

A Beginner's Guide to Surgical Treatment Objective – An Orthodontist's Point of View

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Abstract

Visualising the result of any proposed treatment, not only guides us in each part of the journey toward the final result but also to assess if the treatment objectives are met. Any adverse effects can be easily determined, before the start of the treatment, and necessary alterations to the treatment plan can be made. Various methods in which the result of an orthognathic surgery can be visualised are – overlay tracing, template tracing, cephalometric prediction tracing, computer prediction, feasibility mock surgery, etc. How to carry out these predictions are discussed in detail in this article.

Key Words: *Surgical treatment objective (STO), Cephalometric prediction tracing, feasibility mock surgery, template tracing, dolphin imaging, 3D cephalometric analysis*

Introduction

The lateral cephalogram's advent is one of the milestones in orthodontics. It paved the way of better understanding, diagnosing and ultimately treating the underlying dentofacial anomaly.

A lot of contributions have been made by various authors, like Tweed's diagnostic triangle in 1954 which gained a lot of attention. Following him, various other cephalometric analyses were proposed by Steiner's, Mc Namara, Down's. In 1960, Rickett proposed a method of predicting growth with the help of serial cephalograms taken at different points of time, over a period of time. Holdaway in 1983, stated the importance of the soft tissue parameters in the orthodontic treatment, and suggested a VISUALIZATION of the treatment objective (VTO) – to have an idea as to how the outcome of the treatment would affect the profile of the patient.

This method of visualization, led to the development of a cephalometric prediction tracing by Epker and Fish, which gave a mental image at the outcome for a surgical intervention. In 1985 – Larry Wolford, introduced the term – “**Surgical Treatment Objective(STO)**“,⁽¹⁾ which is basically a visualization of the outcome of an orthognathic surgery prior to the start of treatment, to better assess the end result.

TYPES:

The prediction can be for

- 1) Orthodontic and surgical use
- 2) Surgical use

The Orthodontic and Surgical VTO is discussed further in detail in this article. Surgical VTO is more important from an Oral and Maxillo-Facial Surgeon's point of view.⁽²⁾

ORTHODONTIC SURGICAL VTO:

When a malocclusion is too severe to be corrected by only orthodontic interception, the patient might need a surgical correction, it involves an interdisciplinary approach where the orthodontist and the oral surgeon work together as a team in achieving the best treatment

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results for the patient.

When surgery is planned in the treatment, it is advisable to perform the surgery earlier on in the treatment, as the precision achieved by fixed appliance in orthodontics is better than that of the surgery. There will be rapid tooth movement 3 months Post-Surgery, due to the inflamed bone and there is early improvement of the facial appearance, which aids in better patient compliance.

TWO – PATIENT CONCEPT:

Epker and Fish, came up with something called as the “TWO PATIENT CONCEPT”. A mock surgery was performed in the patients casts and the new set of casts were treated as a second patient. The mock surgery helps the Orthodontist to assess with a Pre – Surgical Orthodontic phase is required or not. If the Mock surgery is carried out after a Pre-Surgical Orthodontic Phase is over, it helps the orthodontist assess if any other corrections need to be made prior to surgery or if the Clinical situation presented before him, at the end of surgical phase (with the help of mock surgery) can be handled and tackled by him, in the Post Surgical Orthodontic Phase.

Another method of applying this two patient concept, is with the help of Cephalometric Prediction Tracing. Various methods of Cephalometric prediction can be carried out and the Prediction obtained at the end can be treated as a Second patient. Now the task is to simply start with patient one and reach the results of patient two. So it becomes easier to envision and tackle the complicated malocclusion involving surgery.

VARIOUS METHODS OF CEPHALOMETRIC PREDICTION :

For decades, Cephalometric prediction was done by hand, manually, by taping acetate sheets to radiographs. In this method the angles were measured directly with the help of protractor, ruler, divider, etc. Then came into play the Computerised methods, in which the landmarks can be directly digitised with the help of an electronic pen or a crosshair cursor. For indirect digitization, a scanner or a digital camera captures the image and stores in the computer’s memory.⁽³⁾

Manual Methods

The first manual method used to predict a mandibular surgery was given by Cohen ⁽⁴⁾. In this method he demonstrated the soft tissues changes by carrying out the usual cephalometric tracing of maxilla, maxillary teeth, followed by the tracing of the lower face. Then another tracing of only the mandible and the lower face was done and cut out. He used divider to record the amount of Mandibular movement and he slid the cut out section over the original section to mock the surgery. Another tracing was done with the new position of the mandible and the soft tissue changes were observed.

A similar method of Overlay tracing was given by Mc Neil ⁽⁵⁾, in which he oriented the patients casts to the post surgical position and that helped determine the amount of posterior movement of the overlay.

Henderson ⁽⁶⁾ proposed a method of using the patient’s profile photograph with a transparency of 1:1 superimposed over the Cephalometric tracing in order to better understand the soft tissue changes. The photographic prediction method was also advocated by Hohl et al ⁽⁷⁾.

