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# cone beam

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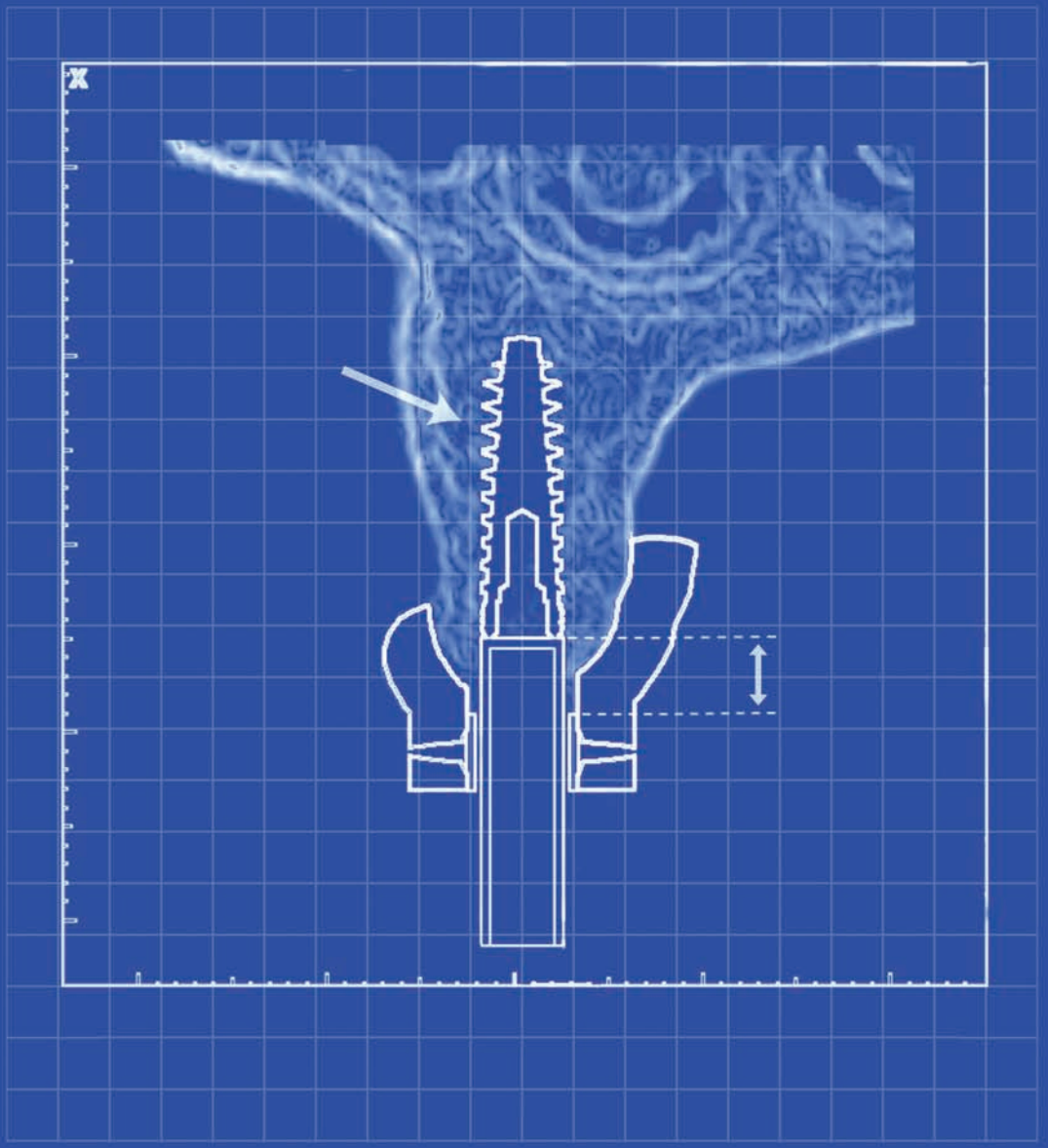

