IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 10 Ser. 5 (October. 2024), PP 01-11
www.iosrjournals.org

A Cephalometric Study Of Vertical Skeletal Changes After Extraction And Non-Extraction Fixed Orthodontic Treatment Of Class I Malocclusion In North Indian Population

Dr. Suraj Shidurkar, Dr. Pooja Sharma, Dr. Atul Singh,
Dr. Omkar Singh Yadav, Dr. Ketki Dalvi, Dr. Banashree Saha[6]
(Department Of Orthodontics And Dentofacial Orthopaedics, K. D. Dental College And Hospital Mathura, India)
(Department Of Orthodontics And Dentofacial Orthopaedics, K. D. Dental College And Hospital Mathura, India)
(Department Of Orthodontics And Dentofacial Orthopaedics, K. D. Dental College And Hospital Mathura, India)
(Department Of Orthodontics And Dentofacial Orthopaedics, K. D. Dental College And Hospital Mathura, India)
(Department Of Orthodontics And Dentofacial Orthopaedics, K. D. Dental College And Hospital Mathura, India)
(Department Of Orthodontics And Dentofacial Orthopaedics, K. D. Dental College And Hospital Mathura, India)

Abstract:
Background: *Orthodontic treatments frequently involve tooth extractions to address crowding and protrusion, but the effects of these extractions on vertical skeletal changes are still debated. Research has extensively covered aspects like soft tissue response and smile aesthetics, yet there is no consensus on their impact on vertical dimensions. This issue is particularly pertinent for hyperdivergent individuals, who make up about 22% of orthodontic patients. A proposed technique for such cases includes counterclockwise rotation of the lower jaw and advancement of posterior teeth to manage open bites or excessive vertical facial height. This study aims to compare vertical skeletal changes in Class I malocclusion patients undergoing extraction versus non-extraction fixed orthodontic treatments.*
Material and Methods: *We analysed pre- and post-treatment lateral cephalometric radiographs from 60 Class I crowding patients, evenly split into extraction and non-extraction groups. Eight vertical skeletal parameters were assessed and compared statistically between the two groups. Superimposition analysis of radiograph tracings was used to explore vertical changes related to molar mesialization, particularly in the extraction group.*
Results: *The extraction group demonstrated significant reductions in vertical skeletal dimensions compared to the non-extraction group. Measurements including FMA, SN-GoGn, Y-axis, SN-PP, and PP-MP showed significant differences, with reductions in the extraction group (P = 0.001). Procrustes superimposition indicated effective molar mesialization in the extraction group, which was not observed in the non-extraction group.*
Conclusion: *Extraction of first premolars in fixed orthodontic treatment leads to a notable decrease in vertical skeletal dimensions, in contrast to the slight increase seen with non-extraction treatments. This reduction is largely due to molar mesialization, which enhances vertical skeletal dimensions and treatment stability in Class I crowding cases.*
Keyword*: Orthodontics; Tooth Extraction; Vertical Skeletal Changes; Molar Mesialization; Class I Malocclusion; Cephalometric Analysis; Hyperdivergent Individuals; Frankfort-Mandibular Plane Angle; Sella-Nasion; Palatal Plane.*

Date of Submission: 02-10-2024 Date of Acceptance: 12-10-2024

I. Introduction

The thought of teeth extraction at the side of orthodontic remedy isn't always a brand-new concept. Therapeutic extractions were previously conducted to create space before fixed appliance orthodontic treatment. Orthodontic extractions may involve the removal of one or more teeth as a requisite of the treatment plan, incorporating serial extractions which are performed as an interceptive procedure during the mixed dentition

stage. Edward Angle proposed that humans were capable of having 32 teeth in normal occlusion and believed that orthodontic treatment for all patients should involve expanding the dental arches. Calvin Case had argued that arches could always be expanded to align teeth. However, he asserted that for many patients, neither esthetics nor long-term stability would be satisfactory through expansion alone. Henceforth, Calvin Case encouraged for the extraction of certain teeth to gain space as a part of orthodontic remedy in a few cases. [1]

Each case should be assessed based on its merits and requirements, rather than extremes. A more sensible approach is warranted. Generally, extractions may be needed during fixed orthodontic treatment to manage excess arch length compared to tooth material, to correct sagittal inter-arch relationships, and to address abnormal tooth size and form or skeletal jaw mal-relationships. An ongoing discussion in contemporary treatment planning involves dental extractions for orthodontic purposes. Many writers have described the association that exists between changes in the profiles of hard and soft tissues, orthodontic therapy, and growth. In spite of the fact that surveys on how an entire part of the delicate tissues respond to shifts interior the positions of the tooth and alveolar framework change, most people believe that orthodontic cures can too moreover influence the delicate tissue profile. Combined with maintaining the vertical dimension during orthodontic treatment, this can add another significant difference. Some have promoted that alterations in vertical dimension during development may also impact the front-to-back positioning of the lower jaw and the formation of the permanent bite. [1,2,3]

Tooth extractions are commonly used in orthodontics primarily to correct crowding and reduce protruded teeth and surrounding bone. For many years, extracting teeth located towards the back of the mouth has been advised, especially for patients with longer faces, to control the vertical measurement. There is controversy within the orthodontic literature concerning the outcome of extraction as well as non-extraction remedy at the mandible`s posterior rotation. Within the idea that mesialisation of the molars may to allow front turn of the jaw, many orthodontists recommend removal of first premolars in patients with a significantly large anterior face and submerged mandible, indeed in the event that dental and skeletal inconsistencies are considered to be negligible. It has been embraced that doing absent with eternal tooth can precisely an open chew or lower the vertical estimate of the confront with the help of pivoting the diminished jaw counter-clockwise, through ahead movement of the raise tooth with the help of utilizing developing a "wedge-like" impact. In any case, diverse investigate has said no principal impacts of extraction cure on facial vertical measurements. [1,4]

