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Effects Of Facial Skeletal Asymmetry Correction By Orthognathic Surgery On Body Posture – A Study Report

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Abstract:
Human face consists of bilateral structures which require coordination to have a balanced or a well-defined symmetrical appearance. Any imbalance or disproportions between the homologous parts of the dentofacialcomplex can lead to asymmetry. Asymmetry can be either in skeletal, dental or soft tissue. Skeletal asymmetries can be masked by the soft tissue structures. Hence any discrepancy in the skeletal measurements and facial appearance should be noted. Even in an esthetically attractive normal individual, asymmetry can be found

1. INTRODUCTION

Human face consists of bilateral structures which require coordination to have a balanced or a well-defined symmetrical appearance. Any imbalance or disproportions between the homologous parts of the dentofacialcomplex can lead to asymmetry. Asymmetry can be either in skeletal, dental or soft tissue. Skeletal asymmetries can be masked by the soft tissue structures. Hence any discrepancy in the skeletal measurements and facial appearance should be noted. Even in an esthetically attractive normal individual, asymmetry can be found

Evidence of asymmetry is appreciated when the deviation of skeletal structure is more than 4mm2. Hence minor asymmetries are not noticed by the individuals themselves. According to Severt and Proffit3, 5%, 36% and 74% of asymmetry is evident in the upper, middle and lower third respectively. Greater incidence in the lower third can be accounted for the longer duration of growth for the mandible according to cephalon caudal gradient of growth4. 40% of males and females are known to be affected with mandibular asymmetry, which affects the patient`s esthetics and functional parameters as well.

Facial asymmetry is more often associated with skeletal class II and class III individuals. Bishara5 stated that genetic or congenital malformations including condylar abnormalities like hyper or hypoplasia, fracture, ankylosis or hemifacialmicrosomia, environmental factors like habits and trauma or/and functional deviations can be the etiological factors. He also classified asymmetries as - Dental, skeletal, muscular and functional asymmetry.

Dento-skeletal deformities are treated by orthopedics, orthodontic, orthognathic surgery or combination of these depending on the severity. Correction at early stages often gives unpredictable results. For growing individuals, treatment is planned at early stages and surgical procedures are carried out after growth is ceased. True dental asymmetry calls only

for orthodontic treatment involving asymmetrical extraction sequence and mechanics per se. Mild occlusal deviations can be treated by occlusal adjustments. 4% of the adult population require surgical corrections like mandibular angle reduction, inferior border osteotomy, soft tissue contouring, when the deviation is severe in the sagittal, vertical or transverse dimensions as they are encountered with TMJ disorders. Correct surgical planning is important for the treatment success. Orthodontic camouflage can be done in patients where surgery is of concern, but with compromised treatment results6.

In dento-facial orthopedics, integration of postural consideration is the recent advancement. The erect posture is maintained by a balance between the craniofacial bones, occlusion and myofascial structures. Upper cervical spine act as a mediator between the head and trunk, thereby giving an inter relation between them anatomically and functionally. Afferents from the jaw apparatus converge on trigeminal nuclei with the sensory impulses from cervical spine. Combination of this, play a role in maintaining body posture. In a skeletal class II cases, the head extends forward upon the spinal column compared to class III individuals. In cases of any deviation from the occlusion like cross bite or scissor bite, lateral bending of the cervical spine called scoliosis can manifest. Transverse malocclusions induce asymmetrical growth of the mandible. Early intervention can alter the skeletal deformity7.This case report will elicit the surgical correction of an individual with skeletal facial asymmetry and its effect on cervical and body posture.

2. CASE REPORT

A 23 years adult male reported to the department of orthodontics with chief complaint of forwardly placed lower teeth and shift in the lower jaw. On investigation, there was no familial history or history of trauma according to his concise.Onextraoralexamination, he had a facial asymmetry with mandibular shift to left.

On intraoral examination (Fig 1), class III canine and molar relation was evident on the right side, whereas, Angle`s class- I molar on left side with crossbite in relation to 12, 11, 21, 23, 24 resulting in asymmetric reverse overjet of 3mm. 16, 37 were missing, which were extracted 7 years ago due to gross decay, causing mesial tilt of 17 and 38. Prosthetic bridge was present in relation to 46,47,48. Also, generalized enamel hypoplasia with lower midline shift to left by 5mm and occlusal cant were evident.