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# Blueprints for success

Dr Scott D. Ganz

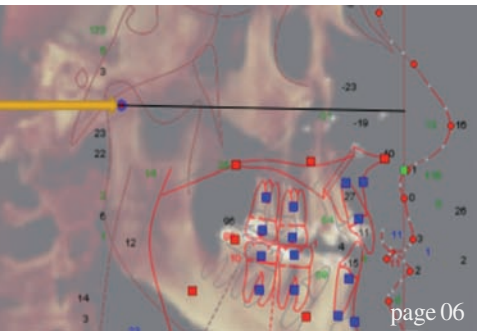
_**Imagine that you have discovered** a wonderful property on which to build your dream home. It may be located in a wooded area, many trees, with great views of the nearby lake, surrounded by boulders and other natural landscape. You may have an idea about the size and shape of your new home; you may even know how many bedrooms and bathrooms, and what size garage would be appropriate for your family and your lifestyle. What would you do next? Hire a bulldozer, cut down the trees, level the property and start digging the foundation for your future home? Of course not, as this would be foolish. To build your dream home, it would be proper to hire an architect and an engineer, and do a geographical survey to assess the property first. Every millimetre would be accounted for, and all of the materials required to build the home inside and out would be determined prior to a shovel even touching the ground. Furthermore, it would likely be necessary for the town or city to review the architectural plans, or blueprints, for approval and proper zoning based on the laws of the land. In order to build the supporting foundation at the correct depth and width, the water table would need to be assessed, and the potential need for dynamite to remove huge boulders from under the earth may lead to extra material and labour costs. Only once all of this information has been assimilated, registered and approved, and the finances are in place can the actual building commence.

When we are assessing our patients for dental implants, orthodontics, oral surgery, or other invasive procedures, we must consider ourselves the architects and engineers of the oral cavity. Prior to touching the scalpel to the patient, it is our obligation to utilise the necessary state-of-the-art tools to assess the patient landscape, which of course includes the bone, adjacent vital structures, soft tissue, teeth, potential implant recipient sites, the need for bone grafting, pathology, and appreciation of the existing occlusion. While clinical experience is of utmost importance, it is of paramount importance to start with the best diagnosis to formulate the treatment plan. Cone beam computed tomography (CBCT) is an essential tool to help clinicians assess each patient, account for every anatomical millimetre, and develop an appropriate plan of treatment that considers all of the procedures that can benefit from a 3-D assessment, thereby removing the guesswork from treatment. CBCT combined with today's powerful interactive treatment planning software empowers clinicians to provide the basic and necessary blueprints for proper patient care.

Within the pages of this issue of cone beam **International Magazine**, some of the best minds in our industry have shared their treatment concepts for various multi-specialty patient presentations, based upon the knowledge gained from 3-D CBCT data. Join us for another issue and follow the evolution of technology that allows us to provide our patients with blueprints for success._

Dr Scott D. Ganz

Editor-in-Chief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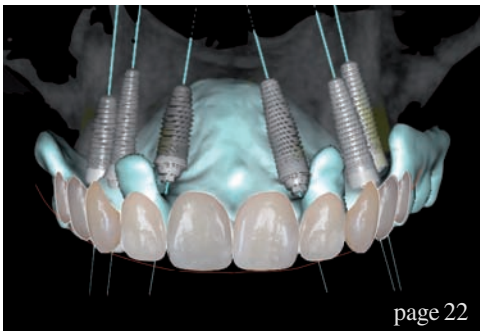
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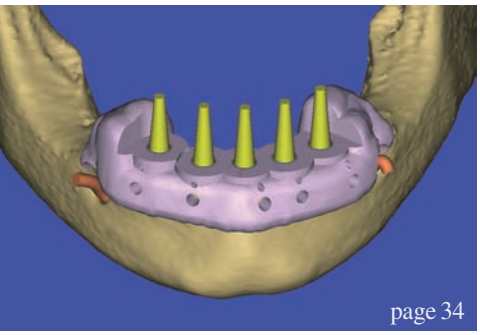
*Cover image courtesy of Dr Scott D. Ganz*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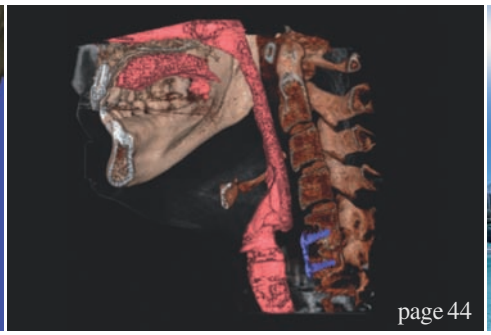
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# Concepts, goals and techniques for successful orthognatic surgery

**Author**_Dr Theodore D. Freeland, USA


**Fig. 1a**_Patient profile.
**Fig. 1b**_Patient frontal.

(Photos provided by Dr Theodore D. Freeland)

**_In this article,** you will be introduced to the concepts, goals and techniques needed to diagnosis surgical cases, when surgical cases should be started and how to gain the knowledge needed to create successful results.

