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Research Paper

Evaluation of Skeletal, Dental and Soft tissue changes After Maxillary Arch Intrusion with Infrazygomatic crest minimplant: A Cephalometric Study.

Santosh kumar Goje [1], Mohini Marathe[2]
[1]*Professor and H.O.D., Department of Orthodontics and Dentofacial Orthopedics, K.M. Shah Dental College & Hospital, Gujarat, India*
[2]*Post graduate student, Department of Orthodontics and Dentofacial Orthopedics, K.M. Shah Dental College & Hospital, Gujarat, India*

ABSTRACT
BACKGROUND: *Skeletal anchorage system may be used for total maxillary arch intrusion as an alternative method instead of surgical approach to correct Class II malocclusion with hyperdivergent growth pattern with retrognathic mandible.*
AIM: *The aim of the study is to evaluate skeletal, dental and soft tissue changes before and after maxillary arch intrusion with skeletal anchorage system in Hyperdivergent individual.*
MATERIAL AND METHODS: *In these retrospective study sample group was composed of 15 patients with Hyperdivergent growth pattern who had undergone Total maxillary arch intrusion. The posterior intrusion was done by Infrazygomatic minimplants and Transpalatal arch placed 6 mm away from palate. The maxillary anterior intrusion was done using minimplant. The study was carried out on lateral cephalograms of the subjects which was taken before treatment and after intrusion.*
RESULTS: *Cephalometric changes obtained with Total maxillary intrusion in the values of SNB, ANB, Wits, PFHAFH, FMA, SN-GoGn, SN-PP, PP-MP, SN-OP, convexity, interincisal angle, U1 –OP, U1-NP, IMPA,U6-PP, U1-PP, OB, B' values were statistically significant.*
CONCLUSION: *Total maxillary arch intrusion with skeletal anchorage system brought changes in the vertical skeletal and dentoalveolar parameter because of the maxillary anterior and posterior dentoalveolar intrusion. Soft tissue changes were also observed but significant changes were seen with soft tissue B' point.*
KEY WORDS: *Total maxillary arch intrusion, absolute anchorage system, hyperdivergent growth pattern*

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I. INTRODUCTION

Class II malocclusion with hyperdivergent growth pattern shows clinical features such as hyperdivergent growth pattern, retrognathic mandible which oftenly is as a result of clockwise rotation of mandible or excessive vertical growth of buccal component. Due to this lower facial height is increased and profile appears convex[1]. It may be associated with gummy smile which is caused by either excessive growth of maxilla or the maxillary dentition associated with imbalance in soft tissue musculature such as short and hypotonic lip[2].

Esthetically, it is inappropriate to intrude only maxillary anterior dentition to correct excessive gingival exposure due to excessive growth of maxilla. As it will produce flat or reverse smile arc which is not attractive and is unpleasant. Hence, total intrusion of maxillary arch is anticipated[4].

Infrazygomatic crest implants are suggested through many orthodontist as they allow to deal with complicated problems which had been limited to miniplates therapy which might be extra invasive and calls for surgical exposure for insertion and removal.

Such a treatment ought to correctly intrude the maxillary dentition, causes counter clockwise rotation of mandible and eliminate the gummy smile without surgical intervention. There is only limited reports who have carried out successful distilization and intrusion of molars with skeletal anchorage system. However no study has been taken up till date which have evaluated skeletal, dental and soft tissue response after whole arch

maxillary intrusion with the help of infrazygomatic implant and other minimplants in skeletal class II adult patient with Hyperdivergent growth pattern, retrognathic mandible and gummy smile.