Control of the vertical estimation at a few points in orthodontic treatment gives requesting circumstances whereas related to diverse treatment objectives. A few ponders have demonstrated that alterations in vertical estimation at a few points of increment may moreover affect the anteroposterior work of the mandible and the change of an eternal impediment. Whereas effects of removal of first premolar treatment or treatment without removal of first premolar, has been altogether examined concerning delicate tissue reaction, grin esthetics, solidness, and diverse parameters, the writing is insufficient on the effect of extractions at the vertical estimation. As holding the correct vertical estimation at a few points of orthodontic treatment is troublesome, in any case, open chomp appearances can result from different skeletal, dental, and utilitarian components such as an expanded mandibular plane point or gonial point, changed front or back facial statures, powerless muscles of the mouth and face, the lip seal is absent and the tongue is forward or tucked in. [1] Various treatment strategies and extraction models have been proposed to address orthodontic treatment discrepancies in hyperdivergent patients. This quiet bunch speaks to a noteworthy rate (22%) of orthodontic patients treated around the world. Orthodontists regularly extricate teeth in patients with expanded front facial tallness. Therefore, the choice between remedy with first bicuspid extraction as well as remedy without extraction of the first bicuspid in the vertical dimension is a common consideration in orthodontic appliances. In any case, conflicting discoveries in past ponders block evidence-based decision-making, driving orthodontists to embrace broadly unique methodologies for patients. Per the wedge theory, extricating four premolars or molars and protracting the back teeth comes about in a counterclockwise revolution of the mandible, in this manner keeping up or expanding the overbite. Whereas well known, this theory lacks an prove base concurring to important investigate. Conflicting reports within the writing fall flat to reach an agreement on whether extractions authoritatively affect the vertical measurement. [1]

In summary, this study aims to compare the vertical skeletal changes resulting from extraction versus non-extraction fixed orthodontic treatments for Angle's Class I crowding malocclusion within a North Indian population. Additionally, the study seeks to explore the correlation between vertical skeletal alterations and molar mesialization specifically in cases involving the extraction of first premolars.

II. Material And Methods

This retrospective investigation took place at the Department of Orthodontics and Dentofacial Orthopaedics within the premises of Kanti Devi Dental College and Hospital, located in Mathura, Uttar Pradesh. Pre-treatment and post-treatment radiographs of 60 Angle's Class I malocclusion patients (30 extraction and 30 non-extraction) as a sample for the study from departments record room.

Study Design: Retrospective in-vitro scientific observational study

Study Location: This study was done in Department of Orthodontics and Dentofacial Orthopaedics, at K.D. Dental College and Hospital, Mathura, Uttar Pradesh.

Study Duration: March 2022 to March 2023.

Sample size: Convenience Judgmental sort of sampling changed into used on this study. Pre- and post-remedy lateral cephalogram radiographs of 60 sufferers have been taken from the report room of the Department of Orthodontics and Dentofacial Orthopaedics. Among those 30 sufferers` facts whose remedy changed into finished through extraction constant orthodontic remedy have been organized withinside the extraction organization and 30 sufferers' facts whose remedy changed into finished through non-extraction constant orthodontic remedy have been organized withinside the non-extraction organization.

Sample size calculation: Sample length calculation become completed through manner of method of the use of G Power Version 3.1.9.6 Programme written through manner of method of Franz Faul University Kielnwhich includes the following formula. Based at the 90% power of the study, five percentage kind I error, and impact length of 0.76 the pattern length got here out to be 60 i.e. 30 in every group.

Subjects & selection method: This changed into an in-vitro scientific observational retrospective sort of study wherein of vertical skeletal measurement adjustments in Groups were divided into those undergoing extraction and those not undergoing extraction had been in comparison radiographically. During this study, molar mesialization examination was also conducted within the extraction group, employing lateral cephalogram superimposition. Cephalometric analysis was performed on both pre- and post-treatment lateral cephalogram radiographs. All data for this study was gathered through clinical measurements and organized into a Microsoft Excel spreadsheet. The feasibility of the study was determined by all of the materials used in this study were easily available and were feasible to collect from the record room of the department. The parameters of the study where duration of the study was one year which was also feasible.

Inclusion criteria:

1. North Indian population (both males and females).
2. 18-35 years age group.
3. Before treatment and after treatment lateral cephalometric radiographs in the natural position of the head of adequate diagnostic quality.
4. Full supplement of teeth (apart from wisdom teeth) and borderline sufferers of Angle`s Class I crowding malocclusion.
5. All patients received treatment using PAE appliances in both upper and lower dental arches, without employing any additional external devices or temporary anchorage methods.
6. Extraction choice need to be completely primarily based totally on orthodontic motives and now no longer at the presence of deterioration or periodontal status.

Exclusion criteria:

1. Cases of Angle's Class II and Class III Malocclusion.
2. Cases involving Angle's Class I malocclusion with bimaxillary protrusion.
3. Patient with missing teeth.
4. Previous history of receiving orthodontic treatment and orthognathic surgery.
5. Patients with previous records of cleft palate, dentofacial deformities or syndromes, craniofacial syndromes, and traumatic injuries affecting facial structures.
6. Patients with extensively decayed teeth.
7. Genetic or evolutionary background, systemic diseases, hormonal imbalances, trauma, endodontic treatment of maxillary incisors, previous orthodontic treatments or crown fractures or dressing of the upper skins.