We'll delve into joint status, soft-tissue analysis, surgical treatment objectives, pre-treatment surgical setups and surgical setups. We'll then follow-up by looking at the concepts of natural head position, the axis-horizontal plane and the true vertical line will be introduced. By the end of this article, you should have:

_An overview of the knowledge needed for successful treatment.
_An introduction into what, when and how to perform successful cases.
_An overview of joint health.
_A summary of the soft-tissue analysis.
_An outline of the surgical treatment objective.
_An overview of diagnostic and surgical setups.

Remember that this article is an introduction only; it's not intended to teach you how to do surgical cases. Advanced training will be needed to master successful orthognathic surgical cases. So with no further ado, let's get started.

## _Functional occlusion

The goal is to obtain functional occlusion. Before treatment, you have to determine if you have an orthognathic surgery case. You don't want to begin orthodontic treatment with the idea that if orthodontics fails, we will do surgery.

You'll see in Figures 1–3 that this case involves every facet of dentistry. Changes occurred not only in the facial features, but also in the teeth themselves. It involved orthodontic and orthognathic surgery, but also lengthening the front teeth by the restorative dentist to achieve the natural smile in balance (Figs. 1–2). To this end, we need to look at five areas:

_joint status,
_soft-tissue analysis,
_surgical treatment objective,

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Fig. 1c

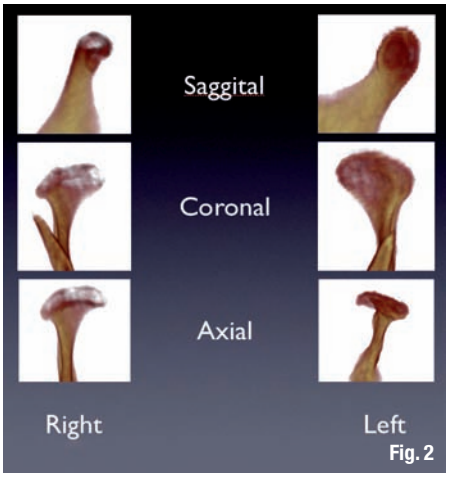

Fig. 2

**Fig. 1c**_Patient oral casting.
**Fig. 2**_Joint degeneration.

_pre-surgical setup/surgical setup technique,
_surgery.

We'll give you a brief overview of the goals for each of the areas, then do an in-depth look into each of them individually.

## _Joint status

Starting with the first area, you need to know the joint status. Is the joint healthy, is it degenerating, is there a disc problem? This means you'll need to apply not only a good clinical exam, but also articulated models that can measure the difference between centric occlusion and centric relation.

## _Soft-tissue analysis

You'll need to know how to analyze the soft tissue. You'll need this because you are looking at everything from a soft-tissue standpoint, or put another way, you're recording the basic measurements that come from soft tissue, not hard tissue. If you deal with hard tissue only, then you will come up short in the soft tissue. Ignoring the soft tissue will result in a face that's not improved, just different.

## _Surgical treatment objective

You need to know how to do a surgical treatment objective. You'll need to know the technique, and you'll need to know how to apply it because the surgical treatment objective allows you to treat the face, the occlusion, in a two-dimensional medium.

## _Pre-surgical setup/surgical setup technique

Once you have established what you'll need to do from the surgical treatment objective, you will need to do what we call a pre-surgical setup. Otherwise you'll need to apply the knowledge you've gained from the patient, soft-tissue analysis and the surgical treatment objective, and perform a three-dimensional workup to make sure what you have planned will work with the joints, muscles and nervous system.

## _Surgery

Finally, you need to know surgery. I recommend that the orthodontist be in the operating room so you know what the surgeon is doing, and how the surgery goes. It's very important to know that the surgeon gets the joints seated in a passive manner. If the joint is stressed, then there's a good chance that we'll have some surgical relapse.

## _Joint status

Joint analysis will include three portions: history, a clinical examination and imaging.

Building a history will be similar to traditional patient assessment. We need to know if there are any family members who exhibit TMJ problems. If yes, then there's a good chance the patient will develop significant joint issues that will affect the outcome of treatment.

After an oral investigation, a thorough clinical examination of the joints will need to occur. We'll be on the lookout for any type of injuries to the mandible. If the patient has had any injury that involves the chin, there's a good chance that the joint may have been damaged.

Finally, we need to look into any past treatment. Has the patient had orthodontics before? Has the patient had a lot of restorative dentistry? This is important because all of the above have a tendency to affect joint status.

