# Accuracy of Dolphin Soft Tissue Visual Treatment Objective (VTO) Prediction in Surgical Cases

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**Abstract**

**Background:** At the treatment planning stage of an orthognathic case, orthodontists frequently use Dolphin® visual treatment objective (VTO) prediction software to help anticipate changes in soft tissues following surgery. While soft tissue prediction in surgical cases is regarded as an essential technique, there is a lack of understanding regarding its accuracy in orthognathic surgical procedures. This study sought to validate the effectiveness of Dolphin Imaging's VTO soft tissue prediction software in such cases, and also to measure the software's accuracy. **Methods:** The records of 18 individuals who received full orthodontic treatment along with maxillary and/or mandibular orthognathic surgery in the form of advancement and/or setback and /or repositioning. The precise skeletal movements attained during surgery were ascertained by tracing and superimposing radiographs taken before and after the procedure. After that, the software was used to mimic surgery and produce a final forecast for the soft tissue profile. The prediction images were then compared with the actual post-treatment profile photographs for determining any differences. **Results** At the majority of landmarks, the software was found to be accurate within an error of 2 mm in the X- and Y-axes. The most off-target forecasts were in the chin area. The greater mean variation in difference was noted at Me' with a value of 2.50. **Conclusions:** Based on clinical observations, it appears that the VTO can be used for patient demonstration and consultation with a physician. This program should be used with caution in order to avoid unreasonably high patient expectations. This study reveals that most of the cases planned for orthognathic surgery can use Dolphin Imaging Software for the prediction of their soft tissue VTO.

**Key Words:** Dolphin Imaging Software, Soft tissue Visual Treatment Objective (VTO), Orthognathic surgery

## Introduction

Cephalometric prediction planning for orthognathic surgery has been an established and trusted planning technique for many years despite its drawbacks. The method's basic idea is to overlay distinct tracing paper cutouts of the dentoskeletal segments that can be moved and pasted in the intended location in order to imitate the intended surgical movements. With this technique, one can visualize a proposed postoperative dentoskeletal outcome that is relatively accurate and estimate the proposed postoperative soft tissue profile.(2)
Derek Henderson, a British maxillofacial surgeon, developed a technique for creating a composite of profile photographs and lateral cephalometric radiographs for profile prediction planning. Henderson defined profile planning as predicting the impact of different facial osteotomies or hard tissue corrections on the face profile and utilizing the results to create a treatment plan.(3)
Modern surgical simulation prediction software packages are essentially computerized versions of the photo-cephalometric "cut and paste" method mentioned above. The methods basically involve digitally entering or scanning a lateral cephalometric radiograph and profile picture, on which dentoskeletal and soft tissue landmarks are digitized. The images are then superimposed using the soft tissue profile outline to create a photo cephalometric composite. Even with the time-consuming data entry, it is faster and easier to make multiple alternative forecasts in cases when the treatment plan is not clear-cut after the creation of the photo-cephalometric image to compare the results. Also it is simple to store and retrieve image predictions later.(1)
The software can be used to propose multiple treatment plans to the patient. The prediction of soft tissue changes can be used in treatment planning as well as educating a patient on postoperative outcomes. If these softwares' are accurate, they can be used to motivate patients for orthognathic surgery.
Many specialized softwares are nowadays commercially available to assist in accurately planning a surgical procedure preoperatively. These softwares are, up until this day, are still being upgraded. The software supposedly indicates the outcome of the surgery; however, the accuracy of these softwares is debatable.(4)

Dolphin 3D Imaging (Dolphin Imaging & Management Solutions, Chatsworth, CA, USA), the industry leader in orthognathic surgical planning, uses a landmark-based photographic morphing algorithm. This algorithm entails the indirect digitization of numerous dental, skeletal, and soft-tissue landmarks from the scanned cephalogram in addition to a profile photo.(5)Once the digitization is complete, the software links up the points to give a recognizable traced image, which can be manually manipulated for improved fit if necessary. It utilizes a landmark-based algorithm for soft tissue prediction. This allows hard-to-soft tissue ratios to be fixed to account for inter-patient variability.

The aim of this study is to evaluate the accuracy of soft tissue predictions in Dolphin Imaging Software (11.95) by comparing prediction images with actual post-treatment profile photos by superimposition in Adobe Photoshop (21.2.2).

