ORIGINAL RESEARCH

Reliability of Hard-and Soft-tissue Computer-generated Predictions of Orthognathic Surgical Patients using VistaDent Software

[1]Sreevalli S Mohan, [2]Mohammadi Begum Khan

ABSTRACT

Introduction: The use of computers in the measurement and analysis of skull radiographs is not new in orthodontics. It has been advocated and practiced for many years, however, its awareness and application is new in orthodontics.

Aims and objectives: To ascertain to what extent the actual surgical soft-tissue outcome for the given hard-tissue alteration matches with the software predicted soft-tissue outcome, using VistaDent software and to analyze the differences in the predictions for single jaw and double jaw procedures.

Materials and methods: This study was of a retrospective nature. Records of 30 orthognathic surgery patients (21 females and 9 males) were entered into the study. All subjects were 18 years of age or older.

Discussion: With variety of surgical options being available for repositioning hard-tissues of the facial complex, a major consideration for both clinician and patient is the resulting changes in facial appearance. Computerized systems play an important role in orthognathic surgery due to their utility in treatment planning, and by increasing patient understanding and acceptance of the recommended treatment.

Conclusion: VistaDent software was quite effective in estimating the change in the soft-tissue related to single jaw and double jaw surgeries except in mandibular advancement, where the prediction of the mentolabial angle tended to be more acute.

Keywords: Dentofacial deformity, Surgical prediction tracing, Visual treatment objective, VistaDent software.

How to cite this article: Mohan SS, Khan MB. Reliability of Hard-and Soft-tissue Computer-generated Predictions of Orthognathic Surgical Patients using VistaDent Software. J Orofac Res 2014;4(2):72-80.

Source of support: Nil

Conflict of interest: None

[1]Associate Professor, [2]Assistant Professor

[1,2]Department of Orthodontics and Dentofacial Orthopaedics Drs Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences, Vijayawada, Andhra Pradesh, India

Corresponding Author: Mohammadi Begum Khan, Assistant Professor, Department of Orthodontics and Dentofacial Orthopaedics, Drs Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences, Vijayawada, Andhra Pradesh, India Phone: 08676257319, e-mail: sabiakareem127@gmail.com

INTRODUCTION

The current focus of orthodontic treatment, apart from establishing the keys to occlusion, is to achieve optimum esthetics. People having dentofacial disfigurements form a small percentage of the population whose facial improvement is not possible with conventional orthodontic treatment alone. Because of the recent advances in surgical techniques, orthognathic procedures often result in stable repositioning of the maxilla, mandible, chin, or alveolar segments. With such a variety of surgical options for repositioning hard-tissues of the facial complex, a major consideration for both clinician and patient is the resulting effects on the appearance of the overlying soft-tissues. Computerized systems play an important role in orthognathic surgery by their utility in treatment planning as well as increasing patient understanding and acceptance of the recommended treatment.

In recent years, a number of computer programs have become available to aid in the diagnosis and treatment planning of dysplasias requiring orthodontics and orthognathic surgeries. Many of these programs offer prediction of soft-tissue modification for a given dental and skeletal change. Knowledge of the accuracy of these prediction capabilities will enhance the confidence of the orthodontist and oral surgeon in applying this tool for planning correction of hard-tissue discrepancies and achieving optimal facial esthetics. Many softwares have been used in the past for prediction of the profiles for the patients undergoing orthognathic surgical treatment. VistaDent is one of the commonly used software for assessment of surgical visual treatment objective (VTO).

AIMS AND OBJECTIVES

1. To ascertain to what extent the actual surgical soft-tissue outcome for the given hard-tissue alteration matches with the software predicted soft-tissue outcome, using VistaDent software.
2. To analyze the differences in the predictions for single jaw and double jaw procedures.

MATERIALS AND METHODS

This study was of a retrospective nature. Records of 30 orthognathic surgery patients (21 females and 9 males) were entered into the study. All subjects were 18 years of age or older. These samples were obtained from orthognathic cases, operated in the SDM Dental College, Dharwad; KLE Dental College, Belgaum; and Ragas dental College, Chennai, India.

Inclusion Criteria Followed

- All the patients were adults (18 years of age or older)
- Patients with no congenital deformity like the cleft lip and palate
- All patients who had undergone standard surgical procedures either Le Fort I maxillary impaction, mandibular advancement or mandibular setback
- All patients who had surgical stabilization with rigid fixation.

Patients were then categorized according to one jaw or two jaw surgeries performed.

Maxillary impaction + mandibular advancement	8 patients
Maxillary impaction alone	9 patients
Mandibular advancement alone	9 patients
Mandibular setback alone	4 patients

Cephalometric Criteria Followed

Both preoperative and postoperative lateral cephalograms of optimum quality and fulfilling the following criteria were chosen:

1. All the radiographs of each patient were taken with teeth in occlusion and the lips in repose. They displayed clear soft-tissue outlines.
2. All preoperative records were taken almost immediately before surgery.
3. Postoperative records were taken between 1 and 3 months after the surgery to enable the accurate visualization of the soft-tissue changes.