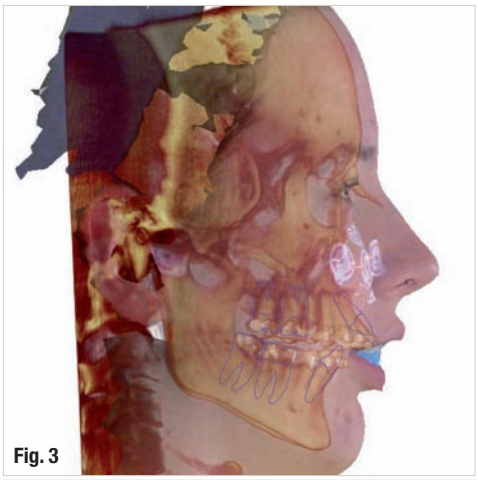

Fig. 3

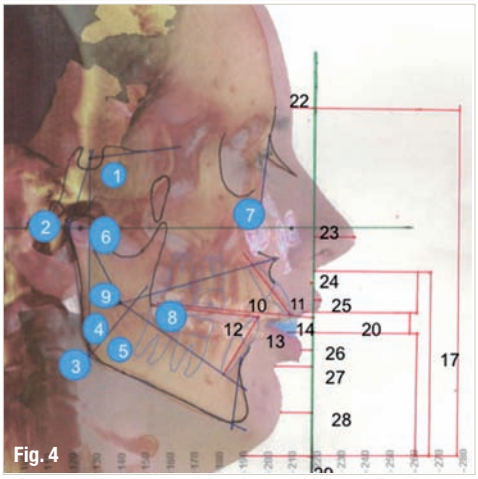


Fig. 4

**Fig. 3**_A state of degeneration: a condyle that is actually changing.
**Fig. 4**_Overlaid soft tissue on top of hard tissue.

## _Clinical examination

Next is the clinical examination. Clinical examination includes the following:

_range of motion,
_symmetry of jaw motion,
_palpation,
_auscultation,
_muscle splinting,
_CR position.

Range of motion should be between 45 mm and 55 mm on opening and includes assessing movement. We're looking for a symmetrical mandible motion —meaning the chin should not deviate to the left or right on opening—and it should be relatively free of dental interference.

Now check for palpation of the muscles of mastication. If you don't check the muscles that move the mandible, then there's a good chance that you'll miss some sort of functional bite issue.

We also listen to the joint with a stethoscope, and we apply some anterior pressure to the disc through external auditory meatus to make sure the disc is functioning properly.

When trying to manipulate the mandible, one can feel the muscles. If the muscles will not let you obtain a centric joint position, then we cannot do a diagnosis because the muscles aren't holding the condyle out of the socket. This is usually due to some inflammation.

Finally, we'll check what we call the centric relation position, which you should be able to feel. It should feel solid and the patient should be able to open from this position with relative ease, and there should be no noises.

## _Imaging

The clinical examination will tell us a lot about the joint status. The use of imaging will help us build our base of case-specific intelligence. We'll use two types of imaging: MRI and cone beam.

*LCBCT*

Most of the time, we start with cone beam because it's easy to obtain a 3-D image of the joints. Thanks to the work of Rickets and Dr Ikeda, we have a way to measure joint position and get an idea if the condyle is basically seated. With cone beam, we can measure the health of the condyles.

Our imaging showed a joint that is in a state of degeneration. The condylar head has changed in vertical height. Therefore, we would expect to see an asymmetrical opening where the chin deviates to the affected side. In all three views (saggital, coronal and axial), we have a condyle that is actually changing, especially when you make a comparison to the left condyle (Fig. 3).

In a side-by-side presentation, you can see that the left side is definitely in a lot better shape, having a more rounded effect to it. The size of the coronal view is one that shows a definite symmetric outline to it as compared to the other side. The axial view confirms this; you see that the shape is better and has a more dense outline.

Thus, our basic imaging system helps us determine that, in this case, one side is going to be the problem side, especially as it pertains to orthognathic surgery.

If we go to the two-dimensional images created in the cone beam, we can see that the right joint has definitely lost vertical height, and we definitely have a joint spacer that is excessive (Figs. 4 & 5).

In the coronal view, we can even see that there may be some sort of cyst formation. When you compare the right side to the left side in the coronal view, you get a more traditional image, which is what we'd like to see. However, there have been some changes that have occurred, because we're starting to see a "bird-beaking" effect in the left joint. The images of the joint are ones that are important in determining if we should proceed with any kind of a surgical correction.

