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**SUMAN GOLLA:** My name is Suman Golla. And I'm delighted to be your moderator for this UPMC Department of Otolaryngology third webinar. This evening, we have Dr. Grant Gillman, who's an Associate Professor in the Department of Otolaryngology, and also, the director of the Division of Facial Plastic Surgery in our department.

He has a particular interest in the clinical and research aspects of management of the complex and simple nasal obstruction. And again, we're delighted to have him talking to us about nasal airway obstruction and clinical exam, management, and further pearls.

**GRANT GILLMAN:** Thank you, Suman. And welcome to the third in the Department of Otolaryngology at the University of Pittsburgh webinar series.

There are so many things that one can talk about when it comes to nasal surgery and improving surgical outcomes, which is the ultimate goal. But so many of the decisions that are made during surgery are really made or predicated upon what we find preoperatively. Get the details, or the subtleties, of the physical examination of the patient presenting with nasal obstruction. One of the single most common complaints presenting to the general otolaryngologist, the rhinologist, the allergist, or the facial plastic surgeon often get short [INAUDIBLE].

And when that happens, we risk compromising the surgical outcome and patient satisfaction even before we get to the operating room. So in the next 45 minutes or so, I'm going to go back to basics. This is not a talk on how to do things surgically, but rather, how to enhance our examination to get the most information possible to facilitate the best possible decisions preoperatively, and hopefully, outcomes postoperatively. I have no disclosures, and there's nothing in this talk that refers to any particular commercial products or bias.

This is the outline for this evening's webinar. I'm going to start with a few comments, a little bit of background and perspective, covers some very basic nasal physiology, review the relevant anatomy-- both with respect to the septum, briefly, and in particular, the internal and external nasal valve, and then move on to the physical examination itself, some thoughts about classification. And I'll touch, finally, upon some of the validated outcome measures that can be applied by anybody who looks out for patients with nasal obstruction. Specifically, were going to pause for comments or questions after the anatomy and the physical examination section and then at the end, after the classification and conclusions. And so we would welcome any questions, comments, or input that anybody might have.

Winston Churchill said, "However beautiful the strategy, you should occasionally look at the results," so for some perspective, after tonsillectomies and adenoidectomies, myringotomies, and tubes, septoplasty is reportedly the third- most-commonly procedure performed by otolaryngologists, which is to say we get a lot of experience. But how well do we do? Or what are our outcomes like?

I'd like to tell you that it depends upon who you read. But the truth is, it doesn't depend on who you read. And the reports to the literature have been fairly consistent over the past 30 years. You get reports like this to 1992-- reportedly effective in 70% of patients with nasal airway obstruction, or like this-- 23% poor or mediocre results, 35% slight or moderate success, and only 42% that would have been deemed good or excellent, or reports like this-- 71% of patients with clinically significant improvement, or the literature has reported success rates between 63% and 85%.

So in fact, if you look back over 30 years worth of literature, the success and satisfaction rates consistently range in the 65% to 80% range, which I think speaks to the subtleties and nuances when it comes to improving the nasal airway, which is often more complicated, as far as getting good outcomes is concerned, than meets the eye. So invariably, it leads us to ask ourselves, if the operation is so easy, how can we fail as much as 30% or 35% of the time?

The objectives of nasal surgery are familiar to all of us. Is to establish a normal anatomic nasal airway, and to minimize the complications of surgery, and specific to this talk-- we're talking about suboptimal outcomes-- dissatisfied, frustrated, or angry patients, and the need for revision surgery. And I think that by harnessing the most possible information from the preoperative exam, that we can take it out a long way to overcoming, in particular, these latter two complications.

So why do we fail? Certainly, one of the reasons that things might go wrong would include progression of evolution of other causes of nasal obstruction-- in particular, allergy or inflammatory problems, poliposis. We're talking about the patient with a nasal obstruction. This is a big problem-- one operation for all patients. Clearly, it's time to think about these patients differently and to try to individualize as much as we can to get beyond success rates of 65%, 80%.

Cartilate drift-- I'm not a big believer in memory, because we've all have patients who started out with, let's say, left-sided nasal airway obstruction. We operated on them, and subsequently, they felt better on their left and now worse on the right. I don't think that there's always memory, per se. But I do think that things can drift as they're healing. And that can affect outcome.

A change in stability of the residual structure-- for sure, when we're taking out parts of the septum cartilate bone, we weaken the underlying structure. And I think that things can be subjected to bumping, or shifting, or bending as they're healing. And so there can be some change in the residual structure that results from the fact that we inevitably weaken what we leave behind.

Unfortunately, the wrong diagnosis or wrong operation, unidentified or persistent nasal valve compromise, or surgical technique-- I think that many failures fall into the wrong diagnosis or inadequate yield from the preoperative exam. The wrong operation, meaning right diagnosis but maybe an operation that was too conservative or just simply failed to appreciate or correct the entire septal deviation, or perhaps missed issues with internal valve angles, external nasal valve compromise, caudal delections that were unappreciated-- that sort of thing. Many of these I think actually fail to notice the diagnosis before the patient gets to the operating room. And I think that success is really built upon a high-quality preoperative exam.

In 2014, we published a study in Laryngoscope on revisions of septoplasty. And we looked at outcomes. But beyond outcomes, we also looked at the sites of failure. So we broke it down into the bony septum to the dorsal septum to the mid-septum to the caudal septum, persistent deviations along the maxillary crest to floor of the nose, allowing for the fact that the patient might have a persistent deviation in more than one area.