## Materials and Methods

### Materials

Pre-treatment and post-treatment Lateral cephalograms who were treated with orthognathic surgery at a dental college, in the last 10 years.

Pre-treatment and post-treatment lateral profile photographs of the patients who were treated with orthognathic surgery atain the last 10 years.

Dolphin imaging software version 11.95(Dolphin Imaging & Management Solutions, Chatsworth, CA, USA), (2019)

Adobe Photoshop software version 21.2.2(2020)

The study was designed as a retrospective observational study. This retrospective study was performed on pre-treatment and post-treatment records of skeletal Class III and Class II patients who were treated with orthognathic surgery ata dental collegein the last 10 years.

The sample size was18 patients.

The present study protocol and design were reviewed and approved by the Ethics Committee.

### Methodology

Once screening of the cases was done, lateral cephalograms of patients who had undergone orthognathic surgical treatment from Department of Orthodontics and Dentofacial Orthopedics, of the dental college were collected.

The study was performed on patients treated in the Department of Orthodontics and Dentofacial Orthopedics, of the dental college. Records of skeletal Class III and Class II patients who were treated with orthognathic surgery at the dental college in the last 10 years were selected. After applying inclusion and exclusion criteria, 18 adult patients (10males, 8females) were included in the study.

The inclusion criteria for the study included Patients who had Class II and class III skeletal tendency and had undergone Orthognathic surgery with,Maxillary advancement, setback or repositioning surgery, Mandibular advancement, setback or repositioning surgery or a combination of Maxillary advancement, setback or repositioning surgery and Mandibular advancement, setback or repositioning surgery and Patients with records 3month after surgery.

The exclusion criteria included Patients with missing records and Patients with records of poor quality.

Each participant's pre-treatment and post-treatment cephalometric radiographs were imported, digitized and superimposed in Dolphin Imaging Software version 11.95.

Dolphin Imaging Software version 11.95 was utilized to perform cephalometric tracing and analysis. SN plane was used as a base to perform superimpositions. The superimposition allowed actual changes achieved by surgery to be analysed and recorded for each subject.

The superimpositions of pre-treatment and post treatment cephalograms of the patients were used to check the skeletal changes which have occurred due to the surgery performed and this data was used to make the predicted outcome. The software was then used to link the pre-treatment lateral profile image with the digitally traced pre-treatment cephalometric radiograph.

The software was then used to superimpose the pre-treatment lateral profile pictures with the cephalometric tracing of the digitally traced pre-treatment cephalometric radiograph.

This was followed by treatment simulation of all the cases based on the skeletal changes from the superimpositions of pre-treatment and post treatment cephalograms.

The soft tissue VTO for all the cases was hence generated using treatment simulation in the Dolphin Imaging Software 11.95.

This predicted treatment simulation lateral pictures were compared to the patients'actual post-treatment profile photograph taken three months after surgery so that any swelling due to the surgical procedure subsided and the changes in soft tissues were stable.

These predicted treatment simulation photographs were superimposed on the patients' actual postoperative photographs. Utilizing Adobe Photoshop version 21.2.2 for superimposition and quantitative validation, we were able to rigidly register the predicted and postoperative soft-tissue images on one another based on unaltered surfaces by superimposing the postoperative and predicted images using the best-fit method.

Well-defined facial markers, like the right-eye outer canthus and soft-tissue nasion, were recorded in addition to the best fit of unaltered surfaces. For added accuracy, the tragion-sellion line and the outer canthus–soft-tissue nasion line were superimposed.

Soft tissue landmarks, were marked on each photograph, were compared through superimposition to determine differences. The differences between the prediction and actual coordinates of nine soft tissue landmarks (Pr, Sn, A', Ls, Li, B', Pg', Gn', and Me') in each axis were then calculated, tabulated, and analysed (Table 1 and Table 2).

When tabulating the data, a positive value represents a more anterior position of the prediction compared to the surgical outcome, and a negative value represents a more posterior position.

This value allowed the determination of whether the prediction was an underestimation or overestimation of the achieved surgical result, which was also recorded.

The source of data was lateral cephalograms of patients who hadunder gone orthognathic surgical treatment from Department of Orthodontics and Dentofacial

Orthopedics of the dental college in the past ten years. Convenience sampling was used for the study.
The sample size for the study was computed by using G* power software. Mean prediction and actual values were 12.16 and 13.16 respectively. For 80% power to detect a significant difference, at 0.61 effect size, minimum 17 samples had to be included in the study.
After applying inclusion and exclusion criteria, 18 adult patients (10 males, 8 females) were included in the study.
For the Statistical analysis Mean and standard deviation was used for continuous variable.
Frequency and percentage were used for categorical variable.

