Research Article

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Mandibular Advancement: Cephalometric Prediction of Post Surgical Outcome

Kishore MSV[1] K Sadashiva Shetty[2] N Viveka Vardhan Reddy[3] Ritesh Rajan[4] R Lakshmi Sravya[5] Varalakshmi Chandaveni[6*]

[1]Professor and Head, Department of Orthodontics, SVS Institute of Dental Sciences, Mahabubnagar, India.
[2]Professor and Head, Department of Orthodontics, Bapuji Dental College, Davangere, Karnataka, India.
[3]Professor and Principal, Department of Oral and Maxillofacial Surgery, SVS Institute of Dental Sciences, Mahabubnagar, India.
[4]Professor and Head, Department of Oral and Maxillofacial Surgery, SVS Institute of Dental Sciences, Mahabubnagar, India.
[5]PG Student, Department of Orthodontics, SVS Institute of Dental Sciences, Mahabubnagar, India.
[6]PG Student, Department of Orthodontics, SVS Institute of Dental Sciences, Mahabubnagar, India.

ABSTRACT

Background: In earlier days, the primary visual aid in discussing treatment with patients was a set of dental casts, the focus almost had to be on how the teeth fit. But as the facial esthetics became an integral part, cephalometric prediction of treatment outcomes has became a necessary part of planning orthognathic surgery for adults

Aim: The aim of this study was to determine the accuracy of pre surgical cephalometric prediction methods to estimate post surgical changes in hard and soft tissues.

Materials and methods: Study included 15 adult patients with age range of 15-24 yrs, mean age of 19.8 yrs. Presurgical decompensation followed by bilateral sagittal split osteotomy was performed on all subjects under the supervision of a single surgeon. Post surgical cephalograms were taken two months following surgery. For estimating the amount of hard and soft tissue changes LEGAN BURSTONE,STEINER'S, Mcnamara and RICKETTS cephalometric analysis were performed. Prediction tracing as given by PROFFIT and WHITE, LEWARD C. FISH and BRUCE N.EPKER were employed. The accuracy of prediction tracings were evaluated by a superimposition method with Basion- Nasion registered at CC point as described by RICKETTS. The horizontal and vertical discrepancy between the prediction tracings and post surgical tracings was measured and compared using paired t- test to evaluate the hard and soft tissue changes.

Results: Hard tissue cephalometric measurements showed a mean relapse of 2mm and an increase of anterior face height by 1.2 mm. Angular and linear parameters of the soft tissues were in good concordance with the prediction except for the soft tissue chin thickness which did not move with the hard tissue pogonion in 1:1 ratio. The mandibular plane angle and gonial angle showed significant increase post surgically.

Conclusion: Simple overlay tracing method will assist the orthodontist, surgeon and patient in estimating post treatment effects. However, caution must be exercised in estimating soft tissue changes and relapse tendency in these individuals.

Keywords: Pre surgical decompensation, Orthognathic surgery, Bilateral sagittal split osteotomy, cephalometric tracing.

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*Correspondence Dr. Varalakshmi Chandaveni.
Department of Orthodontics, SVS Institute of Dental Sciences, Mahabubnagar, India.
Email: varalakshmichandaveni@gmail.com

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INTRODUCTION

In non-growing individuals with severe dentofacial deformities, surgery improves the potential for achieving a satisfactory functional occlusion. Bilateral saggital split osteotomy is the most frequently performed surgery for advancing the mandible in class II patients. Predicting the appearance of patient before performing this surgery is helpful to estimate amount of ideal advancement to obtain pleasing profile. Anxiety on the patient part to know how they look and also proficiency of the operator how much would be ideal, raised demand for obtaining predicted treatment result. Evaluating the outcome increase awareness of patients about the events that surround facial surgery apparently because they view changes in themselves, more vividly than just hearing these things discussed[1].This improvement in appearance is an important motivation for patients to seek orthognathic treatment [2-4]. In earlier days, the primary visual aid in discussing treatment with patients was a set of dental casts, the focus almost had to be on how the teeth fit. But as the facial esthetics became an integral part, cephalometric prediction of treatment outcomes has become a necessary part of planning orthognathic surgery for adults.

With the advent of newer technologies and softwares, computer assisted 3-dimensional (3D) virtual reality surgical planning with three-dimensional (3-D) color facial soft-tissue model generation is now possible [5]. However traditional method of cephalometric prediction is an economical tool for simpler single jaw surgeries without major facial asymmetries. This study tries to evaluate the accuracy of the traditional presurgical prediction method to estimate the surgical outcome.