And what we found was that 72% of our revision patients had persistent deviation involved in the caudal septum. And over 90% had some persistent deviation involved in the dorsal septum, or the valve area-- the suggestion being that we're often deficient in our management of the dorsal and caudal septum. So for starters, if we can better identify the caudal or dorsal deformity with better reliability preoperatively, then they're less likely to be left unaddressed intraoperatively.

In some ways, the simplicity of the terminology that we use routinely diminishes the complexity of the surgery. The terminology is so generic, as to be non-descriptive. Every deviated septum is just called a deviated septum.

As we all know, there could be tilts, and curves, and angles, and telescoping segments. And the deviated septum in a straight framework, or a corporate framework, or internal-valve issues, external-valve issues. But when we get so generic in terms of our description, inevitably, that's going to lead to suboptimal teaching and surgical failures. And then likewise, our surgery itself-- septoplasty-- doesn't often sufficiently define the operation. I think that the better that we can describe it or categorize the deformity, the better we can differentiate one from another where relevant, the better we can begin to think about how to tailor the operation so that there isn't a generic septoplasty anymore, which should lead to better outcomes.

If you look at these noses, these are all deviated septums-- one that looks like it's off the maxillary crest, one that's right off the the nasal sidewall, one that looks like it's off the crest of the opposite side, one that clearly impinges on the nasal- valve-angle dorsally, one that completely obliterates the nasal airway, deep groove over the maxillary crest. These are all deviated septums.

These are all deviated septums-- one that looks like there's a caudal septum bilaterally one that is clearly off the maxillary crest, one that looks like it's fractured, or angled, or badly curved off the crest, and a medial segment of the [INAUDIBLE] that's collapsing towards the patient's right side, one that reaches out and touches the sidewall. These are all deviated septums.

And these patients all have deviated septums. You can see it dorsally here, dorsally here. And then this somewhat S-shaped, a nasal dorsum-- clearly deviated septum there. So what single operation is going to address all these problems?

The preoperative goals are to better identify and describe the fundamental structural issue that's responsible for symptomatic nasal obstruction in a given patient, to better select the right operation and surgical approach for that patient, which should lead to being better, in terms of how we counsel the patient preoperatively. It should better guide us intraoperatively, and hopefully minimize the frequency of suboptimal results in the persistent nasal airway obstruction, the need for radiation surgery and not a happy patient, as I mentioned earlier.

I think a commitment to better outcomes also involves dispelling or disposing of the notion that it's both just a septoplasty, dispelling or disposing of the notion that they can all be done through the inside of the nose. And I think that it needs to be thought of as a more reconstructive procedure, i.e. constructing a patent airway rather than an incisional procedure.

It's worth taking a few minutes to review some basic nasal physiology. Poiseuille's law states that airflow is proportional to the fourth power of the cross-sectional radius. To put it in other words, the degree to which airflow might diminish, if we reduce the size of the airway, might be exponential. And conversely, the degree in which airflow might increase might be exponential with either a decrease in space or an increase in space, respectively. Re

This is a pretty striking slide. Consider that, at least in some parts of the nose, conceding as little as half a millimeter can affect airflow as much as 20%. Or conceding a millimeter might affect the airflow as much as 36%.

Now this isn't true throughout the nasal cavity, because not all space is created equal. Conceding a half a millimeter along the floor the nose clearly is not the same as conceding a half millimeter in the internal valve angle. But it's quite striking to see, at least in some segments of the nose, the extent to which the slightest change in space can result in a pretty dramatic change in airflow.

Ohm's law states that flow equals pressure over resistance. So in situations where we have nasal obstruction or increased nasal airway resistance, to maintain flow requires increasing the driving pressure, or increasing the inspiratory effort, which would be all well and good if the nose was a rigid structure. But it's not.

And so that brings up the Venturi effect-- as inspiratory effort increases, transmural negative pressure increases, creating a suction effect, which, in the nose, leads to collapse of the nasal sidewall. So the nose essentially behaves like the startling resistor. It's a flexible, collapsible tube. So it isn't sufficient if we were to overcome resistance to simply increase the driving pressure, because as that inspiratory effort increases, the nose starts to favor collapse.

That's all I want to say about the physiology, except to stress that it's an important backdrop to whatever might be done surgically to improve airflow. So I'm going to move on and review some of the relevant anatomy. I'm not going to be labial septal anatomy, which is familiar to everyone. The only point I would make here is that septal deflections are not all created equal. It's worth making a note of particularly large spurs, particularly deep grooves over the maxillary crest for the technical challenges they present-- severe fracture lines, or angulations in the cartilage, and in particular, in terms of their functional impact, deflections involving the dorsal and caudal septum.

As air hits the floor of the nose, or pyriform aperture, airflow is largely directed up towards the nasal dorsum and through the internal nasal valve angle. So a disproportionate amount of airflow goes through the valve region. And it is said to account for as much as 50% of the total nasal-airway resistance.

There's been numerous studies that have looked at the frequency with which valve problems might be at least a part of the symptomatic nasal airway obstruction in patients. This author's concluded that up to 13% of patients with nasal airway obstruction have valve pathologies and associated etiology. And I would say that that's probably consistent with my own clinical experience, probably someone in the 13% to 15%, 17% range-- that sort of thing,

So spend a little time talking about the nasal valve. In simple terms, the internal nasal valve corresponds to the middle third of the nose. And the external nasal valve corresponds to the lower third of the nose.

The internal nasal valve is bounded by the caudal margin of the upper lateral cartilage, the septum, medially, the floor of the nose, and the head, or anterior, end to the inferior turbinate. The normal valve angle is typically quoted to being 10 to 15 degrees. And it's more obtuse in the platyrrhine nose, which is why you are less likely to see internal valve issues in the patient with a platyrrhine nose.

