Comparison of 2D and 3D Virtual Planning for Orthognathic Surgery

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INTRODUCTION

2D cephalometric analysis and virtual treatment objective (VTO) has long been a standard part of treatment planning for orthognathic surgery. 3D virtual planning is now accepted as the standard of care. Does 2D VTO still have a relevant role in treatment planning? The objective of this study was to determine the similarity of 2D and 3D virtual planning movements for bimaxillary orthognathic surgery in the horizontal and vertical planes as an answer to this question.

MATERIALS AND METHODS

A retrospective cohort study of patients who underwent bimaxillary orthognathic surgery at the University of Mississippi Medical Center from July 2019 to June 2020 was conducted.

Exclusion criteria included single jaw only, surgery first, hemifacial microsomia (one patient), and cases not planned with 3D Systems Virtual Surgical Planning (VSP®).

Patients underwent traditional planning using 2D cephalometric analysis and 2D VTO with Dolphin Imaging by the primary surgeon (RC). Subsequently, 3D planning was carried out with 3D Systems VSP® to finalize planned movements and fabricate surgical splints. The positional change of the maxillary incisor and any occlusal plane change was transferred from the 2D plan. The same surgeon made subsequent changes in the 3D planning environment as he saw indicated.

The horizontal and vertical position of dental and skeletal cephalometric points as well as the occlusal plane angle and maxillomandibular (ANB) relationship planned with 2D VTO (Fig. 1) and 3D VSP® were compared.

Mean differences between 2D and 3D variables were calculated. A paired two-tailed t-test was used to assess statistical significance. A p-value <u><</u>0.05 was considered statistically significant.

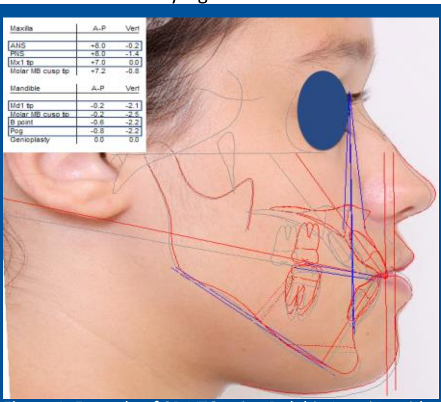

Figure 1. Example of 2D VTO using Dolphin Imaging with linear measurements outlined

RESULTS

30 patients met criteria for the one year time frame of the study. Patient demographics are outlined in Table 1.

Table 1. Patient Demographics

Skeletal Classification	Number of Patients
Class 1	3
Class 2	4
Class 3	23

Dentofacial Deformities	Number of Patients
Anterior Open Bite	8
Facial Asymmetry	9

Maxillary Surgery	Number of Patients
Single-Piece LeFort	19
Multi-Piece LeFort	11

Mandibular Surgery	Number of Patients
Bilateral Sagittal Split Osteotomy (BSSO)	24
BSSO + Segmental Osteotomy	6

Differences in linear (Tables 2 and 3) and angular measurements (Table 4) are depicted in the tables below.

The only statistically significant differences were vertical movements in the mandibular central incisor (MD 1) and pogonion (PG).

Table 2. Differences in Linear Horizontal Movements

	Mean	Range	p-Value
ANS	-0.4	(-2.9, 2.9)	0.14
MX 1	0.0	(-2, 3)	0.92
MD 1	-0.2	(-3.7, 3)	0.30
PG	-0.6	(-4.2, 7.5)	0.22

ANS: Anterior Nasal Spine; MX 1: Maxillary Central Incisor;
MD 1: Mandibular Central Incisor; PG: Pogonion

Table 3. Differences in Linear Vertical Movements

	Mean	Range	p-Value
ANS	0.2	(-0.6, 3.1)	0.07
MX 1	0.1	(-0.5, 2.5)	0.28
MD 1	0.7	(-1.2, 4.2)	0.01
PG	0.7	(-1.4, 5.3)	0.01

ANS: Anterior Nasal Spine; MX 1: Maxillary Central Incisor;
MD 1: Mandibular Central Incisor; PG: Pogonion

Table 4. Differences in Angular Measurements

	Mean	Range	p-Value
ANB	0.2	(-3.4, 2.5)	0.51
OP	0.8	(-5.5, 5)	0.17

ANB: Angle formed by A-point, Nasion, B-point;
OP: Occlusal Plane Angle

CONCLUSION

The 2D and 3D virtual planning movements of the maxillomandibular complex were similar for patients who underwent bimaxillary orthognathic surgery.

Differences between the mandibular incisor and pogonion vertical movements were significantly different. This may be due to differences in the softwares' simulation of autorotation and the ability to simulate final occlusion with 2D VTO. However, these differences on average were small (<1mm), leading one to question their clinical significance.

2D VTO is reliable and still can play a role in surgical planning.

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