Commonly used landmarks, lines, and planes were employed for the cephalometric analysis. The measurements based on these were related to the sagittal and vertical skeletal relation and to the soft-tissue relation as given below.

Measurements Indicating Skeletal Anteroposterior Relationship

1. Angle ANB (Steiner's analysis)
2. Angle NA-Pog (Down's analysis)
3. N-B (COGS analysis)
4. N-Pg (COGS analysis)
5. GO-Pog (COGS analysis)
6. Harvold's mandibular unit length

Measurements indicating Skeletal Relationship

1. N-Sn
2. Sn-Gn
3. N-ANS (⊥HP) (COGS)
4. N-PNS (⊥HP) (COGS)

Measurements depicting Soft-tissue Relations

Total soft-tissue profile angle (N'-No-Pog') (Rakosi)
Soft-tissue profile angle (N'-Sn-Pog') (Rakosi)
G-Sn-Pg (COGS)
N'-Sn (Rakosi)
Sn-Gn' (Rakosi)
G-Pog'(COGS)

Mentolabial angle (angle between tangents to labrale inferioris and Pog') (COGS).

Relationship of the lips in relation to the esthetic lines *viz*. Rickett's E-line, Steiner's-S-line, Holdaway's H-line.

Incisor exposure (Arnett and Bergman's)

The linear and angular measurements selected for specific types of surgeries are as follows:

In patient who underwent maxillary impaction.

Table 1: In patients who underwent maxillary impaction and mandibular advancement

	Hard-tissue	*Soft-tissue*
Angular	N-A-Pog	G-Sn-Pog'
	ANB	N-No-Pog'
		N'-Sn-Pog'
		Mentolabial angle
Linear	N-B	G-Pog'
	N-Sn	N'Sn
	Sn-Gn	Sn-Gn'
	N-Pog	H-Line
	Go-Pog	S-Line
	Mandibular unit length	Li-E-Line
	N-ANS (⊥HP)	Incisor exposure
	N-PNS (⊥HP)	

Table 2: In patients who underwent mandibular set back and advancement

	Hard-tissue	*Soft-tissue*
Angular	N-A-Pog	G-Sn-Pog'
	ANB	N-No-Pog'
		N'-Sn-Pog'
		Mentolabial angle
Linear	N-B	G-Pog'
	N-Pog	H-Line
	Go-Pog	S-Line
	Mandibular unit length	Li-E-Line
	N-ANS (⊥ HP)	Incisor exposure
	N-PNS (⊥ HP)	

The aforementioned values used for this study represent a composite of measurements from various standard analyses. This enables a comprehensive and accurate understanding of changes taking place in specific areas and directions.

Digitization

The VistaDent software program has a digitization regimen for the lateral cephalometric radiograph consisting of

61 landmarks, 41 of which are hard and remaining are soft-tissue points (Figs 1 to 4). For each patient, the preoperative cephalogram tracing was loaded on the VistaDent program. Then a soft- and hard-tissue profile was printed out (preoperative profile) (Figs 5 and 6). Following the superimposition and measurement of the preoperative and postoperative tracings, the surgical subsystem of the VistaDent was used to alter the position of the skeletal structures, thus simulating the different operations. For each patient, all surgical movements are planned according to the millimetric assessment of operative changes in X and Y coordinates. A second printout of the predicted soft-tissue profile becomes available (prediction profile) (Figs 7 and 8). Finally, the post-treatment cephalogram tracing of each patient was loaded into the program (Figs 9 to 11) and an actual postsurgical profile was printed out. Thus, three profile tracing printouts were taken for every patient: preoperative, prediction and postoperative. The previously mentioned reading for each tracing were tabulated and subjected to statistical analysis.

STATISTICAL ANALYSIS

Using SPSS version 12, student unpaired t-test was done to determine which of the soft-tissue readings match with the changes in the corresponding hard-tissue changes for the three groups of surgeries used in the study. Students paired t-test was done to know the difference between the postoperative and prediction tracings of hard-and soft-tissue readings listed above for the three types of surgeries separately.