These slides are taken from a paper by Dr. Dean Toriumi, who did cadaveric sections through the upper lateral cartilage. And what he's showing you this picture here is that if you section the upper-lateral cartilage above the caudal border-- so above the valve angle-- what you see is septum in the middle, upper lateral cartilage here, and a fairly obtuse angle between the two. But when you move down to what is typically cited as the internal valve angle-- that section that's through the caudal end of the upper lateral cartilage-- you see that the actual valve angle between the upper lateral cartilage and the septum medially narrows considerably. In other words, it ends up serving as a bit of a choke zone. For that reason, this area is particularly worthy of increased attention, or focus, on a clinical exam.

Moving on-- the external nasal valve, in essence, corresponds to the nasal alar. So it extends from that alar crease superiorly to the alar rim inferiorly. And the strength of the external nasal valve or alar sidewall generally speaking, corresponds to the stability of the size, strength, and orientation of the lateral crest of the lower-lateral cartilage. The alar labial or alar sidewall, basically contains fibro-fatty tissue, the cutaneous and mucosal elements, and the caudal border, or a segment of the lower-lateral cartilage, which is running obliquely through it. So the support to that area is largely dependent, as I said, on the size, strength, and orientation of the lateral cross of the lower lateral cartilage.

So in a minute, we'll go back to look at the physical examination in greater detail. In both general terms and specific, it says they relate to valve collapse as well. But I'll pause here for any questions or comments if there are any.

**SUMAN GOLLA:** And we haven't received any questions through our audience. But I have a question or a comment. I really appreciated the *Laryngoscope* article that you referenced that you had written-- on the caudal aspect, or the dorsal aspect of the septum being perhaps one of the key areas. And so as a general otolaryngologist, should we be paying more attention to that? Usually, you'll see a spur, or a mole or an obvious deflection. But I did appreciate that that caudal septum is a much more valuable of a player or a role.

**GRANT GILLMAN:** Yeah, thank you. For sure. And I'm going to spend a fair bit of time right at the end-- the last portion of the talk-- talking about the caudal septum in particular. Through the next sort of segment on the physical examination, I'm going to talk about the dorsal septum for sure.

I think that it's really easy sometimes to lose the forest for the trees or trees for the forest for sure. You can look in and see a big, deep groove, or a septum that's way off. But at least, speaking for myself, my notes in the electronic medical record often reference the valve angles themselves. Is it enough of a deflection to impose upon the [INAUDIBLE] angle? Is that something that I need to keep on my radar screen when I've got a patient in the operating room under an anesthetic, on their back, and decongested? If I don't bring those things to my own attention, then I'm out to perhaps under-gauge it intraoperatively when the nose is decongested.

So not only is it important to look at those-- and that's where, I think, the nuances matter. I think they can be very subtle. And I think it brings us back to the slide there I showed in terms of how little a change. And how often do you see patients that go, I just do this a little bit and my breathing's fine. It's that half millimeter or millimeter So absolutely. And we're going to talk more about that.

So the physical examination. The goal of the physical examination, for me, is to better define the site or sites of obstruction-- in particular, to identify the complex septal deformity. In other words, the septum which is more likely to fail or end up in need of revision surgery with just a quote "routine" septoplasty. So in other words, when is a routine septoplasty more likely to fail?

To identify the patient with nasal valve compromise; to classify or describe the deformity, something that we are not taught and that we don't hear much about; and to formulate a surgical plan. In essence, the question there is, when is an open rhinoplasty approach more appropriate? In every patient that presents with nasal airway obstruction, assuming it is of a structural nature, not allergy or adenoid hypertrophy or nasal polyposis, I want to distinguish, first and foremost, whether I'm dealing with, or whether the patient has, a septal deformity, a nasal valve problem, or both.

And then, specifically, I want to document, or make note of, whether I think it's tilted; whether I think there's curves; whether I think there's angulation or fractures in the septum; whether there's spurs; if there's any issue with the caudal septum; whether I think the septum impinges or doesn't on the valve space. So I like to give myself a lot more detail. I spoke earlier about the problem with the generic terminology, just saying deviated septum, or, yup, you're off to the left. I think there's so much more information that will direct what I do surgically.

I want to know if, as far as valve compromise is concerned, whether it's internal nasal valve or external nasal valve, and whether it's static, meaning present at rest, or whether it's dynamic. So in essence, whether it's structurally narrow or whether it's weak, and collapsing with inspiration.

Some of this is obvious, if not routine. But I think the nuances are where the details lie. So I think that more time that is spent on the physical examination is generally rewarded. I look at the external framework. I want to see the alignment of the nasal pyramid. I want to look at the middle nasal vault and the lower third of the nose specifically, that is, the internal and external nasal valve spaces.

I want to see the patient breathe with normal to moderate inspiration to gauge stability of the nasal sidewall, perform a Cottle maneuver, which we're all familiar with-- when the patient distracts the cheek laterally to see whether or not that improves airflow. I do a speculum exam of both the septum and looking at the valve angles in particular, as we were just talking about.

As I mentioned earlier, I like to document for myself whether I think that there's curves, because I think that those are categorically different for me surgically; and if there's fractures or angulations in the septum; to make a note of spurs; the valve angles themselves-- in simple terms, tight, narrow, problem, not a problem; the caudal septum. I think endoscopy is absolutely indicated routinely. There's many patients I've operated on, or that I have seen, where you don't appreciate it with a headlight that there is a polyp in the back, or maybe a septal perforation if it was a revision case, and in some cases a septal perforation where there was no prior surgery. But I want to look for anything else, because I'd rather not miss anything on my exam.