AIMS AND OBJECTIVES

1. To compare the pre-surgical cephalometric prediction tracing and post surgical outcome in orthognathic surgical cases.

2. To evaluate the accuracy and reliability of the prediction by simple overlay tracing method.

3. To assist a surgeon and orthodontist in evaluation of eventual treatment effects and stability of bilateral sagittal split osteotomy.

4. To estimate relapse following surgery.

MATERIALS AND METHODOLOGY

It was a retrospective cephalometric study done by single operator. Duration of the study was 6months. This study was conducted on 15 adult patients of age 15 - 24 yrs (Mean age 19.8 yrs exhibiting severe class II skeletal malocclusion (ANB 6-10°) and retrognathic mandible for which surgical intervention was necessary (only mandibular advancement without genioplasty). For all the patients used in the study pre-surgical decompensation done by pre-adjusted edgewise appliance with or without extractions. Bilateral Sagittal Split Osteotomy for mandibular advancement procedure with rigid internal fixation by screws was carried out under the supervision of a single surgeon. The magnitude of advancement was 5–10mm with an average of 8mm. Lateral cephalograms prior to surgery and after surgery were taken in habitual occlusion with lips at rest position. Post-surgical cephalograms were taken two months following surgery.

Legan Burstone[6,7], Steiner's[8], Mcnamara [9] and Rickett [10] analysis were employed for estimating the amount of hard and soft tissue changes in this study. These analysis include certain angular and linear measurements for both hard and soft tissues. The technique employed for prediction tracing was given by Proffit and White [11], Leward C. Fish and Bruce N. Epker [12] which was, adopted from the mechanics developed by Ricketts for cephalometric analysis and growth prediction by Bench, Gugfno And Hilgers. To evaluate the accuracy of tracings, prediction cephalograms were superimposed over post-surgical cephalograms with Basion-Nasion line registered at CC-point. The horizontal and vertical discrepancy between the prediction tracings and post-surgical cephalograms was measured and compared to evaluate the hard and soft tissue changes.

To compare the pre-surgical values with post-surgical values paired - t-test was used. A p-value of < 0.05, 0.01 was considered to be statistically

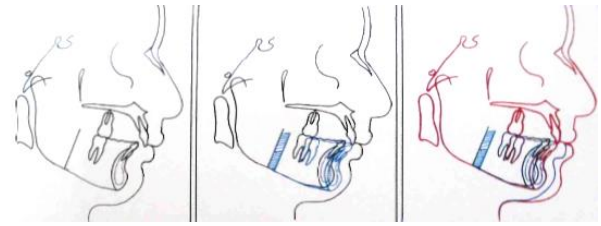

Fig 1: Cephalometric prediction.

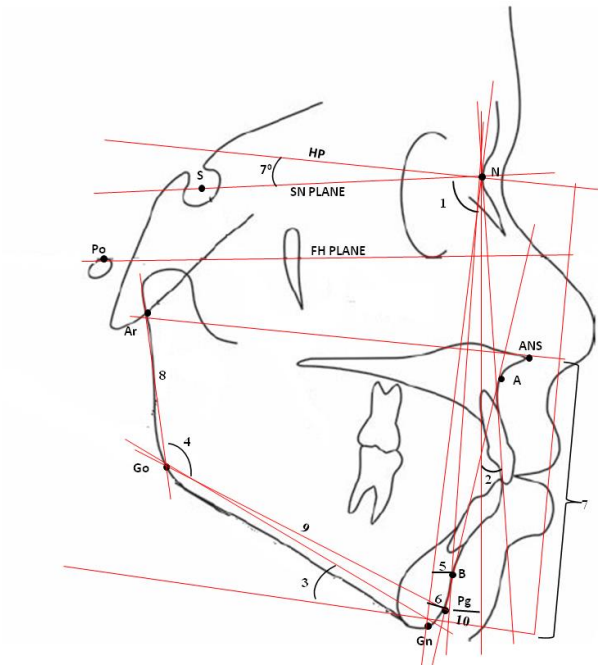

Fig 2: Hardtissue landmarks.