The method of surgical-orthodontic cephalometric soft tissue prediction tracing for mandibular advancement, maxillary superior repositioning and combined maxillary and mandibular surgery was proposed by Fish and Epker ⁽⁸⁾. The authors believed that the three methods explained by them would suffice to predict any Orthognathic surgery.

Computerised methods:

The computerised method, involves digitising the cephalometric tracing and landmarks or to save the image digitally and carry out the tracing on the computer, virtually. There are numerous softwares available which can carry out the Cephalometric Prediction tracings ⁽⁹⁾. The first computer software was developed by Bhatia and Sowray ⁽¹⁰⁾, where they used graphics to mimic the outcome of the surgery.

Later on many softwares were introduced and used by various authors like, Harradine and Burnie ⁽¹¹⁾, Walters and Walters ⁽¹²⁾, Freihofer ⁽¹³⁾, etc.

Currently there is a wide variety of computerized

cephalometric software systems for orthognathic surgery prediction. Quick Ceph was the first commercially available software for orthognathic surgery prediction. The Quick Ceph Image (Quick Ceph Systems, San Diego, California) it is designed for Macintosh computers. It permits a wide range of functions based on a 28-point digitization. When orthodontic and surgical movements are simulated, horizontal and vertical changes are recorded by the computer. The soft tissue adjusts automatically according to predetermined ratios. The majority of these ratios are derived from Wolford et al. (1,14).

The various other softwares available include, The dentofacial planner, Vistadent, Orthodontic Treatment Planner (OTP), Orthognathic Prediction Analysis (OPAL)⁽¹⁵⁾, Dolphin Imaging Software⁽¹⁶⁾, etc.

Video Imaging :

More recently, the introduction of computer software programs with video imaging by Sarver et al. (17), surgery has greatly facilitated and improved the communication of the final predicted esthetic outcome and allowed the clinician to rapidly analyze, plan, perform the simulated surgery.

True vision image processing system (TIPS)⁽¹⁸⁾ is a software that superimposed the patients profile image, captured from the video imaging, over the cephalometric prediction to better visualise the soft tissue changes. Another video imaging software was given by Grubb⁽¹⁹⁾ where the patients study casts data and Cephalometric data can be fed onto the computer and various analysis are carried out by the computer software.

The purposes of calibrating the cephalogram to the profile video image are to: (a) relate the underlying hard tissue to the soft tissue, (b) allow quantification of movements needed for occlusal correction and aesthetic ideal to be achieved, (c) allow realistic movements to be planned and, (d) permit the treatment plan to be designed as close as possible to the patient desires

Video Imaging poses as a major addition to the contribution of computers towards Orthognathic Surgery treatment planning. However, there are also some errors encountered with the use of softwares in Superimposition of facial images and Cephalometric radiographs⁽²⁰⁾.

The 2D views have limitations such as Head positioning errors, rotational errors, etc. It particularly gets tricky when it comes to planning complex surgeries such as in patients suffering from various syndromes, cleft lip and cleft palate, asymmetry, deviated chin etc. (21,22)

Three Dimentional Prediction Methods:

Nowadays, with the advent of various imaging facilities that can capture the patient's hard and soft tissue details in 3D, it has become more easier to predict the outcome of the treatment, in a three dimentional manner. The various three dimentional imaging facilities available are the Computed Tomography (CT), Cone Beam Computed Tomography (CBCT), and Magnetic Resonance Imaging (MRI).

The data obtained from these diagnostic imaging can be fed to the computer and the 3D cephalometric softwares available can be used to carry out the various prediction tracings⁽²³⁾, mock surgeries etc.

The software uses graphic interpretation and mocks the soft tissue changes almost flawlessly, by adapting the soft tissue profile of the patient obtained from the diagnostic imaging. This customised prediction, better enables the visualization for both the clinician as well as the patient who is undergoing the surgery⁽²⁴⁾. Surgeons can benefit from performing mock surgeries, osteotomies on the software, to determine and plan the accuracy of their osteotomies.

The first complete 3D model for prediction of orthognathic surgery developed by Nakasima et al. (25), which can be adjusted to the patient's head from cephalograms, 3D stereophotographs and dental casts. The fusion model replaces the need for model surgery, since the virtual head can be used to design a surgical wafer, which can be used as a surgical guide.

Conclusion

Surgical treatment objective, is a systematic approach towards visualising the end result of surgery, as a part of treatment planning, to better enable both the Surgeon as well as the Orthodontist, to work hand in hand towards the benefit of the patient. The various methods of predicting or mocking a surgery available were given in this article. It is upto the clinician to choose wisely

which method to employ bearing in mind the limitations of each each technique. Each method has its own perks, like being cost effective, simple, quick and easy. It is also noteworthy to mention that the clinicians be mindful in experimenting with various methods available in order to choose the method that works best for them.

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