Procedure methodology

The research took place at Kanti Devi Dental College and Hospital in Mathura, Uttar Pradesh. It was conducted within the Department of Orthodontics and Dentofacial Orthopaedics, utilizing lateral cephalogram radiographs retrieved from the department's record room. Ethical clearance was obtained from the IEC committee. Radiographs were randomly collected from treatment-reported patients and radiographs were evaluated based on their linear measurements with the implementation of a correction factor to eliminate any radiographic error. The armamentarium used to conduct this study included pre-treatment and post-treatment lateral cephalograms, Garware transparent tracing paper (acetate sheet), sticky tape, a 0.5mm lead pencil, an eraser, and a geometry box containing a ruler, compass, protractor, divider, and set-squares. Tracings of these radiographs were performed

on transparent cephalometric tracing paper (acetate sheet) using a pencil. Xerox copies were made from these tracings cephalometric analysis was performed using the parameters listed below. These cephalograms were also used for superimposition analysis. All the obtained data were tabularised and statistical analysis was performed.

Cephalometric Parameters: Six angular measurements were measured with a protractor from six described angles in degree:

a) FMA (Frankfurt-Mandibular Angle)
b) The angle between the S-N plane and the Go-Gn plane (Sella-Nasion to Gonion-Gnathion).
c) The Y-axis is determined by the angle formed when the horizontal line drawn from the Sella point to the Gnathion point intersects with the FH plane.
d) The gonial angle is defined as the angle formed between the line connecting Menton and Gonion and the line connecting Gonion and Articulare at the point Gonion.
e) The angle is created where the Sella-Nasion plane intersects with the Palatal plane.
f) The angle is created where the palatal plane intersects with the mandibular plane.

Two other variables are ratios which were as follows:

a) A method to assess midfacial height by calculating the proportion between the distance from Nasion (N) to ANS and the distance from Nasion (N) to Menton (Me).
b) A method to assess lower anterior facial height by determining the ratio between the distance from ANS to Menton (Me) and the distance from Nasion (N) to Menton (Me).

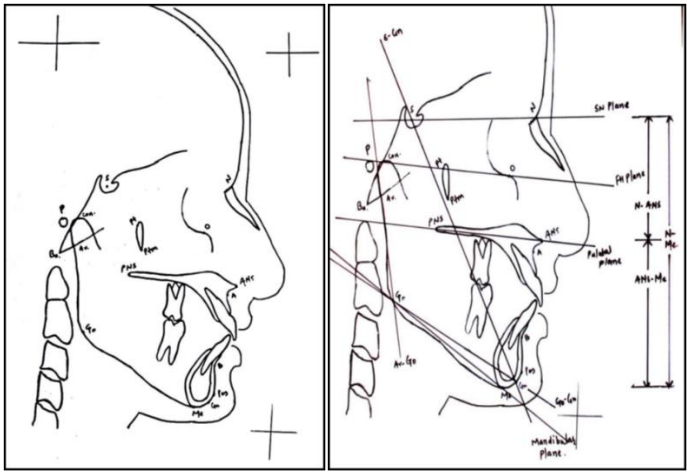


Figure No. 1 - Tracing of Lateral Cephalogram
Figure No. 2 - Parameters that were used in this study

Statistical analysis

The findings obtained from this research were inputted into Microsoft Excel spreadsheet and analyzed utilizing Statistical Package for Social Sciences software version 23.0. Summary statistics encompassing mean, standard deviation, frequency, and percentage were calculated. The significance threshold for this study was established at 5%. Between-group distinctions were assessed via independent t-tests, while within-group variances were examined through paired t-tests. The Shapiro-Wilk test was employed to assess data distribution, and the Levene test was utilized to scrutinize the uniformity of variables.

III. Result

Inter-Group Comparison of Differences Before and After Treatment Value Among Groups:

The mean value of FMA pretreatment in the extraction group was 29.30 ± 4.49 and after treatment the value was 25.55 ± 4.24. In the group without extraction, the average value of FMA before treatment was 24.71 ± 6.40 and after treatment the value was 26.18 ± 6.45. The mean change in pre-post values was statistically more significant in the extraction group compared to the non-extraction group. FMA parameter was decreased for extraction cases and increased for non-extraction cases.

In the Extraction group, the mean pre-treatment value of SN-GoGn was 31.65 ± 5.09 and after treatment the mean value was 30.63 ± 4.66. In the group without extraction, the mean pre-treatment value of SN-GoGn was 28.25 ± 7.13 and after treatment the mean value was 29.75 ± 7.14. The mean change in pre- and post-extraction values in the extraction group was more statistically significant than that in the non-extraction group. Sn-GoGn was decreased in extracted cases and increased in non-extracted cases.

In the Extraction group, the average value before treatment for the Y axis was 60.93 ± 4.03 and after treatment the value was 59.90 ± 3.77. In the group without extraction, the average pretreatment value for the Y axis was 58.21 ± 4.23 and after treatment the value was 59.05 ± 4.16. The mean change before and after extraction in the non-extraction group was statistically more significant than that in the extraction group. In extraction cases, the Y-axis decreased, while in non-extraction cases, it increased.

In the Extractions group, the mean value before treatment of the Gonial angle was 124.45 ± 5.61 and after treatment the mean value was 125.03 ± 6.65. In the group without extraction, the mean pretreatment value for the Gonial angle was 122.90 ± 6.21 and after treatment the mean value was 122.68 ± 5.78. The mean change in pre and post values was not statistically significant, but the gonial angle decreased in non-extraction cases while it increased in extraction cases.

In the Premolars Extraction group, the mean value of SN-PP before treatment was 7.98 ± 4.44 and after treatment was 8.60 ± 4.68. In the group without premolars extraction, the mean pre-treatment value of the SN toward the palatal plane was 8.30 ± 3.89 and after treatment this value was 7.75 ± 3.70. The mean change in pre-post values was statistically more significant in the extraction group than in the non-extraction group.