$$t = \overline{x}_1 - \overline{x}_2 / SE(\overline{x}_1 - \overline{x}_2)$$

where $(\overline{x}_1 - \overline{x}_2)$ = standard error of difference $(x_1 - x_2)$

$$= S = \frac{\sqrt{1}}{n_1} + \frac{\sqrt{1}}{n_2}, \text{ here S = combined standard deviation}$$

$$S = \text{combined SD } \frac{\sqrt{(n_1 - 1)S_1}}{(n_1 + n_2 - 2)} + \sqrt{\frac{(n_2 - 1)S_2}{(n_1 + n_2 - 2)}}$$

x_1 = mean of first group

x_2 = mean of second group

n_1 = sample size of first group

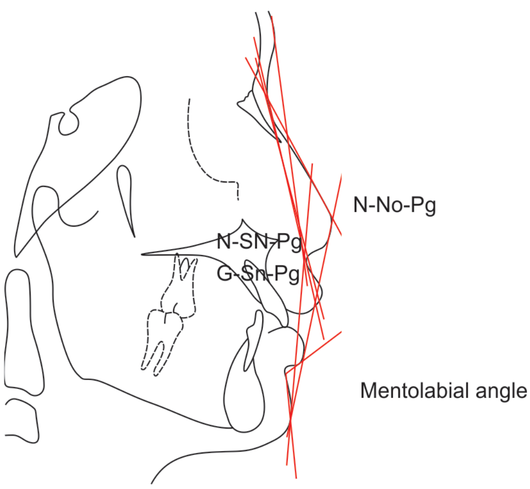

Fig. 1: Angular soft-tissue readings

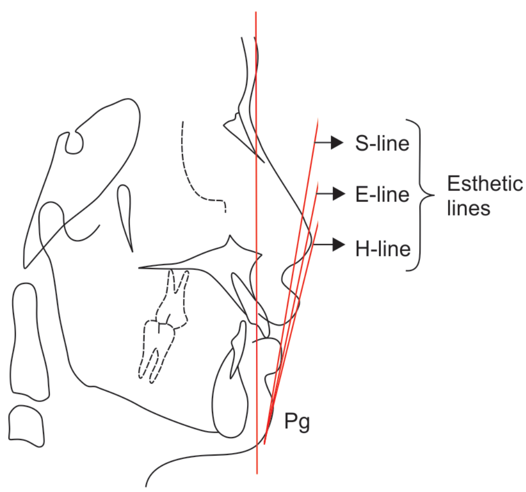

Fig. 2: Linear soft-tissue readings

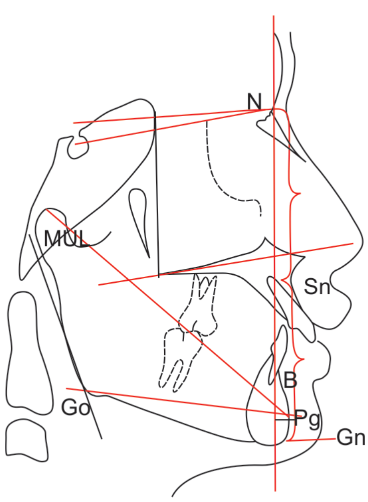

Fig. 3: Linear hard-tissue readings

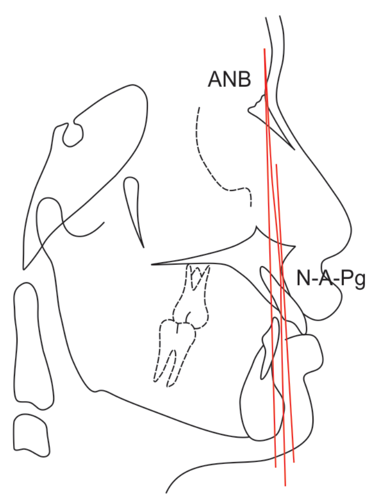

Fig. 4: Angular hard-tissue readings

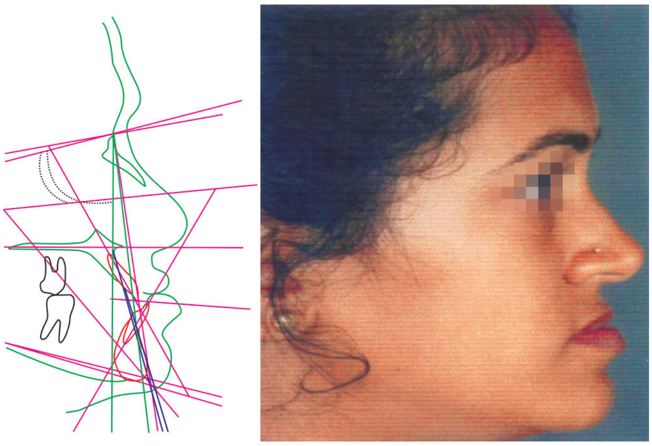

Fig. 5: Preoperative tracing and photograph

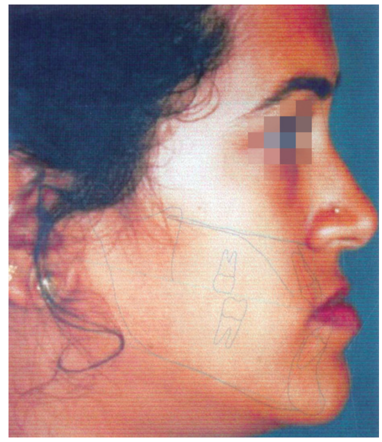

Fig. 6: Preoperative tracing superimposed on photograph

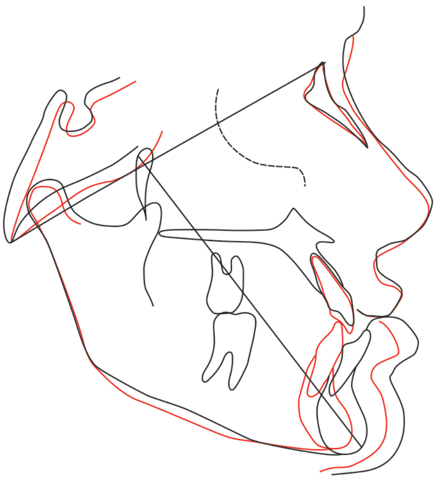

Fig. 7: Superimposition of presurgical and postsurgical tracings

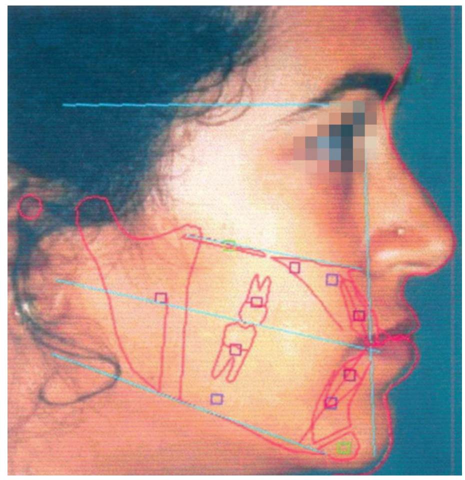

Fig. 8: Predicted photograph with cephalometric tracing

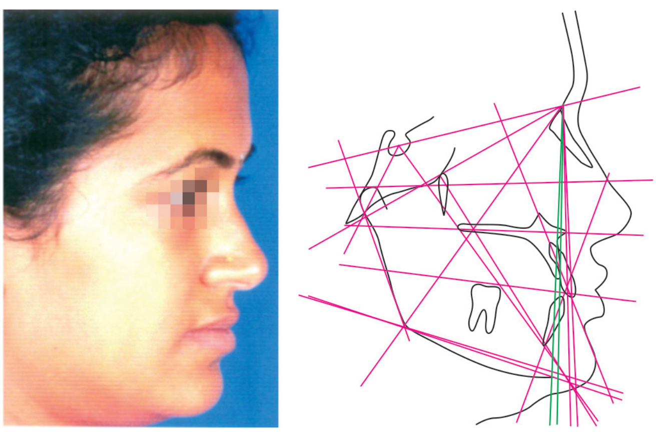

Fig. 9: Postoperative tracing and photograph

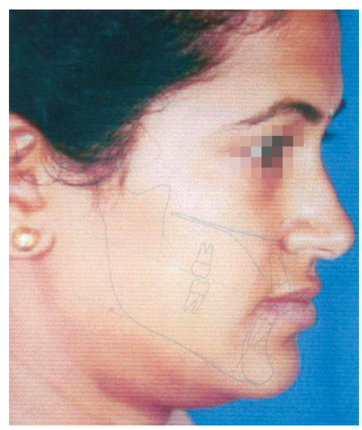

Fig. 10: Postoperative tracing superimposed on the photograph

n_2 = sample size of second group
S_1 = standard deviation of first group
S_2 = standard deviation of second group