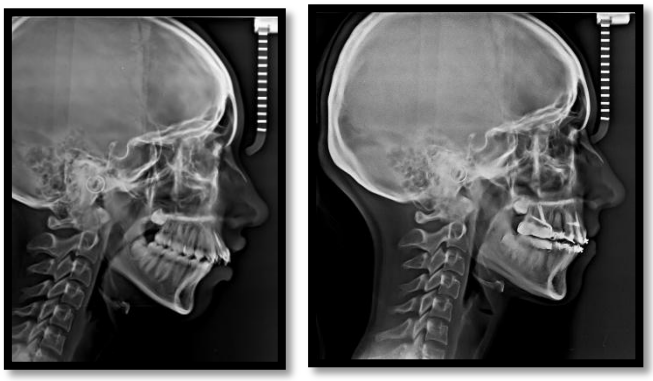
II. MATERIALS AND METHODS

1. The pre-treatment (T0) and post intrusion (T1) lateral cephalograms of 15 subjects who had undergone orthodontic treatment and required whole maxillary arch intrusion was obtained from the archives of the Department of Orthodontics and Dentofacial Orthopedics, K. M. Shah Dental College and Hospital, Piparia, Vadodara. The inclusion criteria was 1) Presence of permanent dentition at the start of the treatment. 2) No missing teeth (excluding third molars) at the start of the treatment. 3) Orthodontic intervention requiring maxillary arch intrusion with IZC implants and anteriorly intrusion with minimplant. 4) Pre-treatment lateral cephalograms showing hyperdivergent growth pattern showing Class I or class II skeletal and dental relationship which requires total maxillary arch intrusion. The exclusion criteria were as follows 1) Faulty radiographs. 2) Incomplete records. The Pre-treatment and Post treatment Lateral Cephalometric analysis was performed on the Dolphin Imaging & software 11.5.12 by principal examiner (figure 1a & 1b).

Figure 1

a) Pre-treatment Lateral cephalograms of patient

b) Post – maxillary intrusion lateral cephalograms of the patient



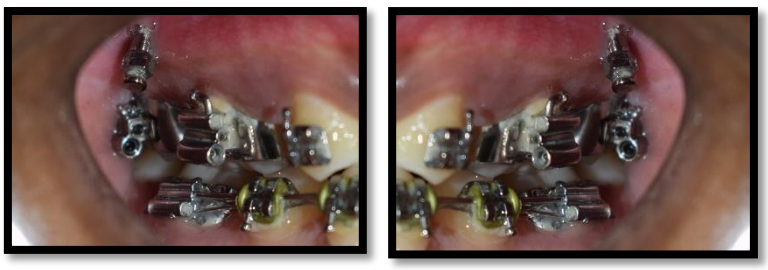
The landmarks used in these analysis of skeletal, dental, and soft-tissue measurements are shown in table 1. The measurements was performed again on randomly selected cephalograms by the same examiner after 2 weeks to reduce method error. Dahlberg's formula was used to check the method error.

Procedures to carry out maxillary arch intrusion:

For correction of vertical maxillary excess with the gummy smile total maxillary arch intrusion was carried out with the help of infra-zygomatic implants and minimplant. The infra-zygomatic minimplants were placed in the maxilla in the region of infra-zygomatic crest which lies higher and lateral to the 1st and 2nd molar region (figure2).

Figure 2

Infrazygomatic implant placement



Transpalatal arch (0.032") is place palatally (figure 3A). Posterior intrusion is carried out by Transpalatal arch placed which is placed 6mm away from palate and E-chain placed buccally from molar to infrazygomatic minimplants. Intrusive force was applied on incisors by placing intraradicular miniscrews (1.5 × 2 mm) in the maxillary anterior region between two central incisors or between the central and lateral incisors (figure 3B). E chain was attached from archwire to the minimplant.

Figure 3

A) Transpalatal arch (0.032") is place palatally

B) Simultaneous anterior and posterior intrusion with the help of minimplant in anterior region and infrazygomatic implants in posterior region

III. RESULTS

The pre intrusion and post intrusion data from skeletal, dental, and soft-tissue measurements were obtained from lateral cephalograms summarized in Table I. Cephalometric changes obtained with Total maxillary intrusion were statistically significant ($P < 0.05$). SNB, ANB, Wits, PFHAFH, FMA, SN-GoGn, SN-PP, PP-MP, SN-OP, convexity, interincisal angle, U1 –OP, U1-NP, IMPA,U6-PP, U1-PP, OB, B' values were statistically significant. According to these findings, the maxillary first molar was intruded on an average by 2.21 mm, upper incisor intrusion was 1.536 mm, the maxillary occlusal plane turned clockwise on an average of 3.33 degree, and mandible came forward by 3.19 mm and SN-GoGn and anterior facial height decreased by 1.841 and 2.94 mm, respectively. Overbite was also reduced by 1.811 mm.