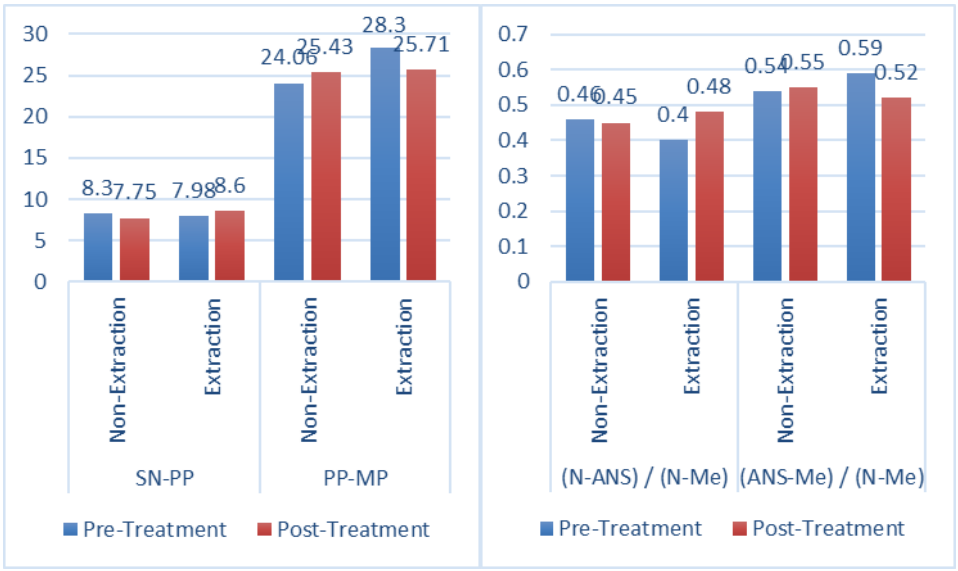
In the Extraction group, the average value before treatment from the palatal plane to the mandibular plane was 28.30 ± 3.55 and after treatment was 25.71 ± 2.93. In the group without extraction, the average value before treatment was from the palatal plane to the mandibular plane. solution is 24.06 ± 7.37 and after treatment the value is 25.43 ± 7.75. The mean change in pre- and post-extraction values in the non-extraction group was more statistically significant than that in the extraction group.

In the Extraction group, the mean pretreatment value of (N-ANS)/(N-Me) was 0.40 ± 0.03 and after treatment values were 0.48 ± 0.01. In the without extraction group, the mean pre-treatment value of (N-ANS)/(N-Me) was 0.46 ± 0.02 and after treatment these values were 0.45 ± 0.02 . The mean change in pre- and post-extraction values in the non-extraction group was more statistically significant than that in the extraction group.

In the Extraction group, the mean pretreatment value of (ANS-Me)/(N-Me) was 0.59 ± 0.03 and after treatment values were 0.52 ± 0.01. In the non-extraction group, the mean pretreatment value of (ANS-Me)/(N-Me) was 0.54 ± 0.02 and after treatment these values were 0.55 ± 0.02 . The mean change in pre- and post-extraction values in the non-extraction group was more statistically significant than that in the extraction group.	GP	Pre-Treatment	Post Treatment	Mean Difference	P value	95% CI
FMA	Non-Extraction	24.71±6.40	26.18±6.45	-1.46±2.93	0.001 (Sig)	-6.40316--4.03017
	Extraction	29.30±4.49	25.55±4.24	3.75±1.30		
SN-GoGn	Non-Extraction	28.25±7.13	29.75±7.14	-1.50±2.13	0.001 (Sig)	-3.63850----1.39484
	Extraction	31.65±5.09	30.63±4.66	1.01±2.20		
Y-Axis	Non-Extraction	58.21±4.23	59.05±4.16	-0.83±2.17	0.001 (Sig)	-2.74680---.98654
	Extraction	60.93±4.03	59.90±3.77	1.03±0.99		
Gonial Angle	Non-Extraction	122.90±6.21	122.68±5.78	0.21±1.73	0.123 (Non-Sig)	-1.36869-.16869
	Extraction	124.45±5.61	125.03±6.65	0.81±1.18		
SN to Palatal Plane	Non-Extraction	8.30±3.89	7.75±3.70	0.55±1.13	0.001 (Sig)	0.45325---1.88009
	Extraction	7.98±4.44	8.60±4.68	-0.62±1.58		
Palatal Plane to mandibular plane	Non-Extraction	24.06±7.37	25.43±7.75	-1.37±2.44	0.001 (Sig)	-5.13572----2.76428
	Extraction	28.30±3.55	25.71±2.93	2.58±2.12		
(N-ANS) / (N-Me)	Non-Extraction	0.46±0.02	0.45±0.02	0.00±0.01	0.001 (Sig)	0.07924-.10742
	Extraction	0.40±0.03	0.48±0.01	-0.08±0.03		
(ANS-Me) / (N-Me)	Non-Extraction	0.54±0.02	0.55±0.02	-0.00±0.01	0.001 (Sig)	-0.10614----.07786
	Extraction	0.59±0.03	0.52±0.01	0.08±0.03		

Table No.1 - Independent t-test used for intergroup comparison and P value more than 0.05 is non-significant.