Paired student t-test was carried out to know whether there was any significant difference between the pretreatment and post-treatment means.

$$t = \bar{d}/s/\sqrt{n}$$

where d = difference between pre- and post-treatment values
$\bar{d}$ = mean of 'd'
s = standard deviation of the difference
n = paired number of observations

Statistical significance was considered to be significant at 5% ($p < 0.05$) level.

RESULTS

Maxillary Impaction with Mandibular Advancement

For the postsurgery and predicted readings for various skeletal parameters in this surgery, only the mandibular unit

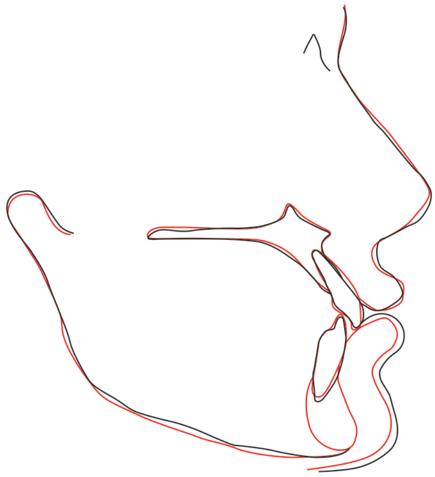

Fig. 11: Superimposition of the predicted and postsurgical cephalometric tracing

lengthshowed a difference that was statistically significant at $p<0.05$. All other parameters closely matched the readings in the postsurgery and predicted values. As far as the comparison of postsurgical and predicted soft-tissue parameters was concerned, the G-Sn-Pg and N-No-Pg showed a statistically significant difference of $p < 0.05$, whereas G-Pg' and N-No-Pg showed a difference that is statistically significant at $p<0.01$. These values did not appear substantial to be relevant clinically. When the corresponding skeletal and soft-tissue readings were compared in the maxillary impaction with mandibular advancement surgery, the angle of convexity, linear dimensions and lower face height readings showed a statistically significant difference (Tables 1 and 2).