**Results**
Subnasale (0.72 mm) was the most accurately predicted landmark in the sagittal plane, followed by the tip of the nose (0.76 mm). The least accurate landmark was Me' (2.17 mm), which was followed by Gn' (1.72 mm).
The most accurate measurement in the vertical direction was the tip of the nose prediction (0.55 mm), which was followed by A' (0.69 mm). The least accurate landmark was Gn' (2.06 mm), which was followed by Me' (1.73 mm).
By tabulating the error frequency of patients within the permissible error range in both the X-(Table 2) and Y-(Table 3) axes, the prediction error of Dolphin Imaging VTO was examined. The data was analyzed using three categories (0.5, 1.0, and 2.0 mm) in order to account for increasing error allowance.
The maximum error allowable that is permissible before it it is of any value for the patient or the practitioner is two millimeters.[5].
Pr (44%) and Sn (44%) in the X-axis were shown to be highly accurate with a high frequency (error <0.5mm). With a frequency of 11%acceptable error, Pg' had the lowest accuracy. A' had a frequency of 100%and was most accurate when the allowable error was 2mm whereas with 61%accuracy, Me' was the least accurate. We are 95% confident that the means of prediction error of Sn are within the allowable error of 2 mm based on the confidence intervals of the mean of prediction error.
Pr (72%) and Sn (56%) were the most often correct landmarks (error <0.5 mm) on the Y-axis. With a frequency of 17%, Li, B', Me', and Gn' had the lowest acceptable margin of error. Pr and A' exhibited 100% accuracy in frequency (error <2 mm). The two with the lowest accuracy (67%) were Me' and Gn'.
Tip of the nose, subnasale and upper lip (87.5%) were the most accurately predicted landmarks in the sagittal plane, when only bi-jaw surgery was considered. The least accurate landmark was Me' (37.5%) when the allowable error was 2mm.
The accuracy of B'(57%), Pg'(42%), Me'(42%), Gn'(42%) was reduced when only mandibular surgeries were considered, however the accuracy of lower lip was still 85% .

Furthermore, the confidence intervals show that we have 95% confidence that the means of the prediction errors for Pr' and A' are within the 2 mm acceptable error range; but, there is a chance that the mean error may exceed this threshold for some individuals. Therefore, the prediction error for Pr and A' is under an acceptable 2-mm threshold, with a 95% confidence level.

**Discussion**

Several software companies developed varying programs which could predict orthodontic treatment outcomes in the early 2000s. These software programs eventually even began incorporating orthognathic surgery outcomes.

A number of studies were carried out to evaluate the orthodontic results for a patient and determine whether they might be utilized for precise cephalometric tracing. Their conclusion gave us the chance to consider how these programs would impact the outcomes of orthognathic surgery. Among these, one was Dolphin Imaging Software which generated digital results that were reasonably accurate.

In his research, Gossett CB assessed the post-treatment results provided by dolphin imaging in comparison to the visual treatment objectives created using conventional methods. He demonstrated in his research that both of these predictions were similar. rendering the use of traditional visual treatment objective unnecessary. (26)

In 2007, Alves PV foresaw that 3D reconstruction would take the place of 2D cephalometric planning as the orthodontic field's future. These 3D reconstructions can be used for resident training. Compared to 2D cephalometrics, this 3D reconstruction has superior visualization, enabling us to diagnose and modify the treatment strategy accordingly. (9)

In a study, Plooij JM examined the 3D analysis's dependability and reproducibility. In his work, which made use of 3D pictures, it was determined that utilizing bone landmarks for soft tissue analysis was not necessary. (10)

Since it has been established that employing bony landmarks for hard tissue changes in orthognathic operations is futile, we limited the use of soft tissue landmarks in our study in order to evaluate the correctness of the soft tissue changes.

With Dolphin Imaging Software, a patient can have various treatment plans created for them. In order to persuade patients to undergo orthognathic surgery, it is possible to evaluate the predictability of the procedure. Most patients may be reluctant to have surgery because they are afraid of what is likely to occur.