Orthopantomogram revealed that there was an increase in height of ramus on right side compared to left with 47 missing, endodontically treated 46, 48 and dental prosthetic bridge in relation to 46,47 and 48. On cephalometric evaluation, he had class- I skeletal base with high mandibular plane angle, proclined upper and lower incisors, reverse overjet and minimal overbite. On PA cephalogram, there was an evident cant of maxilla and mandibular shift to left side by 4.8mm.

Postural examination of the patient was carried out in the dental office, using the Quanpressurometer device (Fig 2) which was designed and patented. Quanpressurometer helps in both static and dynamic assessment of an individual`s body posture. This device

consisted of a force platform with 35 ohms linear strain gauge to measure the foot pressure. Sensors were placed on the force platform at the region of medial calcaneous, hallux and fifth metatarsal region corresponding to both right and left feet, as these areas experience the maximum load of foot pressure. Sensors were assigned as RP1for right medial calcaneous, RP2 for right fifth metatarsal, RP3 for right hallux, similarly LP1, LP2, LP3 for the left feet. The pressure values were displayed on the LCD monitor. A thread was vertically tied to a grid like structure placed on the sides of the force platform, to check for the deviation of structures from the midline. The shoulder tilt and pelvic tilt was observed on the horizontal aspect. On examination, unequal loading was evident between the right and left feet attributing to the irregularity in the patient`s body posture. The loading was higher on the left fifth metatarsal region and hallux region compared to the right, indicating that the patient had more pressure on the left side, revealing an obvious shoulder downward tilt on the left side. Loading was more on the anterior region on both the feet compared to the posterior medial calcaneous region.

3.TREATMENT OBJECTIVES

1) Correction of maxillary canting and lower jaw deviation.
2) Achieve ideal overbite and overjet
3) To achieve good facial profile and esthetics

TREATMENT PLANS

1. SFOA - Surgery first to correct the maxillary canting and facial asymmetry (mandibular deviation) followed by orthodontic approach for reduction of upper and lower anterior proclination
2. Conventional orthognathic surgery: Three phase treatment
    a. Pre-surgical phase to correct the proclination
    b. Surgical phase to correct the asymmetry and canting
    c. Post-surgical phase for settling of occlusion.

Patient opted for second plan as he was in doubt about undergoing surgery as the initial phase.

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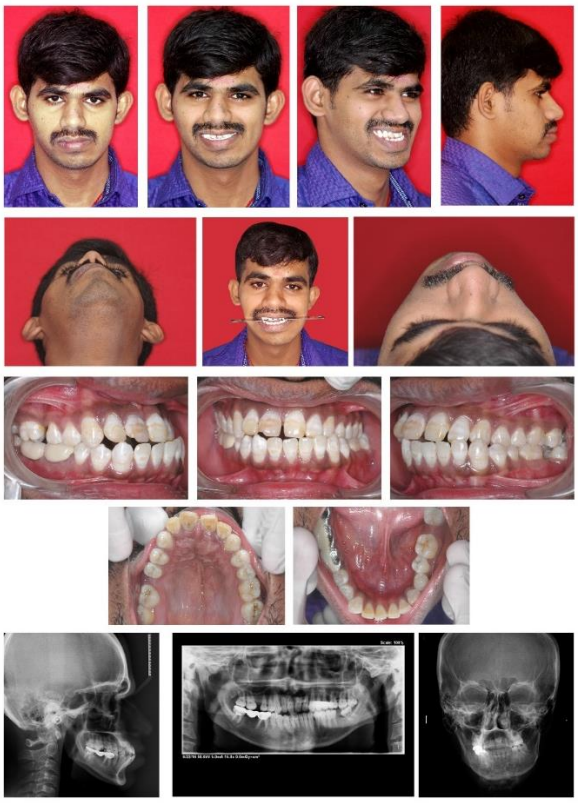

Fig.1. – Pre- treatment records

Fig.2.Quanpressurometer and Pre-treatment Posture Analysis

TREATMENT PROGRESS

In the first phase, therapeutic extraction of all 1st premolars was done to correct the proclination of upper and lower anterior, followed by bonding of pre adjusted edgewise brackets of MBT prescription. Levelling of bracket slots and alignment of teeth was carried out with until 0.019”X0.025” stainless steel arch-wire. Since the mesial tilt of 17 was more, it

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was decided to replace 16. TAD assisted frictional retraction wasdone to achieve group A - maximum anchorage (Fig 3).