Table1 shows pre-intrusion and post-intrusion skeletal, dental and soft tissue parameters

Parameters	Pretreatment		Posttreatment		Difference	Standard deviation	P value
	Mean	Std deviation	Mean	Std. deviation			
SKELETAL PARAMETERS							
SNA -	81.263	1.908	81.124	1.805	0.139	0.481	0.281
SNB	76.776	2.162	78.256	2.558	-1.479	0.697	<0.001
ANB	4.423	1.067	2.988	1.461	1.435	0.809	<0.001
NP- Pt A	2.362	0.782	2.02	0.656	0.342	0.599	0.044
NP-Pt B	-6.664	1.390	-3.469	1.623	-2.195	0.915	<0.001
Witts app	2.583	1.181	1.246	1.065	1.337	0.574	<0.001
PFHAFH	58.670	2.651	59.421	2.657	-0.750	0.381	<0.001
FMA	30.531	1.749	29.122	1.855	1.409	0.443	<0.001
ANS-Me	70.790	4.419	67.8422	4.425	2.948	0.378	<0.001
SN-GOGN	39.614	1.072	37.773	0.998	1.841	0.165	<0.001
SN-PP	6.082	0.998	7.165	0.925	-1.083	0.246	<0.001
PP-MP	32.598	2.666	28.092	2.834	4.506	1.188	<0.001
SN-OP	17.989	1.082	21.325	1.796	-3.336	1.413	<0.001
Convexity	7.590	0.959	5.516	1.387	2.073	0.663	<0.001
SUM	400.694	2.112	401.076	2.275	-0.382	1.514	0.345
DENTAL PARAMETERS							
Interincisal angle	119.176	8.855	117.802	8.883	1.076	0.212	<0.001
U1- FH	128.314	3.690	127.238	3.760	0.788	1.850	0.121
U1-OP	127.147	3.317	126.358	3.327	1.215	0.270	<0.001
U1-NA	28.881	1.377	27.666	1.327	3.550	1.700	<0.001
U1-NA	10.420	1.711	6.869	1.837	0.883	0.274	<0.001
IMPA	94.836	3.411	93.953	3.354	2.210	0.358	<0.001

U6-PP	23.064	1.393	20.854	1.615	1.535	0.694	<0.001
U1-PP	32.390	2.136	30.854	2.261	2.386	0.612	<0.001
U1-EXP	7.247	1.399	4.860	1.259	-0.306	0.361	0.005
L6-MP	30.465	1.120	30.772	1.227	-1.039	0.459	0.012
L1-MP	38.949	2.893	39.988	2.859	2.406	0.757	0.024
OJ	4.796	0.785	2.389	0.392	1.811	0.625	0.028
OB	4.793	0.836	2.982	0.678	-1.479	2.341	<0.001
SOFT TISSUE PARAMETERS							
NLA	91.884	9.906	93.363	8.904	-1.060	0.390	0.029
UL-E	-3.061	0.397	-3.830	0.520	-1.134	0.305	0.023
POG'-SN	-8.327	0.815	-7.266	2.719	-0.592	2.161	0.325
N'-Sn-POG'	122.806	5.588	123.940	3.414	0.836	2.412	0.021
Nas- pro	14.537	0.650	15.129	0.616	-0.675	0.626	0.001
A'	3.472	0.438	2.636	0.450	0.139	0.481	0.281
B'	-9.624	0.852	-8.948	0.888	-1.479	0.697	<0.001

IV. DISCUSSION

Class II malocclusion in an adult with a skeletal Class II profile and vertical maxillary excess is difficult to manage. In patient with severe gingival exposure that is mainly caused by excessive vertical growth of maxilla only doing maxillary anterior teeth intrusion will worsen the smile arch and will not improve aesthetic. Hence, it is appropriate to intrude the whole maxillary arch. But all these procedures are difficult to perform using conventional mechanics[1]. Therefore orthognathic surgical approach as an ideal option considered for the patient to eliminate vertical maxillary excess. As patients are reluctant to undergo orthognathic surgery, therefore a new treatment mechanics is required for the correction of a deep bite and a gummy smile in maxillary vertical excess. These mechanics should effectively intrude the maxillary dentition and eliminate the gummy smile without surgical intervention[7].

A skeletal anchorage system was developed to correct many malocclusion in orthodontics. It allows the distal movement of maxillary molars without any further side effect. In many case report it has been reported that minimplants are used to intrude the maxillary molars in mandible and maxilla and reduced the facial height in adults with a skeletal class II malocclusion with an open bite[5].