Over the years, orthodontics has used Dolphin Imaging Software to give patients visual treatment objectives and a range of therapies according on how well-accepted they are. It is stated that the software is able to evaluate how modifications to hard tissue affect soft tissue variations. Our investigation determined this prediction threshold and forecast accuracy. (11)

Numerous investigations demonstrated Dolphin Imaging Systems' edge over rivals operating in the same industry. (20) These investigations, however still showing superiority, were conducted on earlier dolphin models. (7) The most recent version, 11.95, which has functionality to convert linear data into three-dimensional results, was employed in our investigation. (27)

In a study by Paixão MB, he employed lateral cephalograms and the digitized images from dolphin imaging to evaluate the values predicted by dolphin imaging system 11.0. Both underwent cephalometric tracing, and their linear measurements were contrasted. This demonstrated the accuracy of the usage of Dolphin Imaging Software for cephalometry. (12)

As is well known, the cephalometric study produced by the program is essential to orthognathic surgery. The software can be used to generate surgical predictions once this analysis has been generated. It provides changes in the mandible and maxilla, and by tracking changes in the hard tissue, one may even be able to forecast changes in the soft tissue. Nevertheless, there aren't many studies evaluating its accuracy especially in the Indian population.

Thirteen patients were used in a 2013 study by Andrej Terzic et al. to assess the accuracy of computational soft tissue predictions made from three-dimensional photographs for orthognathic surgery six months after the procedure was finished. Thirteen patients with dentofacial abnormalities had their pre-and postoperative 3D photos, time-matched computed tomography (CT), and cone-beam CT scans of their faces evaluated. With the assistance of specialized software, preoperative CT data and three-dimensional images were combined. The mean differences between surfaces were 0.27 mm for the untreated upper half and −0.64 mm for the surgically treated lower half.

Errors exceeding 3 mm were encountered in 4 % of the upper halves versus 29.8 % of the lower halves. It was found that a certain software platform's accuracy in forecasting 3D soft tissue changes following surgery was inadequate. (14)

In order to evaluate the prognosis utilizing Dolphin Imaging Software and the actual postoperative outcome with skeletal and soft tissue in participants presenting class 3 malocclusions and class 2 malocclusions, Ana de Lourdes Sá de Lira conducted various trials with varying malocclusions. Compared to the maxillary measures, the mandibular dentoskeletal measurements produced better results with the profile. (15)

In an additional investigation carried out the subsequent year, she ascertained that the program yielded inferior outcomes in the mandibular regions as opposed to the maxillary regions. (13)

In 2016, Zhang et al. carried out a study utilizing Dolphin software and its predictive accuracy in bi-jaw orthognathic surgery to compare expected and actual results. The software was used to replicate bilateral sagittal split ramus osteotomy (BSSO) of the mandible and Lefort I osteotomy of the maxilla in thirty patients. Overall mean linear difference was 0.81 mm (0.91 mm for the mandible and 0.71 mm for the maxilla), and overall mean angular difference was 0.95 degrees.

In this study, all patients expressed satisfaction with their postoperative occlusion and facial profile. (29) They came to the conclusion that visual treatment objectives may be projected using Dolphin Imaging Software. Similar findings were also reported in other investigations. (18)

The findings of these investigations demonstrate that, for the most part, the visual treatment goals corresponded to the patient's postoperative results. In these investigations, several surgical techniques were assessed. We have evaluated various types of orthognathic surgery because our study's only objective was to determine the accuracy of dolphin imaging and its ability to evaluate soft tissue changes following surgery.

Mennatallah A et al. evaluated the accuracy of employing virtual planning tools to estimate 3D volumetric soft tissue changes following genioplasty. On average, the software's accuracy was 92.86%. They concluded that the software could be used to predict the changes in soft tissue in patients with chin deformities and that it was dependable. (23)

Several investigations were carried out, and despite the possibility of observer bias throughout the software digitization process, the results were fairly accurate. The studies computed their findings using data that indicated a normal difference of +2 --2 mm. Some studies even considered +or-3mm as the normal range. These studies showed higher accuracy results when compared to the former. (17)

Based on these studies, we considered a 2mm difference to be considered a normal variation. As it would not affect the overall outcome of the generated VTO. (22)

The first person to use Dolphin Imaging Software to evaluate soft tissue alterations in orthodontic extraction patients was Alqerban. He demonstrated that the skeletal and soft tissue changes were accurate, excluding the dental characteristics. (24)

In their work, Bollato et al acknowledged the examination of soft tissue alterations in syndromic individuals after orthognathic surgery. The results demonstrated that digital planning improved the predictability of the achieved surgical outcomes. Additionally, even in complex circumstances, it could be useful in determining outcomes.(25)However in our study, we considered non-syndromic patients' options for orthognathic surgery to maintain the cohesiveness of the study and have a more specific criterion.