Fig.3. Retraction using TADs

Fig. 4. Pre – surgical CT

In the second phase, pre surgicalCT scan was taken (Fig 4) and surgical planning was done using Geoform software (Fig.5). According to classification of surgical treatment planning for facial asymmetries by Reyneke, the patient had Type IVc, which indicated that the discrepancy involved maxilla, mandible and the symphysis with occlusal canting. Hence surgical correction was required in the 3 areas – Maxilla, mandible and genium.[8] Mock surgery was also performed for further cross verification. Face bow transfer was carried out and the cast models were articulated. For the correction of maxillary canting, Le-fort differential impaction was planned – 1mm of impaction on right side and 3mm of dis-impaction on left side with yaw correction of 3º. With respect to the mandible, 4°of yaw correction led to 4.8 mm of BSSO set-back on right side and for a 0.8 mm of advancement on the left side. Also, 2.1 mm of pitch up on right and 6mm of pitch down on left with 4.2 mm of sliding genioplasty. CAD CAM splint was fabricated for the desired occlusion (Fig 6). Fitting of the splint during the surgery was an indicative of successful surgical correction of the jaws as planned. 28 was extracted on table.

Immediately after the surgery was performed, posture was analyzed, which revealed a balanced and uniform loading on both right and left feet. The shoulder and pelvic plane were levelled.

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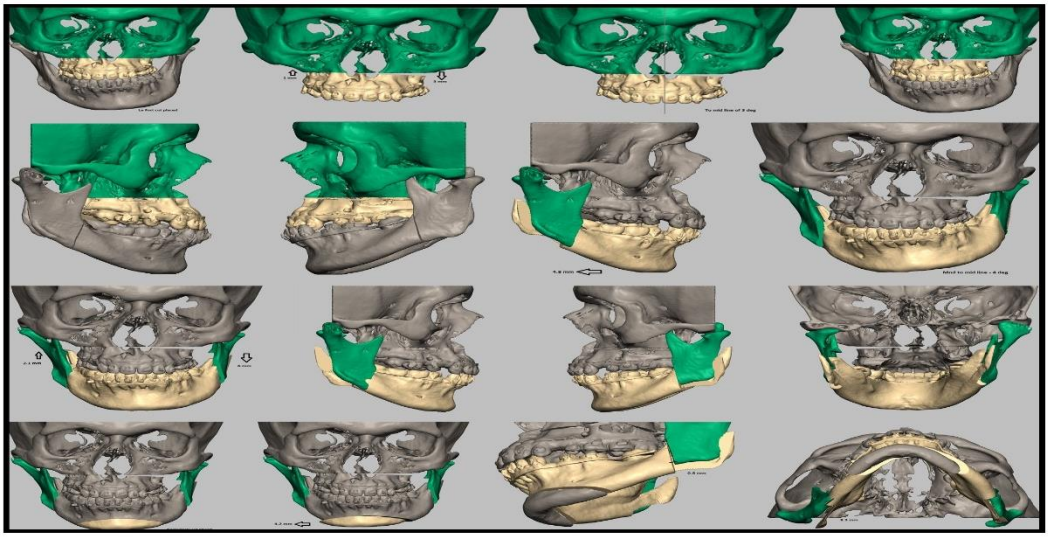

Fig.5. Surgical planning

Fig.6.Facebow transfer, splint and surgery photographs

Fig.7. Post-surgical intra oral photographs

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In the third phase, orthodontic settling and residual space closure was carried out to obtain class- I molar and canine relation on either side (Fig 7).