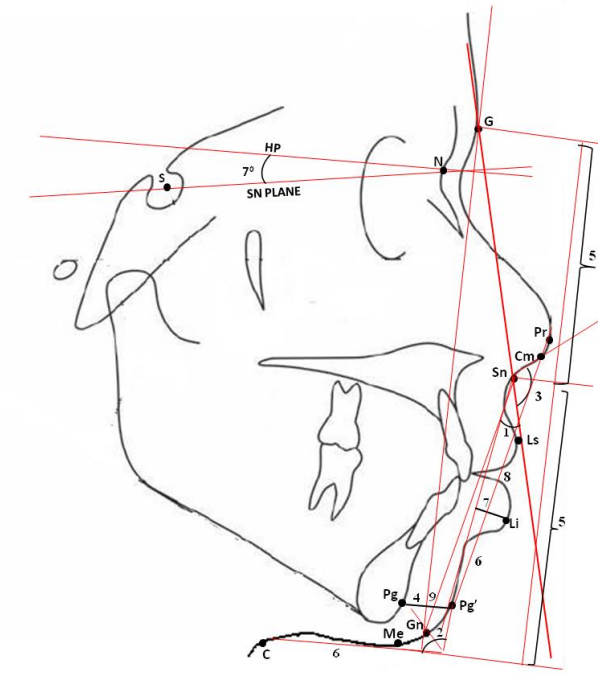

Fig 3: Soft tissue landmarks.

significant, p-value < 0.001 highly significant and p-value > 0 05 to be insignificant statistically.

RESULTS

Comparison between pre-surgical and post-surgical values relating to hard tissue parameters and soft tissue parameters was done using paired t-test as described in table 1 and table 2 respectively. Difference between hard tissue parameters was found to be significant.SNB, MP-HP, Ar-Go-Gn, N-B(11 HP), ANS-Gn(HP), Go-Pg, N-Pog parameters showed statistically significant difference. Correlation was present between N-A-Pg angle, Ar-Go, N-Pg HP values. Difference between soft tissue parameters was not significant expect Pg-Pg', E-line (Lower Lip) which showed a mean difference of -2.87 between predicted value and post surgical outcome.

DISCUSSION

The present study tries to estimate relapse following surgery, measured at various hard and soft tissue points. SNB angle showed great variance (mean difference 2 0± 1.13) between predicted and post-surgical outcome, estimating high relapse at this point. Joseph E. Vansickels [13] studied a group of 19 subjects, treated with sagittal split osteotomies with rigid internal fixation and reported that relapse occurred for advancements of more than 6 to 7mm. Although relapse occured in all cases, it was never greater than 2mm. Inspite of some relapse in anterio-posterior direction, the N-A-Pg angle remained stable without any clinically significant difference.

The mandibular plane angle (MP-HP mean difference -2.07±2.19) and the gonial angle (Ar-Go-Gn mean difference -2.47±2.53) showed statistical and clinical increase with the surgical procedure. The main reason for this increase was the inferior movement of gnathion producing clockwise rotation of the distal segment. Previous studies by McNamara and Carlson [14], Edward Ellis [15] reported similar change. Significant correlation was found between the predicted N-B value and post-surgical value, since surgical lengthening of the mandible few samples was primarily achieved by anterio-inferior advancement of the distal mandibular segment in order to open the bite surgically. This might have resulted in an anterior

Table 1: Mean values and standard deviation of predicted and post- surgical hard tissue cephalometric parameters.

Measurement	Parameter	Presurgical predication Values			Post-Surgical Value			Difference (Mean± SD)	Significance P- value
		Mean	SD	SE	Mean	SD	SE		
Angular(0)	SNB	81.2	2.43	0.63	79.2	2.81	0.73	2.00 ±1.13	<0.01HS
	N-A-Pg	5.87	4.02	1.04	5.6	4.19	1.08	0.27 ± 2.25	0.65 NS
	MP-HP	18.2	6.24	1.61	20.27	6.03	1.56	-2.07±2.19	<.01 S
	Ar-Go-Gn	118.67	6.52	1.68	121.13	7.04	1.82	-2.47±2.53	<.01 S
Linear (mm)	N-B(11 HP)	-3.40	5.57	1.44	-4.80	6.78	1.75	1.40±1.92	<.05 S
	N-Pg	-2.00	4.77	1.23	-2.87	6.07	1.57	0.87±2.70	0.23 NS
	ANS-Gn(HP)	62.40	4.72	1.22	63.40	4.75	1.23	-1.20±1.21	<.001 HS
	Ar-Go	51.07	5.36	1.39	50.47	5.18	1.34	0.60v1.18	0.07 NS
	Go-Pg	81.13	6.73	1.74	79.80	6.17	1.59	1.33±1.72	<.01 S
	N Pog	-4.40	5.47	1.41	-6.73	5.93	1.53	2.33±1.68	<.001 HS

Table 2: Mean Values and standard deviation of predicted and post surgical soft tissues cephalometric parameters.