Maxillary Impaction

In the maxillary impaction surgery group, most of the skeletal predicted readings matched closely to the postsurgical result. However, the values which showed a statistically significant difference between the postsurgical and predicted tracings were N-A-Pg, Sn-Gn and N-Pg. The differences were too less to be clinically relevant hence not considered. When the corresponding skeletal and soft-tissue readings were compared in the maxillary impaction surgery, linear dimensions and lower face height readings showed a statistically significant difference (Tables 3 and 4).

Mandibular Advancement

For the mandibular advancement surgery, there were four values in the skeletal group which showed a statistically significant difference between the actual and predicted namely, N-A-Pg, N-Pg, mandibualr unit length and Go-Pg. Among the soft-tissue readings, G-Sn-Pg, G-Pg, N-NO-Pg and mentolabial angle showed a statistically significant difference. Excepting the reading for mentolabial angle, the differences between the other three were minimum and, therefore, not considered relevant. The difference in the mentolabial angle was quite large and the predicted value was more acute than the actual postsurgical value. The inference drawn from this is that the software tended to keep the lip more protrusive than the actual outcome. When the corresponding skeletal and soft-tissue readings were compared in the mandibular advancement, linear dimensions showed a statistically significant difference at $p < 0.05$ (Tables 5 and 6).

Mandibular Setback

For the mandibular setback, the actual and predicted skeletal as well as soft-tissue readings matched quite well. Only N-Pg in the skeletal readings and G-Pg in the soft-tissue readings showed statistically significant difference (Tables 7 and 8).

DISCUSSION

Prediction of the final treatment results for patients requiring orthognathic surgical correction of severe dental and skeletal abnormalities is complex. With variety of surgical options being available for repositioning hard-tissues of the facial complex, a major consideration for both clinician and patient is the resulting changes in facial appearance. Computerized systems play an important role in orthognathic surgery due to their utility in treatment planning, and by increasing patient understanding and acceptance of the recommended treatment. Knowledge of the accuracy of these predicting capabilities will affect the confidence of the orthodontist and oral surgeon in applying this tool for planning correction of hard-tissue discrepancies and achieving optimal facial esthetics. VistaDent is one of the commonly used software for surgical VTO. The present study was aimed at evaluating the accuracy of VistaDent software in surgical VTO.

As mentioned by Bhatia and Sowray,[1] Ricketts performed extensive pioneering work (1970-80) on computerized cephalometrics covering orthodontic diagnosis, treatment and growth prediction. He also included orthognathic surgery, but in a much less exhaustive way. Friede et al[2] assessed the reliability of predicting the results of 30 orthognathic surgical patients treated with one of the following six types of surgery. The results from Le Fort I surgery with or without a concomitant mandibular set back showed the greatest difference between the predicted and actual outcome. Popisil[3] reviewed prediction tracings of 40 patients who underwent orthognathic surgeries by which they expected to alter the lips, chin and nose. Results showed that 60% of these tracings were inaccurate when compared with postoperative tracings. Eighty-three percent of the prediction tracings for bimaxillary procedures were inaccurate. Gerbo et al[4] did a study to assess the accuracy of prediction tracings

Table 3: Comparison of post and predicted values in skeletal reading: maxillary impaction and mandibular advancement

Variable	Value	Mean	SD	Paired t-value	p-value	Significance
N-A-Pog	Post S	−2.3	0.51	−1.00	> 0.05	NS
	Preread	−2.25	0.46			
N-B	Post S	−0.75	0.70	1.00	> 0.05	NS
	Preread	−0.87	0.64			
N-Sn	Post S	51.6	0.74	0.00	> 0.05	NS
	Preread	51.6	0.74			
Sn-Gn	Post S	59	3.38	0.55	> 0.05	NS
	Preread	58.8	3.22			
N-Pg	Post S	0.25	0.70	−1.4	> 0.05	NS
	Preread	0.62	1.30			
MUL	Post S	113.25	6.02	−2.4	< 0.05	S
	Preread	114.12	6.55			
Go-Pg	Post S	80.87	5.19	−1.00	> 0.05	NS
	Preread	81	5.29			
ANB	Post S	2.12	0.35	1.00	> 0.05	NS
	Preread	2	0			
Hp-ANS	Post S	50	0	0.00	> 0.05	NS
	Preread	50	0			
Hp-PNS	Post S	51.37	0.51	−1.00	> 0.05	NS
	Preread	51.50	0.53			