5. TREATMENT RESULT

Intra-orally, an Angle`s class I molar relation, Class I canine relation was achieved on both sides with an ideal overbite and overjet (Fig 8). Extra-orally, facial symmetry was appreciable (Fig 9). For a better retention, begg`s wrap around retainer for upper arch and lower lingual bonded retainer were given. TADs were removed at the completion of treatment.

Superimposition of cephalometric tracings (Fig 10) before and after treatment showed that the profile and frontal asymmetry were improved with the orthognathic surgery. Differential impaction of the maxilla to correct the occlusal cant correction, has caused the mandible to rotate in the counterclockwise direction, thereby reducing the mandibular plane angle which was evident with the cephalometric readings (Table 1). Pre- and post-surgical CT superimposition and the values reveal an evident correction of the mandibular and facial asymmetry. (Figure 11; Table 2)

The postural assessment at the time of debonding, indicated unequal loading on the right lateral aspect, though the post-surgical analysis dint dictate any. There was no obvious pelvic or shoulder tilt, an evident positive change in the posture due to the change in the occlusal loading as a result of betterment of the occlusal relation and correction of jaw bases surgically (Fig 12). Obvious change in the cranio- cervical angulation was derived at the end of orthodontic and orthognathic surgery, which was evidently seen on comparing the pre and post treatment lateral cephalograms and CTs, indicating a positive effect on the cervical posture.

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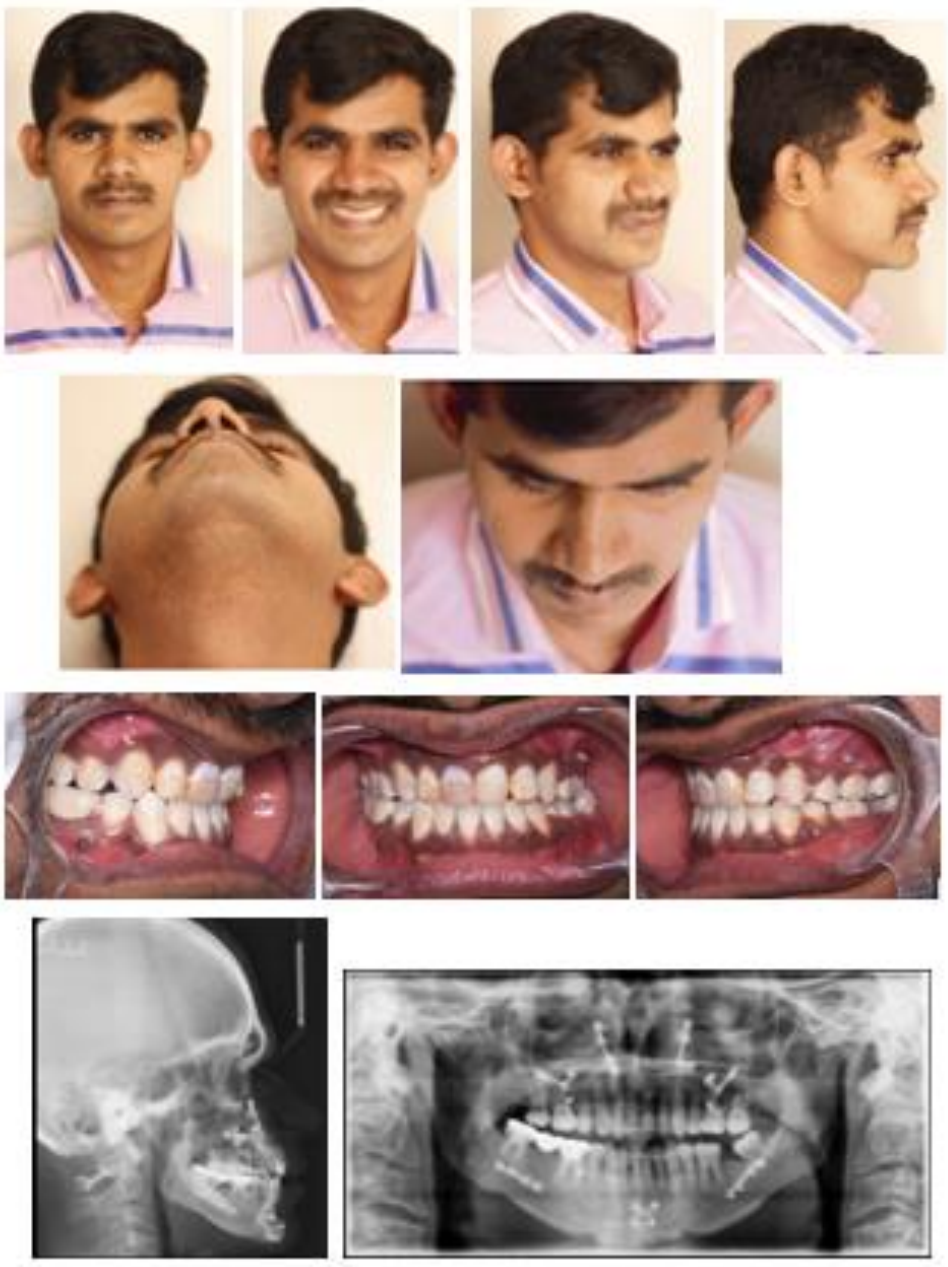

