott Bevans:

It's my pleasure, John. Will look forward to talking again soon.

Dr. John Marinelli:

All right. Now, it's time to transition to the closing portion of the podcast where I will ask a question, pause for a couple seconds, give you a chance to think about it. Then give you the answer.

Dr. John Marinelli:

First question for today is what is angle's classification for molar occlusion? Angle's classification for molar occlusion is split up into three classes where class one is normal occlusion and is defined by the mesial buccal cusp of the maxillary first molar lying in the buccal groove of the mandibular first molar. Class two is retrognathic or overjet where the mandible sits more posteriorly. And class three is more prognathic where the mandible sits more anteriorly.

Dr. John Marinelli:

Next question is define horizontally and vertically unfavorable fractures. A horizontally unfavorable fracture is one that is unable to resist the upward displacing forces on the mandible by muscles of mastication when viewed in the horizontal or sagittal plane.

Dr. John Marinelli:

Muscles typically responsible for horizontal unfavorability include the temporalis, masseter and medial pterygoid. Vertically unfavorable fractures are fractures that are unable to resist the medial displacing forces on the mandible by the muscles of mastication when viewed in the vertical or axial plane. Muscles typically responsible for vertical and favorability include the medial pterygoids, suprahyoid muscles and digastric muscles.

Dr. John Marinelli:

And last question of the day, describe the indications for open reduction of subcondylar fractures. The classic indications for open reduction of subcondylar fractures include invasion of the joint by foreign

body, lateral extracellular displacement, inability to achieve occlusion with closed reduction or involvement of the middle cranial fossa or external auditory canal by the fracture.

Dr. John Marinelli:

All right Well, that about wraps things up for today. Thanks so much for joining us. We'll see you next time.