And palpation. And I'm going to come back to palpation in a minute, but I think it's something that is underdone and hugely important.

As it relates to the nasal valve, I think it's important to inspect the caudal septum as it imposes on the external valve space-- the nares or the nasal vestibule-- and the internal valve angle with minimal opening of the speculum or distraction of the nostril. I think it's easy to open things wide and underappreciate a problem. It's easy to put an endoscope in and go right past a problem. So I think that it's really critical that those spaces are evaluated as close to the native state, as close to what they are without any instrumentation in the nose as is possible.

I'm going to stress several times through the presentation the value of palpation of the caudal septum. It's not something that is generally taught or spoken of, but it's something that is routinely a part of my examination, and I think should be routinely a part of the examination in all patients of whom nasal surgery is even in a consideration. And particularly because caudal septums can often be much different and much more severe or complex than can be appreciated on speculum exam alone.

Because we have the ability just via palpation to extend or improve the power of our examination-- the information yield, it goes without saying that we should be taking advantage of that. Very often I'm surprised by what I learn through palpation of the caudal end of the septum, which might otherwise be somewhat concealed behind the width of the medial crura and the calumella. And I'll come back to that.

As far as the external nasal framework of the nose is concerned, I look at the alignment of the nasal pyramid. Take this patient here, where the nasal bones are obviously obliquely off towards his right side. I have to make the determination as to whether or not I think it's sufficient to draw the dorsal septum and the upper lateral cartilages with it in a case like this one. Or it may be more minor, but that's going to raise the issue as to whether or not the patient should have osteotomies. I'm looking at the width and stability of the middle nasal vault. This patient has obvious collapse of the middle nasal vault on his left side.

Externally, I'm looking at the shape and stability of the lateral crura of the lower lateral cartilages as it imposes on the external nasal valve. I'm looking at the nasal base for symmetry in the caudal septal position. I'm going to move on to how you establish the diagnosis, in other words, what you would see of an internal valve problem, and share some of my clinical examples. So remember, we're talking about the middle third of the nose.

As far as an index of suspicion based on history or physical examination, certainly it's got to get on my radar screen if the patient's had prior nasal surgery, in particular reduction rhinoplasty; if the patient complains of, or mentions, or if I hear whistling through the nose upon inspiration; if the patient says that they feel like something sticks or is collapsed. I'll have them point right to the middle nasal vault if there's a history of nasal trauma.

With narrowing of the internal valve, typically what you'll see is either pinching of the middle third of the nose or a so-called hourglass deformity, or in some cases, a dorsal septal deflection into the nasal angle. So the valve angle itself might be narrow not only from collapse of the upper lateral cartilages, but also from a dorsal septal deflection into the valve angle. And it's important to try and figure out to what extent it's one or the other. There might be dynamic instability-- medial shift of the caudal border of the upper lateral cartilage on inspiration at a positive caudal or a modified caudal maneuver.

One example is a patient who obviously underwent a very aggressive dorsal reduction in a prior rhinoplasty. This was done many years ago. There was no effort made to restore the width or support to the middle nasal vault, osteotomies to infracture the nasal bones. And then what happens is the upper lateral cartilages collapse [INAUDIBLE] immediately, giving you a little bit of narrowing of the mid vault, as you see here.

These are both patients with a middle-third deformity. Neither of these patients have had operations. This one presenting for just nasal airway obstruction, and this one interested in a cosmetic rhinoplasty, the importance being that we're already starting out with some compromise in the internal valve angle on both of these patients. This one, which wouldn't get any worse with a septoplasty. And certainly you might make him breathe just fine with a septoplasty, although you might be able to reduce his airway resistance more with some procedure that affected the width of the middle nasal vault. And this one that is almost surely going to get narrower if you proceed with a dorsal reduction and don't re-establish width to the middle nasal vault.

Another patient, and then nasal bones off to the right side. Post traumatic deformity. The pyramid, as they say here, goes left. The dorsal septum goes left, and there's obvious collapse of the middle nasal vault on the right side.

A patient here who had an operation a year earlier. This is her right side. That's the septum, that's the nasal sidewall. Good valve angle in here. This is her left-side septum here, obvious medial collapse, and narrowing of the internal nasal valve angle. That's the upper lateral cartilage right there. This is at rest. This is what it looks like when she takes a breath. It gets even narrower. So she's got both a static and dynamic collapse of the middle nasal vault on her left side.

I'm going to move on to the diagnosis and some examples of external nasal valve compromise. And then we'll look at the septum and caudal septum more specifically.

So as you recall from earlier, I noted that the stability of the external nasal valve is proportionate to the size and strength and orientation of the lateral crus of the lower lateral cartilage. So causes of external nasal valve collapse might be over-aggressive cephalic resection of the lateral crus, as might be seen from a cosmetic rhinoplasty; natively weak concave or recurving lateral crura; cephalic positioning of the lateral crura, where instead of providing support to the alar lobule, they're overly cephalically malpositioned, and no longer providing appropriate support to the nasal ala; the over-projecting nasal tip, with very thin alar sidewalls and typically weak, thin lateral crura; the caudal septal deviation as it imposes on the nasal vestibule. It can also result from trauma or from facial paralysis.

Typically on the physical examination you see things like this. Either a buckled or concave alar sidewall, like you see here on this patient's left side; collapse of the nostril margin at rest, either in a static tense or on moderate inspiration. This is an inspiratory view in this patient, as you see here. You may see natively concave, weak, hypoplastic, malpositioned, or recurving lateral crura. We'll talk a little bit more about those in a minute.