Fig 8 – Post treatment photographs

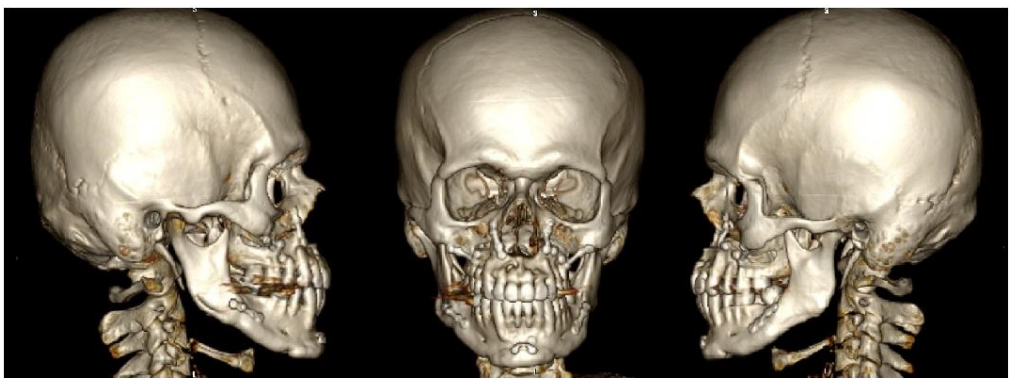

Fig 9: Post-surgical CT

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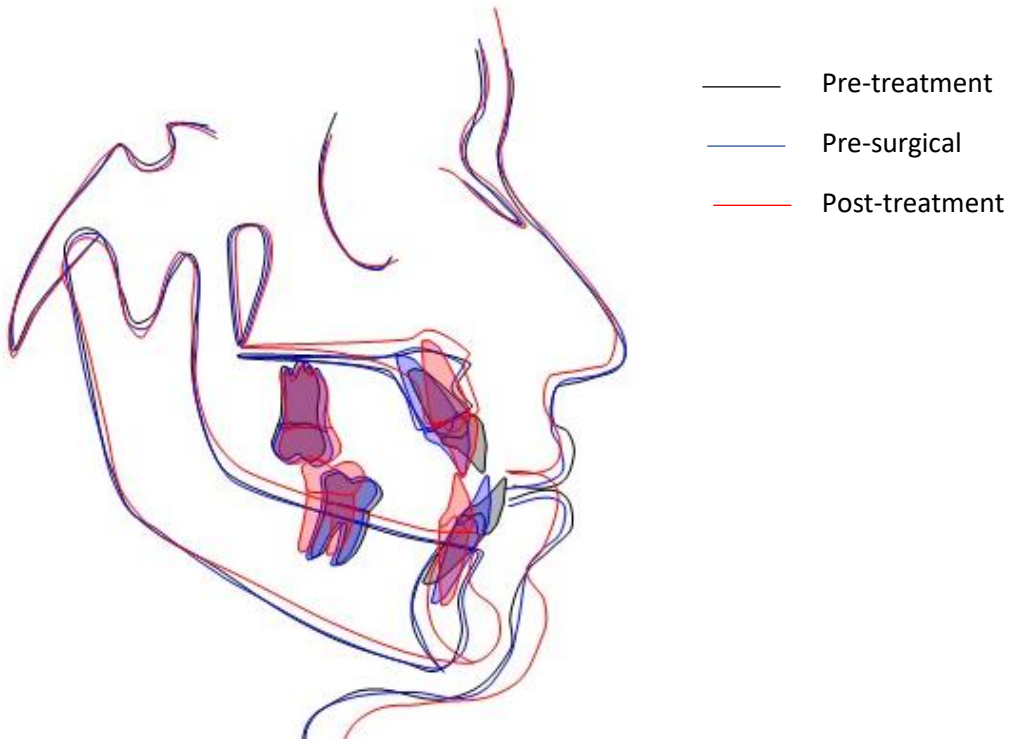