The soft tissue alterations in individuals receiving bi-jaw orthognathic surgery were measured by Y J Chang. Homogeneous landmarks were used to determine all of the modifications. According to the results, there was a 0.9 ratio of soft tissue displacement for every hard tissue displacement. And that is how the program calculates the ultimate result after orthodontic surgery that involves modifications to hard tissue. (16)

In a systematic review, Kaipatur et al. looked into how well computer systems predicted skeletal changes following orthognathic surgery. Out of the 79 articles found, only 9 met the requirements for selection. They came to the conclusion that computer programs were unable to accurately forecast the bone alterations brought about by orthognathic surgery. (19)

However, multiple studies evaluated the accuracy of soft tissue prediction models with Dolphin Imaging.(4)The virtual treatment was considered accurate; all hard tissue landmark differences were less than 1mm. The soft tissue model by Dolphin Imaging showed significant differences of more than 2mm for several landmarks, most of which were in the lower chin area (21).Digital surgical planning performed significantly better in terms of the accuracy of jaw repositioning than the traditional protocol.

Understanding how accurate Dolphin VTO's predictions are will assist clinicians in treating complex surgical cases, effectively educating patients, and setting reasonable expectations. It is important to remember that the VTO forecasts utilized in this study are predicated on the idea that pre-surgical orthodontic tooth movements and surgical jaw and tooth movements will proceed precisely as expected. The real soft tissue profile results would likely diverge more from the VTO projections if the surgical procedures were not performed exactly as planned.(6)

Using two distinct linear parameters, the software's VTO makes predictions based on the direction of movement in either the vertical and horizontal directions. According to this study, Dolphin Imaging's accuracy varied based on the soft tissue landmark in both the vertical and horizontal directions.

In comparison to the sagittal direction, the predictions regularly performed better in the vertical direction. The results of Lu et al., who demonstrated that the vertical predictions were more consistently accurate with prediction results, are supported by this data.(8)

In this study, we examined 18 patients, which was more than the power analysis's recommendation of 17 individuals. The calculated prediction error findings in this investigation were in good agreement with those of earlier research. Accuracy was 81% along the horizontal direction and 85% along the vertical direction with acceptable error set at 2.0 mm.

For inaccuracies less than 2.0 mm, research by Pektas et al. estimated an overall inaccuracy of 68% in the vertical direction and 91% in the sagittal direction. Me' and Gn', however, were not included in Pektas' study. Me' and Gn were not as precise as other landmarks.(28)

The accuracy improved to 87.29% along the X-axis and 89.71% along the Y-axis for errors <2.0 mm,if Me' and Gn' are not included in our study.

Orthodontists, surgeons, and laypeople all deemed prediction errors of 1.0–2.0 mm to be clinically acceptable, according to Kazandjian et al.[(30)] The majority of the literature groups errors into <1.0-, 1.0–2.0-, and 2.0-mm categories. While the acceptability of error within the range of 1.0-2.0 mm was determined to be dependable, Kaipatur and Flores-Mir pointed out that accumulating areas of permissible errors separately could result in an overall unacceptable prediction.[(19)]

This study used multiple categories of acceptable error to analyze and understand the results more thoroughly. Me's prediction was the least accurate in our analysis. For both the X and Y axes, the accuracy within 2.0 mm was 61% and 67%, respectively. This is in line with most research, which suggests that the Me' is the Dolphin VTO's weakest predicted area. The nose tip (Pr) exhibited the maximum accuracy within a 2.0 mm error in both the X- and Y-axes (94%) and 100%, respectively.

Tip of the nose, subnasale and upper lip (87.5%) were the most accurately predicted landmarks in the sagittal plane, when only bi-jaw surgery was considered. The least accurate landmark was Me' (37.5%) when the allowable error was 2mm.

The accuracy of B'(57%), Pg'(42%), Me'(42%), Gn'(42%) was reduced in the sagittal plane, when only mandibular surgeries were considered, however the accuracy of lower lip was still 85% .