You can see alar rim notching or retraction from prior rhinoplasty, suggesting over-resection of the lateral crura; cephalic retraction of the nostril rim or alar notching, suggesting inadequate support to the sidewall; and again, improved nasal airflow with lateralization or stabilization of the alar rim. I mentioned the Cottle maneuver before.

So here are some examples of some other clinical cases. In this patient, you can see there's a very rounded contour to the lateral crus medially, which then disappears into this concavity here. So there's a very deep left alar crease. A concave lateral crus out here. And as you see here on the base view, albeit subtle, some buckling of the alar sidewall into the external nasal valve.

And this is a patient who had Bell's palsy years earlier, did not recover completely, had no breathing issues before, but lost the muscular tone to the nasal dilators, and as a result developed a breathing problem. You can see that she's now got this concavity in the ala on her right side, right here. And a little bit of medial buckling of the sidewall.

This is a patient here who has obvious narrowing of the mid vault. So he's got an internal nasal valve compromise as well. You can see that he's got a very rounded nasal tip. If you start to look on his three-quarter views, you can see his lateral crura start out nicely convex and then disappear. These are the recurving lateral crura, the lateral crura that recurve back towards the septum and start to compromise the valve space there. You see he's got a concavity lateral to them as a result. You see it again here on his nasal base, the lateral crura recurving, as they are there.

This is what you might see. I don't normally shoot a CT scan for this, but it shows recurvature of the lateral crura quite well. It was an incidental observation on a scan, so I took a picture of that.

This is a patient looking endoscopically in the nose, septum in the mid line. Lower lateral cartilage on the patient's right side, septum here on his left side. You can see the way the lateral crus recurves, comes all the way around in this patient to touch the septum.

This is a patient who's got an obvious external valve problem, even at rest. As you see, there's buckling of the alar sidewall bilaterally, albeit more dramatically so on her right side, and inspiratory or dynamic collapse where the whole situation gets worse. So these are the kinds of things that you might see with external valve problems. A few other examples.

Very challenging case. Never had a prior operation. You can see the buckling or concavity of the alar sidewall here. The shadowing here, which is suggesting some alar collapse on her left side. You see the cartilage of the septum on her left, and the fact that the medial crura and columella completely tilt and collapse off towards her right side.

This gentleman here had no prior surgery, fairly significant external valve problem. And so you should be able to grasp that there's so much about the physical exam as you work your way down the nose, and then through the inside of the nose. But You look at pieces like this, or this one [INAUDIBLE], and it should become self-evident that this is not just a deviated septum, and that strictly regarding this as a septoplasty and something that can be done endonasally is almost surely going to lead to a suboptimal outcome.

So that's a summary of what one should be considering together with some clinical examinations as it relates to examination of the external framework of the nose and the internal and external valves. I'll just pause here again.

**SPEAKER 1:** Yeah, we're happy to take your questions. And I think you can email, as listed in your webinar login.

So I have a question for you. Sometimes patients will come in and they'll say, I can't breathe through my nose. And how do you tease out-- and you alluded to this earlier, with the congestion versus the obstruction, and you ask them, and they're just-- I just don't know. I can't breathe.

**GRANT**

**GILLMAN:**

Yeah, well, as you well know, as somebody who deals a lot with the allergic patient, there is a fine line between congestion and obstruction. In patients who are more thoughtful and more articulate, you're better able to define that, I think. And actually, I take a complete history. I do try and get a sense of whether or not there is any kind of allergic or inflammatory basis to their symptoms. All of my patients that come in with nasal obstruction get a questionnaire that they fill out while they're waiting in the waiting room or in the exam room before I get there that asks, specifically, questions that are targeted to allergic rhinitis.

So that's a routine part of their history. And if I get a sense that that is part of the problem, then an appropriate allergy work up is part of the equation. Because I think that, for any patient with obstruction, there's structural problems and there's inflammatory problems. And you're allowed to have both. It's important to understand that, if you have an allergic problem, that surgery is not going to cut that out. And if you have a structural problem, you can treat the allergies all day long, but they're not going to straighten something that's crooked.

And for those patients that have both an inflammatory problem and a structural problem, they need to understand, too, that surgery is not an end completely unto itself, that they need to be committed. And they have to understand that it's going to be important to commit to long-term management of the inflammatory problem, too. So I think that that's stuff that is important to elaborate on your history.

I'll move on now. We'll talk about the nasal septum. So I mentioned earlier about identifying the complex septal deformities, which is part of the goal of the physical examination of the septum. In other words, as I said earlier, when is a routine septoplasty more likely to fail? Or when is an open rhinoplasty a more appropriate operation for the full correction of a deviated septum?

So the question that needs to be asked in all of these patients, the high risk patient, is, is there valve compromise? Is there a deviation of the dorsal septum? And if so, is it something that I can manage endonasally, which might be more doable if it's a gentle curve in the dorsal septum versus a fracture or an angulated septum, where the fracture line runs right up through the dorsal septum. Is there a caudal septal deviation? And finally, are there complex deformities in regions that are critical to nasal support, namely the L-strut, that can't simply be treated with conventional, traditional techniques or an SMR?

To put it differently, there's your picture of a standard SMR. And we're all taught that it's important or essential to preserve at least a centimeter or a centimeter and a half of an L-strut, of a dorsal strut, one contiguous dorsal strut and caudal strut. And while that is true, and I agree with that, it's important to understand that that operation is limited in terms of its ability to address curvatures or angles that are in the residual L-strut. Namely, angles or curvatures that are in the dorsal deviation itself, or in the caudal septum itself.