Temporary Anchorage Device have been popular among orthodontist as they are useful in managing difficult malocclusions in adults. However, due to interradicular position of the miniscrews, high failure rate, and their tendency to move when loaded has limited their application for conservative treatment of skeletal malocclusions, particularly when there is crowding.

Skeletal orthodontic anchorage systems can provide adequate anchorage for management of severe malocclusions without extensive patient compliance. The Infrazygomatic crest is an ideal maxillary site for the placement of orthodontic bone screws to retract both arches[7]. The advantage of extralveolar implants over minimplants are that they are least in risk to damage the roots, larger quantity of cortical bone present at insertion points which allows the minimplant with larger diameter i.e. 2mm and greater length (12-14 mm) to be placed. IZC implants do not interfere with mesiodistal movement of teeth or group of teeth. The percentage of failure rate is less in IZC minimplants as compared to conventional minimplants. The less number of minimplants are required to solve the complex problems. In present study IZC minimplants and TAD were used for intrusion of molars and anterior teeth[11].

In vertical maxillary excess cases with the mandibular retrognathism, intrusion of maxillary molars causes autorotation of mandible. Lin et al reported several cases in which the maxillary molar were intruded and facial profile was improved as a result of mandibular rotation. For intrusion of the maxillary dentition, the following factors should be considered such as upper incisor exposure, smile arc, and steepness of the occlusal plane. Maxillary incisor exposure at rest and during smiling determines the amount of intrusion desirable for the anterior teeth[13].

Smile arc is a good clinical indicator of occlusal plane steepness. In a flat Or reverse smile arc, more intrusion of the posterior teeth would be considered favourable for improving smile arc consonance[13]. However, careful monitoring is necessary during actual treatment because the center of rotation during mandibular autorotation was reported to show large individual variation[14].

In these study rigid transpalatal arch was kept 6 mm away from the palate to allow for intrusion of the molars while preventing palatal crown inclination. A greater dimension wire for the transpalatal arch is advised for better torque control of the upper molars. Because the optimal intrusion force necessary on the posterior segment is greater than that required for the anterior teeth, elastomeric chain was connected directly from the IZC minimplant to the molars only, whereas the anterior segment was effectively intruded by the Elastomeric chain attached from archwire to interradicular minimplant[14].

Yao et al evaluated the amount of intrusion with miniscrews implants on 26 permanent first and 17 permanent second molars. They reported net intrusion of approximately 3-4 mm for the first molars and 1-2 mm for the second molars at a mean of 7.5 months[16]. In the study done by Akan et al, reported maxillary molar

intrusion was 2.32 mm, 2.76 mm of clockwise rotation of maxillary occlusal plane, anterior facial height and SN-GoGn decreased by 1.81 and 1.68 mm, respectively. No soft tissue changes were observed.

The result of the present study showed that the skeletal and dental changes on lateral cephalograms after total maxillary arch intrusion showed statistically significant difference ($P < 0.001$). The parameters such as SNB, ANB, Wits, PFHAFH, FMA, SN-Go 75Gn, SN-PP, PP-MP, SN-OP, convexity, interincisal angle, U1 –OP, U1-NP, IMPA,U6-PP, U1-PP, OB, B' values were statistically significant. According to these findings, the maxillary first molar was intruded an average of 2.21 mm, upper incisor intrusion 1.536mm, the maxillary occlusal plane turned clockwise an average of 3.33 degree, mandible came forward by 3.19 mm and SN-GoGn and anterior facial height decreased by 1.841 and 2.94 mm, respectively. Overbite also reduced by 1.811 mm and soft tissue B point was advanced by 0.67 mm.

V. Conclusion

Total maxillary arch intrusion with skeletal anchorage system brings about changes in the skeletal and dentoalveolar parameter because of the maxillary anterior and posterior dentoalveolar intrusion. Soft tissue changes were also observed but significant changes were seen with soft tissue B' point. Long term prospective studies should be carried out to evaluate long term treatment results.

Availability of data and materials

The author declare that all data generated or analyzed during this study are included in this published article and its supplementary information files.

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Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Author's contribution

The first author and second author performed the study. Both the authors read and approved the final manuscript.

Competing interests

There are no competing interests.

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