Measurement	Parameter	Presurgical Prediction values			Post- Surgical Values			Difference (Mean± SD)	Significance P-value
		Mean	SD	SE	Mean	SD	SE		
Angular(0)	G-Sn-Pg	14.67	4.40	1.14	13.67	4.48	1.16	1.00±2.40	0.08NS
	Sn-Gn-C	112.67	9.90	2.56	112.20	12.32	3.18	0.47±5.5	0.75NS
	Cm-Sn-Ls	96.07	8.94	2.31	96.20	10.83	2.80	-0.13±5.15	0.92 NS

Linear(mm)	G-Pg	-5.80	5.35	1.38	-5.60	5.15	1.33	-0.20±2.40	0.75 NS
	G-Sn&Sn-Me (HP)	1.00	0.11	0.03	0.99	0.12	0.03	0.01±0.03	0.70 NS
	Sn-Gn&C-Gn	1.30	0.44	0.11	1.29	0.44	0.11	0.01±0.17	0.96 NS
	Li(Sn-Pg')	5.33	2.47	0.64	5.13	2.90	0.75	0.20±1.26	0.55 NS
	Si-(Li-Pg')	6.13	1.19	0.31	6.40	1.55	0.40	0.27±1.28	0.43 NS
	E-Line(Upper lip)	-2.47	2.59	0.67	-2.93	3.10	0.80	0.47±1.64	0.29 NS
	E-Line(Lower lip)	0.20	3.19	0.82	0.13	3.44	0.89	0.07±0.53	0.87 NS
	Pg-Pg'	8.27	2.19	0.56	11.13	3.29	0.85	-2.87±1.85	< 0.001 HS

positioning of point-B and inferior positioning of pogonion, with an increase in anterior facial height, confirming previous studies by Ive.J. McNeill and West [16], Kohn M.W [17]. White R.P. Proffit and Cramer & Markell [18]. The length of the body of the mandible measured from gonion to pogonion, showed a mean difference of 1.3mm, estimating amount of relapse in horizontal direction. Significant difference in N perpendicular to pogonion value could be because of a combination of factors in two planes, the amount of relapse that was seen Post-surgically in horizontal direction, and intentional clockwise rotation of distal segment in an attempt to open the bite in vertical plane. This is in accordance with studies conducted by Edward Ellis[15], McNamara and Carlson [14] and Singer and Bays [19].

Good correlation was found between the predicted and post-surgical soft tissue changes. In this study lower lip demonstrated reduction in thickness, as well as lengthening and straightening with an accompanying decrease in mentolabial fold as per the prediction and post-surgical outcome. In the studies carried out by Quast et al [20], Lines and Stein hauser [21] and Mommaerts, H. Marxer [22], the horizontal change of the labrale inferius and mentolabial fold was not significant, similar to this study. A great variation (P-value < 0.001 HS) existed in relation to chin thickness (Pg-Pg') between the predicted and post-surgical values,as proposed in previous studies by Quast et al [20], Hernandez Orsini [23] hard Pogonion did not move in 1:1 ratio with soft tissue pogonion. Several studies suggested a mean relapse of 20% in mandibular advancement procedure indicating over-correction in order to counteract the relapse tendency, which was further proved in this study. However, amount of relapse evaluated at point B and Pogonion was never greater than 2mm to be clinically discerned. It is further suggested that if a more realistic long-term prediction of the post surgical soft tissue profile is desirable then ratios incorporating mean relapse should be used rather than estimates based on a 1:1 relationship.

Limitations of the study include as it was a cephalometric prediction, with the radiographs there will be magnification error and human error in marking landmarks. Considering the economic status of the patients, every patient cannot afford all the 3 dimensional diagnostic aids so with the cephalometric prediction we can motivate patients, and can explain how much error is possible with this type of predictions.

CONCLUSION

Diagnosis and planning for surgical orthodontic treatment is best accomplished by joint participation of an orthodontist and oral surgeon. To make a prediction, the orthodontist and surgeon should thoroughly plan treatment in detail and perform mock orthodontic and surgical treatment to test the feasibility of the therapy. Prediction tracings have a lot to offer in the planning of surgery in cases where occlusion and facial esthetics can be

successfully corrected by unimaxillary or bimaxillary procedures and & also in decision making. However prediction of expected amount of relapse and the amount of overcorrection necessary would show the expertise of the clinician.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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