And so there certainly needs to be an adequate dorsal strut and caudal strut at the end of an operation. But it doesn't mean that it should never be violated, or it doesn't mean that the patient needs to leave with the very one that came with. It might need to be reconstructed. And that brings me back to the paper that I referenced earlier in terms of sites of failure. And I think it's so important to identify that high-risk septum preoperatively. Because if the full correction of that is something that is not within the comfort zone of the examining physician, then they should send them to somebody who does that kind of work. Because these are so much more complicated to do as revision operations, when there isn't as much of a substrate-- i.e. septal cartilage or bone-- to harvest, to work with, not to mention the inherent scar tissue.

So I referenced earlier classification. And there really isn't any single universally accepted or comprehensive classification system, for that matter. But making the effort to use some system, or to differentiate them one from another in some way gets me thinking about a surgical plan tailored to the type of deformity I see. Just saying deviated nasal septum to the left, it doesn't do that any more than saying neck disease is any guide to the head and neck cancer surgeon.

So this is a classification system that was published by Bahman Guyuron, Dr. Guyuron, in Cleveland in 1999. And I use this as a starting point, and I go from there. And I'm going to work my way through this. What this doesn't do for me, really, is distinguish between curves or tilts or fracture lines or angles. And those, for me, have different implications surgically. It doesn't do anything to highlight the caudal septal deviation in particular.

And if there is one question that I've been asked more than any other when it comes to managing the patient with the deviated septum over the years, it's people coming up and saying, well, how do you manage the caudal septal deformity? So clearly it's a different animal. And then it doesn't tell me anything about the strength or curves or angles or direction of the caudal septal deformity. So I use this as a sort of beginning, or as a reference point, and I work from there. So I'll work through some of these, and how I use them.

The septal tilt deformity is the commonest variation according to Guyuron, and I would tend to agree with that. That's the nose where the septum is basically tilted from one side of the nose as it extends from the dorsum, along here, to the floor of the nose. So it's tilted off the sagittal plane, if you will. And you may see a groove over the maxillary crest on the side opposite the deviation. But typically there's no impression of a curvature within the septum. And this tilt may or may not extend through the caudal septum, which it may therefore need to be addressed. And externally they're typically straight, although not always.

This is also the kind of septum that might respond well to just a routine operation, or a routine SMR. This is what you might see endoscopically. And again, there's no real sense of a curvature. There's a fairly broad tilt, but fairly straight, no imposition upon the internal valve angle.

As you move down through the classifications-- so I'll see patients where my notes might say, APD, Atrial Posterior Deviation. In these cases, there's more of a septal curvature extending from the dorsum down to the maxillary crest rather than just a tilt. And that curve is often well visualized from the contralateral side. Those are cases where you look in and it doesn't just look it's tilted or off the crest. But often the base might be centered on the crest. The crest itself may be deviated, but you distinctly get the impression of a curve as you're looking in from the contralateral side.

In the worst of cases, that curve may extend right through the caudal septum. It may be really obvious, as in a case like this, and it may be more subtle. And that's information that you get when you palpate the nose, and you can actually get a sense of that curvature. And that gives you a heads up in terms of what you might need to be doing, and also what you need to keep your eye on intraoperatively, in addition to how you might counsel a patient. Because I think when you're going to take on a correction of a deviation of a caudal septum that the counseling is a little bit different because of the risk, potentially, of changes in the supratip dorsum as you work on the caudal septum below it.

This is what it looks like endoscopically. And unlike the septal tilt, when you look at this one, there's not only the distinct impression of a curvature here, but one of the things that you notice, also, is that it impacts upon the internal nasal valve angle. And so if you approach this patient with a moderately severe curvature with an overly conservative operation, you're going to leave them with persistent obstruction in the region of the internal nasal valve and have a symptomatic and unhappy patient.

So if the septal anteroposterior curve extends to the caudal strut, and you leave this strut completely intact, without disrupting its integrity in any way, then the deformity in this L-strut persists. The caudal septum is attached to the anterior nasal spine. It's one contiguous piece with the dorsal septum, which is attached to the overlying skin and the upper lateral cartilages. And that deforming tension in the L-strut persists. And if you leave it completely unviolated, that patient's left with a residual curve.

So if I'm looking at a patient, and I make note preoperatively of what I'd call an AP curve, I know there's a good chance that I'm going to have to do something to adjust the caudal septum to help take that curve out. The C-shaped cephalocaudal deviation is the next one that Guyuron describes. That's a septal curvature, again, rather than a tilt, but in this case along the cephalocaudal orientation. It's not unlike what you'd see here. And again, it imposes on the valve angle. And so it has to be thought of differently than your typical septal tilt.

And these are often apparent externally. In these cases, in fact, the patients may complain of nasal airway compromised bilaterally because of the curvature of the septum to one side and the internal nasal valve compromise on the other. And so, in a nose like this, they're likely to need an external approach-- spreader graft to try and expand the width of the middle nasal vault, on the left side in this case, and at the same time to straighten out the dorsal strut, plus or minus osteotomies, depending on whether one thinks there's much of a bony problem or not, for optimal correction.

The S-shaped anterior-posterior deviation that Guyuron described is really very similar to the C-shaped, except that it adds an extra twist. But the considerations are very similar, assuming it's a curve, as they might be for a simple AP curve. Where they get different is where there are no longer curves, but maybe fractures or angles, as I mentioned earlier. But when I see something like that, again, I'm going to be thinking ahead of time that it's going to require some kind of caudal septal adjustment or reconstruction, which might include shortening the caudal septum above the anterior nasal spine.