Fig 10 – Superimposition of pre-treatment, pre-surgical and post-treatmentlateralcephalogram

Table.1. CEPHALOMETRIC ANALYSIS

PARAMETERS	NORMAL	PRE-TREATMENT	POST TREATMENT
SKELETAL			
S-N (BJORK`S)	71+/- 3 mm	65 mm	65 mm
SNA (Steiner)	82° +/- 2°	91°	92°
SNB (Steiner)	80° +/- 2°	89°	90°
ANB (Steiner)	0° – 4°	2°	2°
FACIAL ANGLE (RICKETT`S)	87° +/- 3°	88°	92°
N – ANS (COGS)	51.5 – 57.9 mm	47 mm	45 mm
N – PNS (COGS)	52.2 – 55.6 mm	53 mm	50 mm
N – A – Pg (COGS)	-2.5° – 10.3°	1°	0°
N – Pg (COGS)	-12.8 – 4.2 mm	6 mm	10 mm
B – Pg	7.2 – 10.6 mm	5 mm	9 mm
Maxillary length (COGS)	55.2 – 60.2 mm	58 mm	58 mm
Mandibular length (COGS)	68.5 – 80.1 mm	78 mm	76 mm
Ramal length (COGS)	47.8 – 56.2 mm	46 mm	46 mm
MP - HP (COGS)	17.1° – 28.9°	31°	28°

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GONIAL ANGLE (COGS)	112.6° – 125.6°	128°	125°
DENTAL			
UPPER 1 TO NF (COGS)	28.4 – 32.6 mm	29 mm	31 mm
LOWER 1 TO MP (COGS)	42.0 – 45.1 mm	43 mm	45 mm
INTERINCISAL ANGLE (Steiner`s)	131°	95°	134°
SOFT TISSUE			
S LINE – UPPER LIP	0 +/- 2 mm	3 mm	0 mm
S LINE – LOWER LIP	0 +/- 2 mm	4 mm	-1 mm