Level of significance: HS at 1% p < 0.01 (Highly significant at p < 0.01); S at 5% p < 0.01 (significant at p < 0.05); If p value is >0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant

Table 4: Comparison of corresponding readings of skeletal and soft-tissues: maxillary impaction group and mandibular advancement

Group	Variable	Mean	SD	t-value	p-value	Significance
Skeletal tissue	NA-Pg	−0.12	0.35	2.70	< 0.05	S
Soft-tissue	G-Sn-Pg	−0.71	0.48			
Skeletal tissue	N-Pg	−0.37	0.74	3.10	< 0.01	HS
Soft-tissue	G-Pg	−1.42	0.53			
Skeletal tissue	N-Sn	−1	1.41	−1.61	> 0.05	NS
Soft-tissue	N-Sn	0.20	1.87			
Skeletal tissue	Sn-Gn	−1.70	1.64	−10.71	< 0.01	HS
Soft-tissue	Sn-Gn	4.30	0.67			

Level of significance: HS at 1% p < 0.01 (Highly significant at p < 0.01); S at 5% p < 0.01 (significant at p < 0.05); If p value is > 0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant

Table 5: Comparison of post and predicted values in skeletal readings: maxillary impaction

Variable	Value	Mean	SD	Paired t-value	p-value	Significance
N-A-Pog	Post S	−3.33	1.22	−3.50	< 0.01	HS
	Preread	−2.25	1.13			
N-B	Post S	−1.11	1.05	−1.83	> 0.05	NS
	Preread	−0.66	0.86			
N-Sn	Post S	51.22	2.16	1	> 0.05	NS
	Preread	51.11	1.90			
Sn-Gn	Post S	59.33	2.23	2.82	< 0.05	S
	Preread	58.66	2.17			
N-Pg	Post S	−0.33	0.70	−8	< 0.05	HS
	Preread	0.55	0.52			
MUL	Post S	112.11	9.18	0	> 0.05	S
	Preread	112.11	9.18			
Go-Pg	Post S	73	3.96	0	> 0.05	NS
	Preread	73	3.96			
ANB	Post S	2.22	0.44	1.88	> 0.05	NS
	Preread	1.66	0.70			
Hp-ANS	Post S	48.88	1.36	0	> 0.05	NS
	Preread	48.88	1.36			
Hp-PNS	Post S	52.88	3.01	0	> 0.05	NS
	Preread	52.88	3.01			

Level of significance: HS at 1% p < 0.01 (Highly significant at p < 0.01); S at 5% p < 0.01 (significant at p < 0.05); If p value is > 0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant

Table 6: Comparison of corresponding readings of skeletal and soft-tissues: maxillary impaction group

Group	*Variable*	*Mean*	*SD*	*t-value*	*p-value*	*Significance*
Skeletal tissue	NA-Pg	−0.77	0.66	−0.84	> 0.05	NS
Soft-tissue	G-Sn-Pg	−0.50	0.54			
Skeletal tissue	N-Pg	0.75	0.33	3.34	< 0.01	HS
Soft-tissue	G-Pg	0.25	0.75			
Skeletal tissue	N-Sn	−0.55	1.06	0.94	> 0.05	NS
Soft-tissue	N'-Sn	−1.75	0.53			
Skeletal tissue	Sn-Gn	104.50	0.69	−16.2	< 0.01	HS
Soft-tissue	Sn-Gn'	103.75	0.69			

Level of significance: HS at 1% $p < 0.01$ (Highly significant at $p < 0.01$); S at 5% $p < 0.01$ (significant at $p < 0.05$); If p value is > 0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant

Table 7: Comparison of post and predicted values in skeletal readings: mandibular advancement

Variable	*Value*	*Mean*	*SD*	*Paired t-value*	*p-value*	*Significance*
N-A-Pog	Post S	−2.22	0.66	−2.80	< 0.05	S
	Pre-read	−1.44	1.013			
N-B	Post S	−0.55	0.72	−0.55	> 0.05	NS
	Preread	−0.44	0.52			
N-Pg	Post S	−0.55	0.72	−2.52	< 0.05	S
	Preread	1	0.86			
MUL	Post S	112.33	7.29	−5.96	< 0.01	HS
	Pre-read	113.77	7.42			
Go-Pg	Post S	87.55	3.87	−2.52	< 0.05	S
	Pre-read	88	3.80			
ANB	Post S	2.77	0.44	2.29	> 0.05	NS
	Pre-read	2.22	0.44			

Level of significance: HS at 1% $p < 0.01$ (Highly significant at $p < 0.01$); S at 5% $p < 0.01$ (significant at $p < 0.05$); If p value is > 0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant

Table 8: Comparison of corresponding readings of skeletal and soft-tissues: mandibular advancement group