In the saggital view, the right side, the joint looks pretty normal. However, if we look at it in a transverse direction, you'll see less joint space laterally than you do medially, something we see in both the left and right joints (a much bigger joint space). That's why it's important that you not only look at a saggital view, but you also need to look at the coronal view to see if you have a transverse problem occurring in the joints.

## _Soft-tissue analysis

When we're trained in orthodontics, we're trained in hard-tissue analysis, otherwise all of our cephalometric analysis are based on hard structures.


Fig. 5


Fig. 6


Fig. 7

**Fig. 5**_ Establishing the true vertical line based on natural head position.
**Fig. 6**_Glabella to subnasale (SN).
**Fig. 7**_Establish the horizontal position.

If you use hard structure to determine soft-tissue corrections, then you'll come up short of good facial aesthetics. That's why a soft-tissue analysis is so important

Using soft-tissue markers with 3-D facial mapping, we are able to diagnose the soft tissue, and we can also relate it to the hard tissue.

In Figure 4, we've overlaid the soft tissue on top of the hard tissue. With the markers on, after we convert it to a two-dimensional X-ray, we can see where the sub-pupal area is, where the cheekbones are and where the alar base is. In addition, you will see a marker that we call a hinge access marker, which comes from establishing the true hinge axis of the patient. There is also a marker that's placed on the nose that we call the horizontal point.

We are going to analyze everything from a basic coordinate system of a true vertical to an axis horizontal.

The image is orientated from the axis horizontal plane and the true vertical plane, which is based on the patient's natural head position.

Figure 5 shows how these two corners are at 90 degrees from each other. In this analysis, we're going to record all the soft-tissue measurements, both horizontal and vertical, and we're going to base them on the line that runs through the subnasale (SN). This establishes the true vertical line based on natural head position.

Furthermore, we're including a few hard-tissue measurements that will tell us about the architecture of the mandible. These come from Rickets and from the Jarabak analysis. With this analysis, we can cover the basis that we need for orthodontics, but we can also cover what we need in a surgical workup.

We also need a frontal analysis, which is taken from the patient's face. Most of the frontal workup is done in examining the patient clinically. This enables us to look at the orbital rim, cheekbone, sub-pupil, alar bases, nasal bases and canthus of the eyes.

All of this enables us to assess if we have transverse asymmetries, where the occlusal plane is canted instead of level. This also holds true with the mandibular plane, which we may also find is canted. This is especially true in cases where there's a degenerative process happening in one joint.

## _Head position, profile and frontal analysis

The natural head position is different for each individual patient. This will make the distance recorded for Glabella to the true vertical line different.

To measure how far Glabella is from SN (true vertical line), we first need to establish the patient's natural head position (Fig. 6). To do so, we have the patient stand in front of a mirror. First, the patient is asked to close his eyes and bob his head up and down three times.

**Fig. 8**_Surgical treatment objective.
**Fig. 9**_Completed the extrusion of the maxillary segment and balanced the occlusal plane.
**Fig. 10**_Establishing the true vertical line.

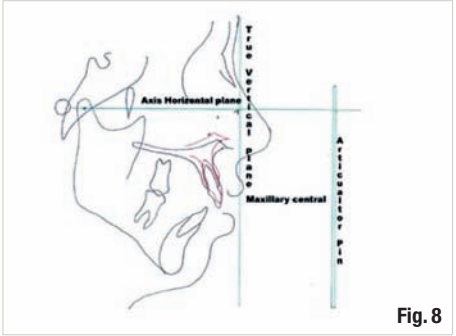

Fig. 8

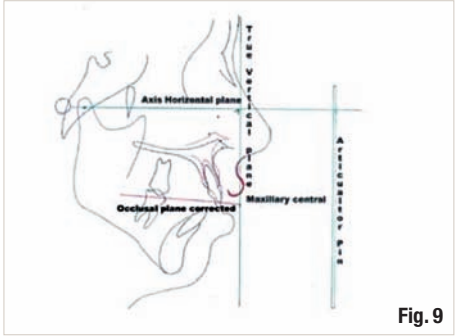

Fig. 9

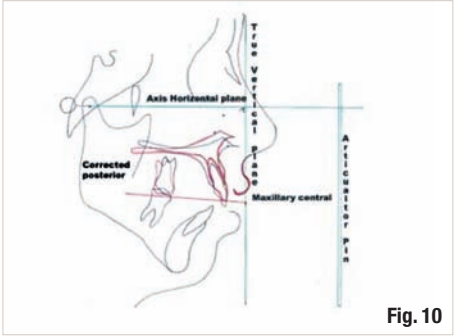

Fig. 10