And it may involve transecting it if it's particularly flimsy or fractured or angulated, and maybe even battening it or replacing the entire caudal septum as indicated. But I'm already thinking about how much more is going to be involved and again, having to decide, is this in my wheelhouse? And is this something that I can do through the inside of the nose?

The S-shaped cephalocaudal deviation that he describes is relatively uncommon, and again, similar to the C-shaped cephalocaudal deviation. More complex because it adds an additional twist, but similar principles with bilateral considerations, and generally speaking, one that is going to have to be visible externally and have to be opened up for an optimal correction. In those cases, I might be thinking about possible transection of the dorsal strut, and realigning it to take out the curve, or spreader grafts, osteotomies, again. But certainly something that's going to employ or require functional rhinoplasty skills for the sake of correcting the deviation in the septum.

Which brings me to caudal septal deflections. The view of the nasal base is very telling, and really needs to be considered in all patients. Simply put, the greater the deformity evident on examination of the nasal base, the greater the likelihood of the patient needing more complex surgery, ideally as the first operation to correct their breathing issue. Because these can be very complicated, or complex to do as revision operations.

Caudal septal deviations often include both aesthetic and functional consequences. There can be twisting of the tip of the nose, obstruction of the nasal vestibule, an imposition on the external nasal valve space, as we see here, internal valve obstruction just through torque that's transmitted right up and through the internal nasal valve and dorsal septum. And they can be often quite challenging to correct because of the risk of weakening or compromising both tip or dorsal support.

Diagnosis [INAUDIBLE]. Again, the examination involves anterior rhinoscopy and endoscopy; and inspection of the nasal base of the external alignment for tip deviation; curvature along the nasal dorsum or the dorsal septum; and then examination of the height of the supratip dorsum, which might give you some sense of the support provided by the caudal septum underneath it.

And again, I always include palpation in any patient with nasal obstruction. Much more important in the patient with the caudal septal deformity. When I'm palpating, it gives me a sense of both the shape of the caudal septum-- as I mentioned earlier, is it a tilt, is it an AP curve? Is it fractured, angulated? Is it completely rotated off the parasagittal plane? I get a sense of the strength of it. Is it strong, is it weak? Is it flimsy, has it been shortened? And in particular, the direction of the deflection.

For all intents and purposes, if the caudal end of the septum is pointing to the floor, or north-south, there's a lot of things that I can do fairly simply to correct that. And on the other hand, if the caudal edge of the septum is sort of oriented at more of an east-west direction, as it is in this patient here, where it's completely fractured and rotated off the parasagittal plane, it's a much more complex correction. And so this guides me in terms of what I might have to do intraoperatively.

So I put on a glove, and I palpate them all, because I can't reliably tell. When I look at a patient like this, it might just have a tilt to the caudal septum off the anterior nasal spine. I can't tell reliably looking behind the columella whether I'm looking at a tilt, whether there might be an AP curve, or whether it might be a caudal septum that's actually completely rotated off the parasagittal plane.

Consider this patient who I saw recently. This is what it looks like. It looks, for the most part, like he's got a big curve, or off the crest well into his left nasal airway. Well, when you put a glove on and palpate this patient, you come to realize that the caudal edge is here. The caudal septum runs completely parallel to the floor of the room, and turns 90 degrees. So it's completely rotated off the parasagittal plane.

This is the very same patient's nose when you open it up. You can see in his case that he's had a fracture. He's had a history of paranasal trauma through the septum that runs all the way up through the nasal dorsum. There's no way that I can leave a patient like this with an L-strut and correct this angle. So this needs, obviously, wide exposure-- complete transection through the dorsal strut and re-orientation of those two segments, either with spreader grafts or a caudal septal replacement graft maybe integrated with the spreader, but clearly in need of a much more complex operation. And it's so much easier to do these primarily, where there's big septal cartilage to harvest to facilitate that correction.

It enables me to classify it, ultimately. So I can answer the questions, is it the caudal-end of a septal tilt. Is it a mild AP curve? Is it fractured or angulated, or bent or buckled? Or is it completely rotated off the axis of the dorsal septum, or off the parasagittal plane? And that guides me through my thoughts already about can I do this simply, shorting over the anterior nasal spine. Or will I need to do something that's more involved, like using a reinforcement or batten graft, which I can do endonasally? Do I think it's going to need to be stabilized with spreader graft, which I'll need to do through an external approach? Or do I think I'm going to need replace and reconstruct it completely with a free graft?

Ultimately, when it comes to the caudal septal deformity, my goal is to answer this question. Can I do it endonasally, or does this need to be done through an external rhinoplasty approach? Because if you've identified the caudal septum as a problem, then you have to be prepared to deal with it if you're going to schedule this kind of a case. And this is something that should be appreciable on a preoperative evaluation simply through palpation.

The last thing I want to say is I want to reference briefly validated outcome measures. In 2004, Stuart et al., Dr. Mickey Stewart, validated what was referred to as the NOSE scale, the Nasal Obstruction Symptom Evaluation scale. It's a simple five-point questionnaire, each question graded from 0 to 4. The cumulative score is multiplied by five to give you a score out of 100, with a higher number being indicative of more severe nasal airway obstruction. So It's widely recognized, and probably now the gold standard as far as disease-specific quality of life outcome measures that are sensitive to changes in nasal airway obstruction.

It takes a patient minutes to fill this out. I have all my patients fill this out, again, preoperatively, in the waiting room, in the exam room. I put this into my electronic medical record. And you can use these things postoperatively to gauge or follow your own outcomes. And I don't think you could say enough about that for all of us.