Group	*Variable*	*Mean*	*SD*	*t-value*	*p-value*	*Significance*
Skeletal tissue	NA-Pg	−0.77	0.83	−0.15	> 0.05	NS
Soft-tissue	G-Sn-Pg	−0.83	0.40			
Skeletal tissue	N-Pg	−0.44	0.52	2.19	< 0.05	S
Soft-tissue	G-Pg	−1.16	0.75			

Level of significance: HS at 1% $p < 0.01$ (Highly significant at $p < 0.01$); S at 5% $p < 0.01$ (significant at $p < 0.05$); If p value is > 0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant

Table 9: Comparison of post and predicted values in skeletal readings: mandibular set back

Variable	*Value*	*Mean*	*SD*	*Paired t-value*	*p-value*	*Significance*
N-A-Pog	Post S	−0.50	1	1	> 0.05	NS
	Preread	−0.75	1.25			
N-B	Post S	0.75	1.50	1.73	> 0.05	NS
	Preread	0.25	1.89			
N-Pg	Post S	−0.55	1	5	< 0.05	S
	Preread	−1.75	1.25			
MUL	Post S	104.50	1.73	1.56	< 0.01	NS
	Preread	103.75	2.50			
Go-Pg	Post S	75.25	1.50	1.00	> 0.05	NS
	Preread	75.00	1.41			
ANB	Post S	1	0	0	> 0.05	NS
	Preread	1	0			

Level of significance: HS at 1% $p < 0.01$ (Highly significant at $p < 0.01$); S at 5% $p < 0.01$ (significant at $p < 0.05$); If p value is > 0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant

Table 10: Comparison of corresponding readings of skeletal and soft-tissues: mandibular set back group

Group	*Variable*	*Mean*	*SD*	*t-value*	*p-value*	*Significance*
Skeletal tissue	NA-Pg	0.25	0.50	−1.41	> 0.05	NS
Soft-tissue	G-Sn-Pg	0.75	0.50			
Skeletal tissue	N-Pg	1.25	0.50	−0.92	> 0.05	NS
Soft-tissue	G-Pg	1.75	0.95			

Level of significance: HS at 1% $p < 0.01$ (Highly significant at $p < 0.01$); S at 5% $p < 0.01$ (significant at $p < 0.05$); If p value is > 0.05 then the significance level decreases; hence it becomes nonsignificant; NS: Nonsignificant; S: significant; HS: highly significant generated by Quick Ceph image software in 35 patients with severe dentoskeletal discrepancies and treated with mandibular setback/advancement. Results showed a good correlation between predicted and actual changes except for soft-tissue point B and E plane. Jacobson and Sarver[5] did a retrospective study to evaluate the accuracy of surgical prediction of maxillary repositioning using dentofacial planner software. The results showed that on an average for each patient, 80% of actual results fell within 2 mm of prediction and 43% fell within 1 mm of prediction. Cousely and Grant[6] did a study to evaluate the accuracy of OPAL™ cephalometric prediction software. The results of the study showed that prediction of some of the principal OPAL variables (SNA, SNB, LAFH%, OJ, OB) were reasonably accurate in terms of mean values. A considerable number of studies carried out with various prediction imaging programs reveals a consensus toward the variability in lower lip predictions, Sinclair et al 1995;[7] Eales et al 1994;[8] Kolokitha et al 1996;[9] Jacobson 1998;[10] and Rakosi 1982.[11] VTO was assessed through many other studies done by Hing,[12] Guess and Solzer,[13] Lew,[14] Konstantina and O'Reilly,[15] Nimkarn and Miles[16] Eales et al,[17] Aharon et al[18] and Upton et al.[19]

The materials of the present study included pre and post-treatment lateral cephalogram tracings and profile photographs of 30 patients who had undergone various orthognathic surgeries. VistaDent software was used for computerized prediction of surgical results. Earlier studies had compared postsurgical and predicted photocephalometric tracings using different softwares. Our study differed in that, we first calculated the actual skeletal change during surgery (postsurgical ceph values minus presurgical values) and then these values were fed into the computer software program as the treatment effect for the respective surgical procedures. This prediction result obtained from the software was compared with the actual surgical result. The reason for using this method is that it avoids the variability, which would arise due to the disparity in the planned surgical movements and the actual alterations.

CLINICAL IMPLICATIONS

1. The VistaDent software in our present study showed a good match between the predicted and actual outcome of surgery, both in the skeletal and in soft-tissue parameters, except for the mentolabial angle in the mandibular advancement surgery. Hence, VistaDent software can be used as an aid in giving a fair idea to the clinician about the skeletal and soft-tissue outcome of the proposed surgeries.
2. Soft-tissue algorithms need to be improved for the lower lip.
3. When the patient is shown the computer generated image, he should be informed of inaccurate lip depiction.