Graph No.1- Intergroup Comparison Of FMA, SN-Gogn,Y-Axis And Gonial Angle



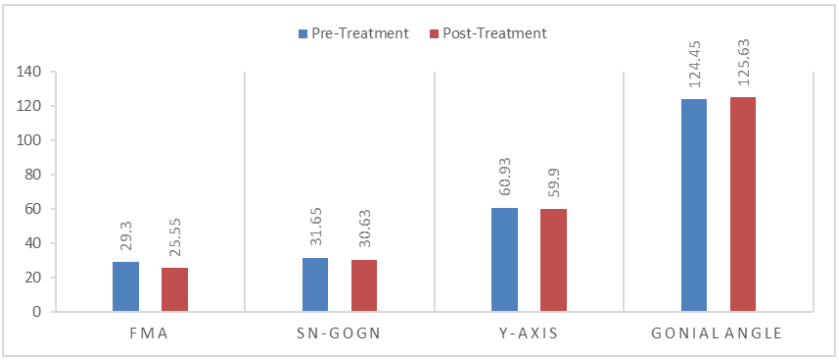
Graph No.2- Intergroup Comparison Of SN-PP And PP-MP
Graph No.3- Intergroup Comparison Of (N-ANS) / (N-Me) / (N-Me)

Comparison within the extraction group: difference in value before and after processing in different cases:

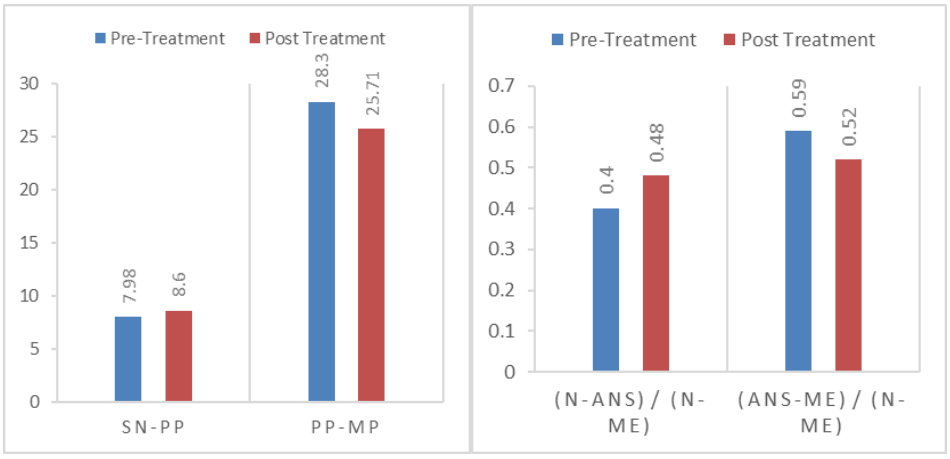
The mean pre-treatment value of FMA was 29.30 ± 4.49 and for post-treatment this value was 25.55 ± 4.24. FMA values decreased significantly after orthodontic treatment. The mean pre-treatment value of SN-GoGn was 31.65 ± 5.09 and after treatment the value was 30.63 ± 4.66. SN-GoGn values decreased significantly after orthodontic treatment. The mean pre-treatment value of the Y axis is 60.93 ± 4.03 and for post-treatment the value is 59.90 ± 3.77. There was a significant decrease in Y-axis values after fixed orthodontic treatment. The average value of the Gonial angle before treatment was 124.45 ± 5.61 and after treatment is 125.03±6.65. The Gonial angle value decreased significantly before and after treatment. The mean pre-treatment value of SN up to the palatal plane was 7.98 ± 4.44 and for post-treatment the value was 8.60 ± 4.68. There was a significant increase in SN-PP Angle after orthodontic treatment. The average value before treatment of the PP-MP angle was 28.30 ± 3.55 and after treatment this value is 25.71 ± 2.93. There was a significant decrease in values of PP-MP angle after orthodontic treatment. The mean pre-treatment value of (N-ANS)/(N-Me) was 0.40 ± 0.03 and after treatment the value was 0.48 ± 0.01. There was a significant increase in (N-ANS)/(N-Me) values after orthodontic treatment. The mean pre-treatment value of (ANS-Me)/(N-Me) was 0.59 ± 0.03 and post-treatment values were 0.52 ± 0.01. There was a significant change in (ANS-Me)/(N-Me) after orthodontic treatment.

	Pre-Treatment	Post Treatment	Mean Difference	P value	95% CI (Lower-Upper Bound)
FMA	29.30±4.49	25.55±4.24	3.75±1.30	0.001 (Sig)	3.26 to4.23
SN-GoGn	31.65±5.09	30.63±4.66	1.01±2.20	0.017 (Sig)	0.19 to 1.84
Y-Axis	60.93±4.03	59.90±3.77	1.03±0.99	0.001 (Sig)	0.66 to 1.40
Gonial Angle	124.45±5.61	125.03±6.65	-0.58±3.54	0.001 (Sig)	0.37 to 1.25
SN to Palatal Plane	7.98±4.44	8.60±4.68	-0.62±1.58	0.042 (Sig)	-1.20 to -0.02
Palatal Plane to mandibular plane	28.30±3.55	25.71±2.93	2.58±2.12	0.001 (Sig)	1.78 to 3.37
(N-ANS) / (N-Me)	0.40±0.03	0.48±0.01	-0.08±0.03	0.001 (Sig)	-0.09 to -0.07
(ANS-Me) / (N-Me)	0.59±0.03	0.52±0.01	0.08±0.03	0.001 (Sig)	0.06 to 0.09

Table No. 2- Paired t-test used for intragroup comparison and a p-value of more than 0.05 is non-significant.



Graph No.4- Intragroup comparison of FMA, SN-GoGn, Y-axis and Gonial angle for the extraction group



Graph No.5- Intragroup comparison of SN-PP and PP-MP for the extraction group.
Graph No.6- Intragroup comparison of (N-ANS) / (N-Me) and (ANS-Me) / (N-Me) for the extraction group.