This suggests that the accuracy is considerably less in cases where only mandibular surgeries are performed and for bi-jaw surgeries the accuracy is relatively more in the maxillary region when compared to the accuracy of predictions in lower jaw region.

The study was retrospective in nature, and different surgeons operated on each subject separately accounts for a few of the study's limitations. The results of the surgery and the pictures collected by other specialists might have been impacted by this. A prospective study would have been better. However, given the intricacy of these conditions, it would be very difficult to carry out. In this work, the Dolphin VTO was analyzed in two dimensions. In order to compare the outcomes, future research should analyze the samples utilizing three-dimensional technologies.

**Conclusion**

After analysing the results obtained from our study, it is observed that Dolphin imaging software version 11.95gave good predicable results in terms of soft tissue changes. Accuracy was 81% along the X-axis and 85% along the Y-axis with acceptable error set at 2.0 mm.

The most accurate prediction was seen in the tip of the nose (Pr). This can be attributed to the fact that usually, orthognathic surgery will not affect these points much. Soft tissue changes most likely will not be observed.

All the mean values obtained were present below 2 mm except Gn' and Me'. The greater mean variation in difference was noted at Me' with a value of 2.50.

However, an average accuracy above 85% accuracy shows that Dolphin Imaging Software can be used to predict the soft tissue outcomes preoperatively in orthognathic surgery.

In our study, we found the inaccuracy to be confined to the chin region suggesting that more improvement needs to be done in these areas. However, this statistical significance can be attributed to intraoperative changes to the treatment plan, which were not accounted for in this study.

Thus, based on this study, the software may be sufficient for usage both for the pre-operative cephalometrics and mock surgery, as well as to convince a patient for orthognathic surgery. However, more improvement in determining the soft tissue changes, especially in the chin region is required as it may not determine the outcomes of genioplasty conclusively.

A few of the study's limitations can be attributed to the fact that this was a retrospective study and that various surgeons operated on each individual independently. The results of the surgery and the pictures collected by other specialists might have been impacted by this. A prospective study would have been better. In this work, the Dolphin VTO was analysed in two dimensions. In order to compare the outcomes, future research should analyse the samples utilizing three-dimensional technologies. Also further studies may be conducted with a larger sample size and multiple observers to accurately determine the accuracy of the soft tissue VTO generated by Dolphin Imaging Software.

On the basis of our study, we conclude that

1. Dolphin imaging produces accurate soft tissue VTO predictions for patients with satisfactory outcomes for the Indian population.

2. The Dolphin imaging software tool can be used to present cases, educate and motivate patients, and get their informed consent for orthognathic surgery.

3. When the measurement range is less than 2 mm, the VTO software program is unreliable for treatment planning precise movements. However, it may be helpful for gross movements and predictions.

4. In this algorithm, the chin prediction is the least accurate. The software needs to be used carefully to avoid unreasonably high patient expectations and disappointment.

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**Pictures**


**Fig. 1: Illustration of pre-treatment photograph (A), treatment simulation(B) and actual post treatment photograph(C)of a subject included in the sample.**