SUMMARY AND CONCLUSION

The study was conducted to evaluate the efficacy of VistaDent software in predicting changes following four different orthognathic surgeries. The evaluation was done using records of 30 patients of which, 8 patients had undergone maxillary impaction and mandibular autorotation, 9 of each had undergone maxillary impaction and mandibular advancement and 4 patients had undergone mandibular setback. The surgical movement from each patient was fed into the VistaDent Program, and a comparison was made with the actual postsurgical tracing at 40 hard-tissue points and 20 soft-tissue landmarks. Results were tabulated and statistically evaluated.

The conclusions derived from the study were as follows:

1. VistaDent software was quite effective in estimating the change in the soft-tissue related to single jaw and double jaw surgeries except in mandibular advancement, where the prediction of the mentolabial angle tended to be more acute.
2. The most statistically significant differences between the VistaDent software predicted profile tracings and the post-treatment radiographic profile tracings were in the horizontal and vertical landmarks associated with the lower third region.
3. This type of software is an important aid to the orthognathic planning process, but should always be interpreted with caution. When used for the patient motivation, the patient should be informed that the results shown by the software are not 100% accurate or achievable.

REFERENCES

1. Bhatia SN, Sowray JH. A computer-aided design for orthognathic surgery. Br J Oral Maxillofac Surg 1984;22(4):237-253.
2. Friede H, Kahnberg KE, Adell R, et al. Accuracy of cephalometric prediction in orthognathic surgery. J Oral Maxillofac Surg 1987;45(9):754-760.
3. Pospisil OA. Reliability and feasibility of prediction tracing in orthoganthic surgery. J Cranio Max Fac Surg 1987;15(2):79-83.
4. Gerbo LR, Poulton DR, Covell DA, et al. A comparison of a computer-based orthognathic surgery prediction system to post surgical results. Int J Adult Orthod Orthognath Surg 1997;12(1):55-63.
5. Jacobson R, Sarver DM. The predictability of maxillary repositioning in Le Fort I orthognathic surgery. Am J Orthod Dentofac Orthop 2002;122(1):142-154.
6. Cousley RR, Grant E, Kindelan JD. The validity of computerized orthognathic predictions. J Orthod 2003;30(2):149-154.
7. Sinclair PM, Kilpelainen P, Philips C, et al. The accuracy of video imaging in orthognathic surgery. Am J Orthod Dentofac Orthop 1995;107(2):177-185.

8. Eales EA, Newton C, Jones ML, Sugar A. The accuracy of computerized prediction of the soft-tissue profile: a study of 25 patients treated by means of the Le Fort I osteotomy. Int J Adult Orthod Orthognath Surg 1994;9(2):141-152.
9. Kolokitha OE, Athanasiou AE, Tuncay OC. Validity of computerized predictions of dentoskeletal and soft-tissue profile changes after mandibular setback and maxillary impaction osteotomies. Int J Adult Orthod Orthognath Surg 1996;11(2): 137-154.
10. Jacobson A. A textbook on radiographic cephalometry-from basic to video imaging. 1st ed. Quintessence Publishing Co. Inc: Illinois; 1995. p. 53.
11. Rakosi T. A textbook on atlas and manual of cephalometric radiology. 1st ed. Wolfe Medical Publications Ltd: London; 1982. p. 35-37.
12. Hing NR. The accuracy of computer-generated prediction tracings. Int J Oral Maxillofac Surg 1989;18(3):148-151.
13. Guess MB, Solzer WW. Computer treatment estimates in orthodontics and orthognathic surgery. J Clin Orthod 1989; 23(4):262-268.
14. Lew KK. The reliability of computerized cephalometric soft-tissue prediction following bimaxillary anterior subapical osteotomy. Int J Adult Orthod Orthognath Surg 1992:7(2): 97-101.
15. Konstiantos KA, O'Reilly MT, Close J. The validity of the prediction of soft-tissue profile changes after Le Fort I osteotomy using the dentofacial planner (computer software). Am J Orthod Dentofac Orthop 1994;105(2):241-249.
16. Nimkarn Y, Miles PG. Reliability of computer-generated cephalometrics. Int J Adult Orthod Orthognath Surg 1995;10(1): 43-52.
17. Eales EA, Jones ML, Newton C, et al. A study of the accuracy of predicted soft-tissue changes produced by a computer software package (COG3.4) in a series of patients treated by the Le Fort I osteotomy. Br J Oral and Maxillofac Surg 1995;33(6):362-369.
18. Aharon PA, Eisig S, Cisneros GJ. Surgical prediction reliability: a comparison of two computer software systems. Int J Adult Orthod Orthognath Surg 1997;12(1):65-78.
19. Upton PM, Sadowsky PL, Sarver DM. Evaluation of video imaging prediction in combined maxillary and mandibular orthognathic surgery. Am J Orthod Dentofac Orthop 1997;112(6): 656-665.