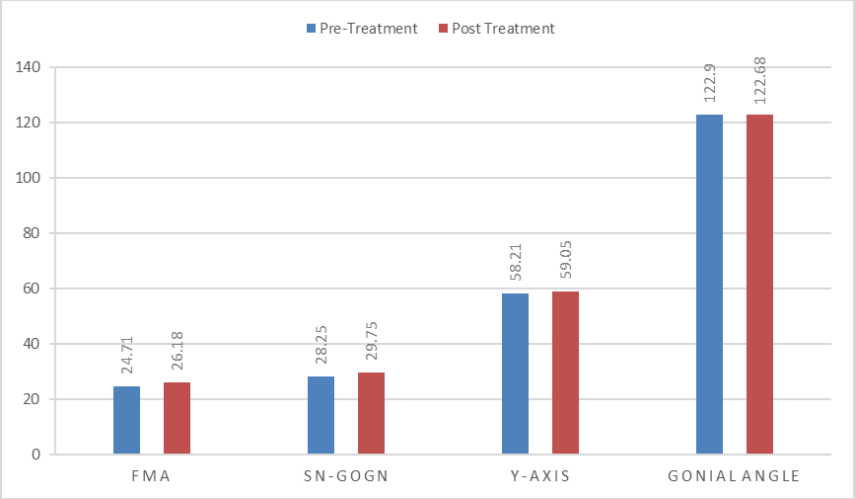
Comparision within the non-extraction group: difference in value before and after processing in different cases

The mean pre-treatment value of FMA was 24.71 ± 6.40 and for post-treatment this value was 26.18 ± 6.45. FMA values increased significantly before and after treatment. The average value before treatment of SN-GoGn was 28.25 ± 7.12 and after treatment was 29.75 ± 7.14. There was a significant increase in SN-GoGn values before and after treatment. The average value before treatment for the Y axis was 58.21 ± 4.23 and after treatment the value was 59.05 ± 4.16. There was a significant increase in Y-axis values before and after treatment. The average value of the gonial angle before treatment is 122.90 ± 6.21 and after treatment is 122.68 ± 5.78. There was an insignificant change in the gonial angle value before and after treatment. The mean pre-treatment value of the SN-PP angle was 8.30 ± 3.89 and after treatment this value was 7.75 ± 3.70. There was a significant decrease in SN-PP angle value after orthodontic treatment. The average value before treatment of the PP-MP angle is 24.06 ± 7.37 and after treatment this value is 25.43 ± 7.75. There was a significant increase in the value of the PP-MP

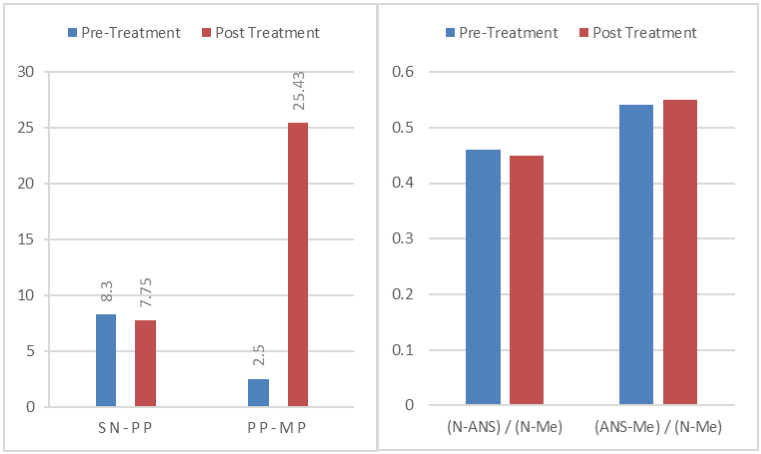
angle before and after treatment. The average pre-treatment value of (N-ANS)/(N-Me) was 0.46 ± 0.02 and after treatment this value was 0.45 ± 0.02. There was a significant change in (N-ANS)/(N-Me) values before and after treatment. The mean pre-treatment value of (ANS-Me)/(N-Me) was 0.54 ± 0.02 and after treatment the value was 0.55 ± 0.02. There was a significant change in (ANS-Me)/(N-Me) values before and after treatment.

	Pre-Treatment	Post Treatment	Mean Difference	P value	95% CI (Lower-Upper Bound)
FMA	24.71±6.40	26.18±6.45	-1.46±2.93	0.001 (Sig)	-2.56 to -0.36
SN-GoGn	28.25±7.13	29.75±7.14	-1.50±2.13	0.001 (Sig)	-2.29 to -0.70
Y-Axis	58.21±4.23	59.05±4.16	-0.83±2.17	0.044 (Sig)	-1.84 to -0.02
Gonial Angle	122.90±6.21	122.68±5.78	0.21±1.73	0.442 (Non-Sig)	-0.42 to 0.86
SN to Palatal Plane	8.30±3.89	7.75±3.70	0.55±1.13	0.013 (Sig)	0.12 to 0.97
Palatal Plane to mandibular plane	24.06±7.37	25.43±7.75	-1.37±2.44	0.005 (Sig)	-2.28 to -0.45
(N-ANS) / (N-Me)	0.46±0.02	0.45±0.02	0.00±0.01	0.002 (Sig)	0.003 to 0.014
(ANS-Me) / (N-Me)	0.54±0.02	0.55±0.02	-0.00±0.01	0.002 (Sig)	-0.014 to 0.003

Table No. 3- Paired t-test used for intragroup comparison and P value more than 0.05 is non-significant and p-value less than 0.05 is significant



Graph No.7- Intragroup comparison of FMA, SN-GoGn, Y-axis and Gonial angle for the non-extraction group.