So to summarize, I think a comprehensive exam should include an evaluation of the septum, the valves, and the external framework both at rest and with inspiration. Palpation is so easy to do, and so informative. I think it has to be a routine part of the exam. A thorough pre-op exam should guide pre-op and intra-op decision making that can in turn improve outcomes.

If the nasal bones are displaced, I then have to decide whether the functional impact is sufficient to shift the dorsal septum and the upper lateral cartilage, in which case I might consider osteotomies. I did have to decide whether there's problems in the middle nasal vault, or the internal valve angle. And then I have to break it down and try and elaborate as to whether or not I think it's the dorsal septum, something that I might be able to correct endonasally, or the upper lateral cartilage. In which case it may require some form of internal valve surgery specifically targeted to the valve and to the upper lateral with spreader grafts or flaring sutures or batten grafts.

I look for lower-third irregularities, and problems with the external valve and the caudal septum. And with that, try to decide whether the patient needs surgical manipulation or reconstruction of the lateral crura and the nasal tip, or the columella. And whether or not the caudal septum is an issue that's going to need to be addressed, and whether I need to do that endonasally or externally.

And just to bring you back to this slide, once again, just to highlight the fact that the nuances matter. And I think that the more committed we all are to a more comprehensive exam of the patient presenting with nasal airway obstruction, a really common problem that we all see, the more likely we are to design an operation that is uniquely tailored to that patient, and to move towards better outcomes. When you look at numbers like these, it's easy to see that the nuances matter.

Last thing I'll say, and then field to any other questions, is just to remind you of the upcoming webinar. The fourth in our series [INAUDIBLE] is on December 6th, when Lori Zitelli will be talking about tinnitus retraining therapy, how to live with the sounds. And with that, I thank you for your attention and welcome any questions or comments.

**SPEAKER 1:** We do have some questions. We have one here that says, before operating on a patient with a deviated nasal septum and allergic rhinitis, how long do you place the patient on an intranasal steroid before re-evaluating the need for surgery?

**GRANT GILLMAN:** That depends on the patient. As I mentioned earlier, if the patient has two problems, I think that the ideal correction, and the optimal correction of that patient is going to be to manage both problems. So I don't think that there's any defined period of time. I just think the answer is it all depends. If it's a milder deflection, a mild tilt, it's not so severely compromised, the patient doesn't sound that symptomatic, or for that matter, the patient is either not a great surgical candidate, or adverse to an operation, then there's no limit on how long I might try managing the inflammatory component.

On the other hand, it depends on the severity. If I have a patient who's got a fracture or angulation of the septum, it goes right off to the nasal sidewall, completely obstructs the nasal vestibule, I can spray that all day long. Not only are they not ever going to get into the middle, but the spray itself is less likely to be effective. Because in that case, it's hitting the deviation of the septum. It's not getting to the target.

To that point, we're actually looking at that right now. I'm doing a study that's looking at outcomes of nasal surgery in patients with and patients without allergic rhinitis to compare the two. And one of the issues that we're looking at in specific to patients with allergic rhinitis is whether their, either, need for medication diminishes or whether they perceive those medications to be more helpful to them.

Interestingly enough, what we found in our study of outcomes of revision nasal airway surgery is that there were lots of patients who are desperately using decongestants, and antihistamines, and antihistamine decongestants, and all kinds of nasal steroid sprays in an effort to relieve what is a structural problem. And in our patient, we looked at medication use. And of those patients who were on medications-- nasal steroid sprays, decongestants, antihistamines-- to treat their nasal obstructions, and we saw the patients who were on them, something along the lines of 80% of them found no need for medication at all postoperative.

So it makes you wonder how much money you spent, and how many people are over-treating themselves in a desperate effort to relieve a structural problem. So I just think it's important to look at them both individually and to consider the patient as a whole.

**SPEAKER 1:** OK. We have a few more questions here in our last few minutes. Is it always necessary to remove a maxillary crest spur just because it is there after you have corrected the other cause of the obstruction?

**GRANT GILLMAN:** I think that's a good question. I think the simple answer is no. I think, from a functional point of view, deviations along the floor of the nose are less likely to have a functional impact on nasal airflow. There was a study done years ago by Philip Gold at the University of Toronto where they took 20 normal healthy subjects, and they applied something along the lines of-- I think it was something not unlike gel foam in varying thicknesses, and used a little adhesive that would allow it to adhere to the septum. And they increased the thickness of this piece that they were putting in from a millimeter, to two, to three, to four, to five to see how far they could get before a patient became symptomatic.

And in fact they found that, along the floor of the nose, they could get four or five millimeters of deviation before patients noticed it at all. Whereas in the internal valve angle it's minimal. It might be a millimeter or a millimeter and a half. How important is it to correct the spur? If it's reaching out and touching the inferior turbinate, and you think that, or you believe that those can be related to things like facial pain, sure.

I think that it depends on how the operation's evolving, what your comfort is in elevating mucosa off sharp edges or spurs. If there are already, in the course of the operation, mucosal tears, and you look at a spur, and you know that the mucosal, which is thin and attenuated over the apex of that spur, is likely to tear, you may look at that and think, I don't want to cause any more trouble. I don't want to make things worse. I don't want to create a septal perforation. If everything is proceeding well, and it's a significant spur, and I can give the patient that much more space, sure. Then I might go for it. But I don't think that they have the same functional impact as deviations higher up. So I individualize.

**SPEAKER 1:** Well, as we conclude, I'd like to thank Dr. Gillman very much for giving us a practical approach to our sometimes very difficult patients with nasal airway obstruction. Thank you very much for all of your insight and knowledge.

**GRANT GILLMAN:** Thank you. And enjoy the rest of your evening. Your evening.