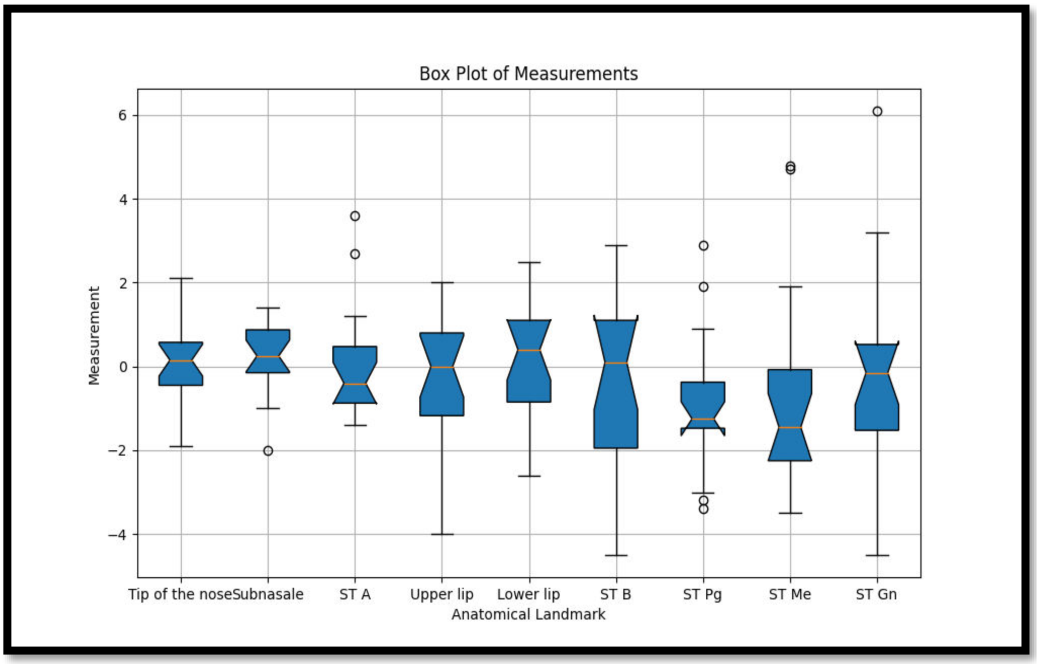


**Fig. 2: Data box-plot along X-axis**

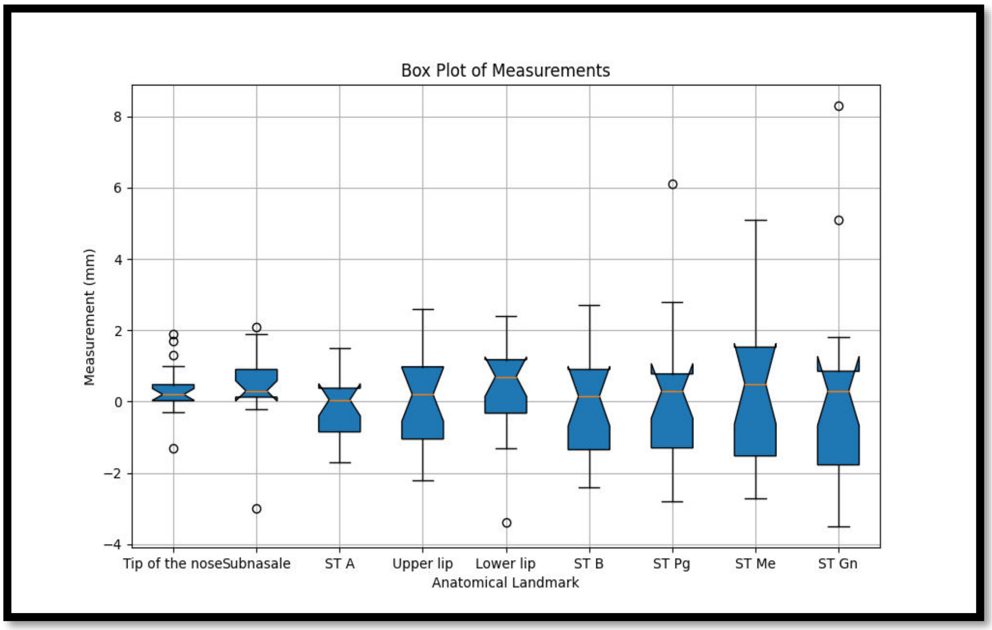


**Fig. 3: Data box-plot along Y-axis**

## Tables

**Table 1: Description of soft tissue cephalometric landmarks used in this study.**

| Facial Cephalometric Parameters | |
|---|---|
| Tip of the nose (Pr) | the most prominent or anterior point of the nose |
| Subnasale (Sn') | the point at which the columella merges with the upper lip in th mid-sagittal plane |
| Soft tissue A point (A') | the point of greatest concavity in the middle of the upper li between the subnasale and labrale superioris |
| Upper lip / Labral Superius (Ls) | a point indicating the mucocutaneous border of upper lip |
| Lower lip/ labraleInferiu (Li) | median point in the lower lip margin of the lower membranous lip |
| Soft tissue B point (B') | the point of greatest concavity in the middle of lower lip betwee Labrale Inferius and soft tissue pogonion |
| Soft tissue pogonion (Pg') | the most prominent point on the chin |
| Soft tissue gnathion (Gn') | midpoint between the anterior and inferior points of soft tissu chin |
| Soft tissue menton (Me') | lowest point on the contour of soft tissue chin |