Graph No.8- Intragroup Comparison Of Sn-Pp
Graph No.9- Intragroup Comparison Of (N-Ans) / (N-Me) And (Ans-Me) / (N-Me)

IV. Discussion

The treatment (extraction or not) of each orthodontic patient is determined by specific diagnostic criteria. Orthodontic treatment involves changes to the skeleton, teeth and soft tissues after treatment. Most orthodontic corrections involving dental and soft tissues are of clinical interest. However, changes in bone characteristics are assessed using cephalometry.

Vertical skeletal changes after fixed orthodontic treatment are a highly controversial topic. Thus, certain studies support the contention that molar extraction reduces the vertical dimensions of the skeleton in hyperdivergent patients and provides better control of vertical dimensions compared to non-extraction strategies. Control of vertical dimensions is always an important issue in orthodontic treatment. Vertical dimensions are important elements of the human face that influence facial contours and often play an important role in treatment planning to determine which method to use for fixed orthodontic treatment. For example, in a hyperdivergent patient, the orthodontist is concerned that the vertical dimensions of the face are reduced or at least unaffected, and therefore certain Rely on strategy. Examples: tooth extraction, headgear pulling up, etc.

Orthodontists typically avoid extracting teeth in hypodivergent patients who have low anterior facial height and moderate to severe hypodivergent cases. This is because the height of the lower frontal face is reduced and the low-diversity and convergent chin-base relationship becomes severe, which may result in a worsening of the patient's facial contour.

Therefore, considering the vertical dimension, the decision to extract a tooth is an important issue in treatment planning and has received great attention in the literature. Orthodontists typically remove first premolars with angle class II, division 1, low divergence malocclusions where camouflage treatment is mandatory. However, the decision to extract the first premolar in an angle class I case usually depends on the severity of crowding, rotated teeth, proclination of the incisors, deep occlusion, and space management. The orthodontist will decide whether to perform a first premolar extraction depending on the vertical dimensions of the skeleton, space management, and facial contours. In the case of borderline angular Class I malocclusions, when space management cannot be achieved with various non-extraction techniques, the orthodontist extracts the first premolars in both arches and extracts the molars in both arches. Decide to allow centralization of the tooth (if the extraction space is not fully utilized). Try using different methods to close the arch to close the extraction space and achieve a good facial contour. In such cases, vertical skeletal changes are usually affected.

Several studies have been conducted to date to determine the similarity of changes. Various authors have attempted different methods to assess vertical skeletal and soft tissue changes after fixed orthodontic treatment. This study also used non-extraction cases as a control group to compare with extraction cases and used cephalometric parameters to measure vertical changes in borderline cases of angle class I malocclusion after fixed orthodontic treatment.

In this study, all lateral cephalogram radiographs were taken in the department's records room. Radiographs were randomly collected by implementing inclusion and exclusion criteria, and radiographs were evaluated based on linear measurements implementing a correction factor to exclude magnification errors. These X-rays of his were traced onto tracing paper and Xerox copies were made. Cephalometric analysis was performed on Xerox copies using the parameters used in this study. All data obtained were tabulated in a Microsoft Excel spreadsheet, and statistical analysis was performed using SPSS statistical software version 23.0.

In this study, patients who had their teeth extracted showed a decrease in vertical bone density compared to patients who did not have their teeth extracted, at a statistical significance level of approximately 5%. ($P = 0.01$). Despite statistical significance, the small differences between groups make it debatable whether the results are statistically significant. However, of all variables at the end of treatment, only one of their angles, the gonial angle, showed a significant difference between the two groups and was lower in the withdrawal group than in the zero-withdrawal group. Other variables showed that the loss of anterior face height decreased in the tooth extraction group while it increased in the tooth extraction group.

Our findings showed that patients who underwent tooth extraction treatment had lower vertical skeletal dimensions than the non-extracted group, and the difference almost reached the conventional statistical significance level of 5% ($P = 0.04$). Despite being statistically significant and the difference between groups small, it's miles questionable whether or not the outcomes are clinically significant.

In the tooth extraction group, FMA, SN-GoGn, and Y-axis parameters decreased in the tooth extraction cases, but increased in the non-extraction cases, indicating that the vertical skeletal dimension decreased in the tooth extraction and non-extraction groups. it was done. The number of cases has increased slightly. Extract group. Consistent with our findings, Aras [5] investigated open bite cases and reported a significant decrease in the SN to Gn angle after extraction of four second premolars, and also we also reported a non-significant decrease after molar extraction. 4 first premolars. In support of our results, in the study of Meral et al. [6] no significant differences between groups were observed after treatment of the SN-to-go-me angle. Additionally, Kumari et al. [7] found that there was no significant difference in the mean change in the Y-axis between extracted and non-extracted cases. Additionally, the post-treatment differences between groups in his Y axis of Luppanapornlarp et

al. [8] This study may be due to the morphologically different pretreatment groups rather than the treatment itself. Regarding the FMA aspect, our results are consistent with previous studies that reported non-significant changes between the two treatment groups. Cocaderelli et al. [9] also reported a slightly higher but non-significant increase in FMA and SN-to-Go-Gn angle in a group of non-extracted patients. Regarding the slight closing of the palatal plane compared to the angle of the mandibular plane, our results are consistent with those of Kirschneck et al. agree [10].

In the current study, the gonial angle decreased in both groups, but it was not statistically significant. Regarding our results, Kirschneck et al. [10] observed a decrease in the group of patients undergoing enucleation, albeit with a larger value (- 2.5, SD 4.5). Most authors did not assess changes in gonial angle, while others could not confirm similar results. Nevertheless, the gonial angle is an important element of the craniofacial complex, providing information about the symmetry and vertical dimensions of the facial skeleton. Angular angle changes can have two different causes. Either the jaw rotates and the position of the joint's cephalometric landmarks changes, or there is an actual morphological change in the angle between the ramus and the base of the mandible. A slight deviation in joint identification can affect the gonial angle due to the curvature of the mandibular condyle.