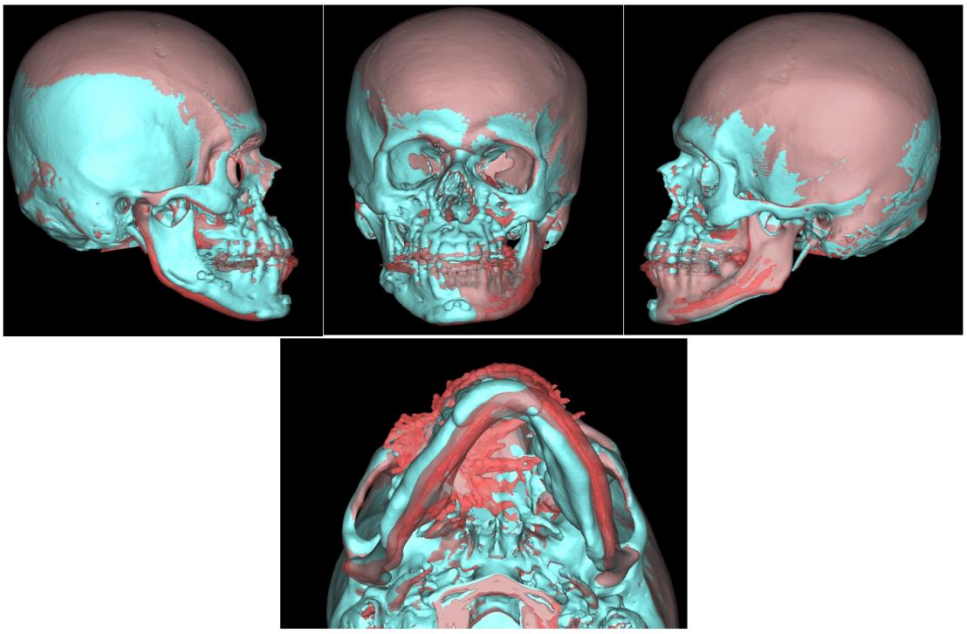

Fig.11. Pre- and post-surgical superimposition using CT

TABLE. 2. PRE AND POST TREATMENT CT VALUES

PARAMETER	PRE-TREATMENT	POST-TREATMENT
DISTANCE BETWEEN ANS & X PLANE (MID – SAGITTAL PLANE PASSING THROUGH ANS, ANTERIOR CLENOID PROCESS AND BASION)	4 mm	3mm
DISTANCE BETWEEN PNS & X PLANE	0.2 mm	0.1 mm
ANS – PNS ANGLE	4.46°	4.4°
DISTANCE BETWEEN Me & X PLANE	5 mm	3 mm
ANGLE BETWEEN Me & X PLANE	5°	3°
DISTANCE BETWEEN Y PLANE (HORIZONTAL PLANE - 7° LINE FROM FRANKFORT HORIZONTAL PLANE) & INTERDENTAL BONE BETWEEN RIGHT 1^{ST}& 2^{ND}	66 mm	61 mm

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MOLAR		
DISTANCE BETWEEN Y PLANE & INTERDENTAL BONE BETWEEN LEFT 1^{ST}& 2^{ND} MOLAR	60 mm	63 mm
DISTANCE BETWEEN Y PLANE & POINT ON THE INTERDENTAL BONE BETWEEN RIGHT 1^{ST}& 2^{ND} MOLAR IN THE MANDIBLE	85 mm	95 mm
DISTANCE BETWEEN Y PLANE & POINT ON THE INTERDENTAL BONE BETWEEN LEFT 1^{ST}& 2^{ND} MOLAR IN THE MANDIBLE	80 mm	80 mm
ANGLE BETWEEN Y PLANE & NASAL PLANE (ANS-PNS)	2.8°	2.1°
ANGLE BETWEEN Y PLANE AND MANDIBULAR PLANE	26.1°	35°
DISTANCE BETWEEN Y PLANE & ANS	46.8 mm	42 mm
DISTANCE BETWEEN Y PLANE & PNS	49 mm	45 mm
DISTANCE BETWEEN Y PLANE & Me	68 mm	71 mm

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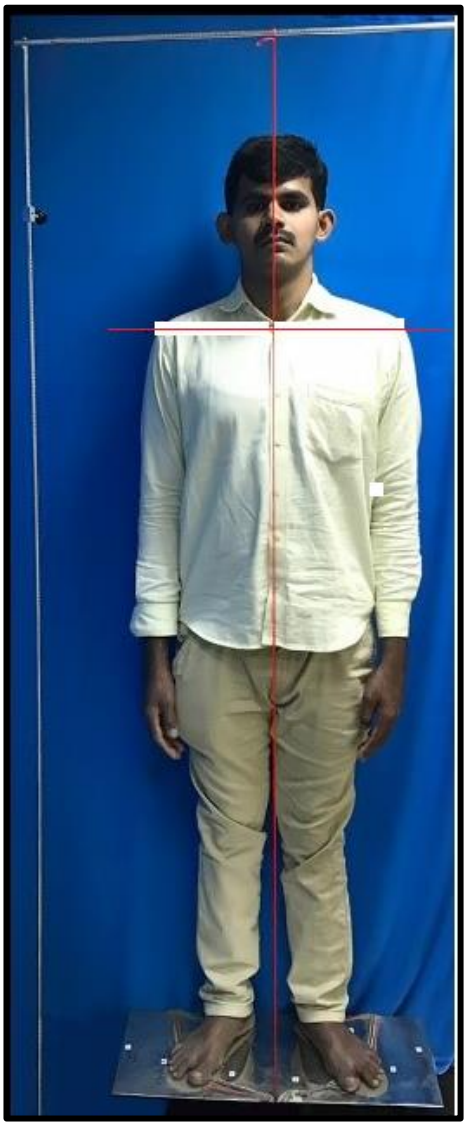