In the nonextraction group, angular measurements assessing vertical skeletal changes related to the alignment of the mandible with respect to the anterior cranial base showed a nonsignificant increase, thus consistent with the findings of other authors such as Kirschneck et al. [10], Sivakumar et al. [11] and Cocaderelli [9]. However, the statistical significance of the overall within-group difference indicates that the treatment significantly affected and increased vertical skeletal dimensions in patients without tooth extraction. In contrast to our study and other authors, Meral et al. [12] showed that postoperatively, the angle of the palatal plane to the MP (mean difference - 1.5, $P < 0.05$) and the angle from the SN to the gomi (mean difference - 1.5, $P < 0, 01$) decreased significantly Discovered Non-extraction therapy.

As a result, the anterior facial height ratio (N-ANS/N-Me) increases in the tooth extraction group, while it decreases in the non-tooth extraction group, resulting in a lower anterior facial height ratio (ANS-Me/N-Me). There was found. Me) decreased in the extraction group, but increased in the non-extraction group. Therefore, our results differed from those reported by Kumari et al. [7], who observed a significant increase (mean difference 1.1, $P = 0.005$). Sivakumar [11], who also found a small but non-significant increase of 0.08 ($P = 0.81$) after treatment without tooth extraction.

To examine vertical changes and mesialization of the molars, a Procrustes overlay was performed on the lateral cephalograms of patients whose parameters were close to the mean values. Procrustes' overlay technique aims to treat all landmarks equally, so no points were arbitrarily weighted more than others. Additionally, each superimposed track had a defined size. As a result, we were able to identify pure shape changes that are not affected by size. Procrustes overlay revealed a successful mesialization of the molars in the extraction group in both dental arches and a decrease in the vertical dimension of the skeleton. However, no centralization of molars was observed in the non-extracted group. In support of our results, Beit et al. [2] observed that in a cephalometric overlay, molar mesialization was observed in the tooth extraction group compared to the nonextraction group. In contrast to our results, Garlington et al. [13] observed forward rotation of the mandible on cephalometric overlay in 17 of 23 cases treated with 4-second premolar extraction.

According to the "wedge effect" theory, the lower jaw can be closed, allowing vertical control when extracting molar teeth. Due to the positive mesial drift pattern, Joondeph and Riedel [14] recommended serial extraction of the second premolars to control overbite. To close an open occlusion before inserting a retainer, Pearson [15] recommended that for patients with high diaphragm he remove four first premolars and use a vertical traction chin cup. Recommended. He proposed several theories to explain possible reasons for the observed occlusal closure. One of these, he said, was to cause the molars to shift mesially "out of the wedge," allowing the jaw to rotate forward and "hinge closed."

In this study, we considered that the cause of vertical changes in the skeleton after fixed orthodontic treatment was the displacement of molar teeth due to the dentofacial complex acting as a hinge. In the tooth extraction group, the molars were displaced mesially and vertical skeletal dimensions decreased, similar to the “wedge” hypothesis.

The results of this study conclude that tooth extraction affects the vertical dimensions of the skeleton, as shown in the present study, but questions remain to be elucidated regarding the possibility of returning to the original dimensions. I am. Furthermore, for class I crowding with extraction angle, mesialization of molar teeth was observed, which had a positive effect on vertical skeletal dimensions.

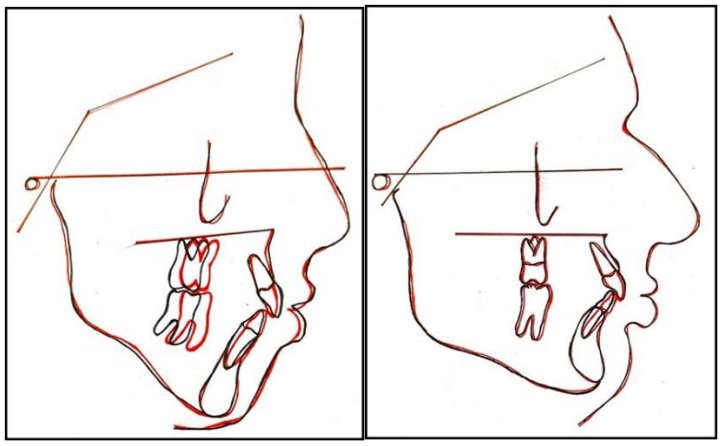


Figure No. 3- Procrustes Superimposition- Extraction case: Black line- Pre-Treatment, Red line- Pre treatment

Figure No. 4- Procrustes Superimposition- Non-Extraction case: Black line- Pre-Treatment, Red line- Pre treatment

V. Conclusion

1. The vertical skeletal dimensions of the sufferers have been stricken by the selection to go through extraction or non-extraction remedy in Angles Class I crowding cases. Compared with non-extracted patients, the extraction sufferers confirmed a discount withinside the vertical skeletal dimensions, indicating a giant usual distinction among the 2 groups. s
2. Non-extraction cases exhibited a slight increase in vertical skeletal dimensions after fixed orthodontic treatment in Angle's Class I crowding cases.
3. The vertical skeletal dimensions were positively impacted by molar mesialisation in extraction Angle's Class I Crowding cases.
4. Skeletal vertical measures were marginally higher in those who did not get extractions and somewhat lower in those who had their four first premolars extracted. However, given the small-scale intergroup discrepancies, the data might not be very therapeutically valuable.

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