Fig.12. Post treatment postural analysis

6. DISCUSSION

The developmental type of facial asymmetry is idiopathic and non - syndromic in nature. When there is no obvious history of facial trauma: abnormal muscle function, habitual chewing on one side or persistent sleep on one side can be suspected.9 Skeletal asymmetry can involve either or both the jaws. It can also be due to various skeletal structures on one side of the face. In such cases, there can be compensation of growth on the contralateral side. If occlusal interferences prevent proper intercuspation on centric relation, then there can be lateral shift of the mandible thereby leading to functional asymmetry.

An esthetic face always has its facial structures similar on both sides, sometimes dissimilarity happens with growth that may be subclinical. Severe dis-similarity of facial structures occurs because of trauma or genetic factors. Few studies reported that left side of face is dominant or larger with normal growth 10,11,12. While other studies in controversy reported that skeletal structures of right side of face are larger than the left side, with statistically significant difference 13,14,15,16,17. This difference in skeletal structures on either side of the face can

causes imbalance in occlusion causing abnormal stress distribution on articular surfaces and dysfunctional osseous remodelling of condyles, causing the internal derangement and functional impairment of the temporomandibular joints (TMJs), finally leading to osteoarthritis 18,19,20. Kanavakis et al21 suggested that this mechanical effects of loading was because of the flatter occlusal plane on deviated side resulting in more molar contacts that causes increase in force application to the TMJs during normal functions that initiates bone remodelling, affecting the bone mass. Zhang et al22 suggested that even minor trauma can occur on the anterior slope of the deviated side which acts as the initial sign of TMDs in asymmetric patient.

The treatment modality depends on the patient`s concern for aesthetics, the amount of sagittal and vertical discrepancies of the jaws and the occlusal considerations. In general, mandibular asymmetries when present in concordance with occlusal canting, bi – jaw surgery becomes essential.1 Thus, surgical approach with Lefort I osteotomy and bilateral sagittal split osteotomy with asymmetric setback is always the best choice for an adult because it causes the condylar head to move more posterior on larger setback side than the lesser one23. This positional change in condyle leads to a healthy TMJ in facial asymmetric patient after orthognathic surgery24. Olmos et al25 showed that any improvement in the condyle fossa relation can lead to an improvement in the body posture. The possibility of posterior condylar displacement can result in forward head posture and has a long-lasting effect on the mandibular rest position26.

In the present case, lateral shift of the mandible towards left depicts the facial asymmetry, also it gives a false appearance of skeletal class- III because of class-III molar and canine relationship and reverse overjet. His shoulder level was slant depicting asymmetrical loading of force. Thus, surgical plan was considered an essential part of treatment to correct the asymmetrical face, unhealthy TMJ and improper posture. With this treatment approach, it is always important to investigate the planes, especially, palatal and mandibular plane. Here, palatal plane inclines down on his right side creating an occlusal cant and mandibular plane inclines down and shifts to left leading to increased loading of condyle on left side.

Thus, Lefort I osteotomy was considered with differential impaction to correct the canting, followed by BSSO with differential setback for correction of the shift and to equalize the condylar loading force. For a favourable profile, genioplasty had to be performed. The bony segments are fixed with the help of surgical plates and screws.

The surgical and orthodontic correction not only bring about change in the facial corrections, but also the position of the condyle and body posture could be improved. This was supported by Liukkonen et al 27, stating that there is increase in craniofacial angulation after the mandibular set back surgery. Phillips et al28, emphasized that this change is evident during the first year of surgery and combination surgery produces a significant increase in cranio-

cervical angulation than single jaw surgery. He also stated that, after 1 year of surgery, the mean cranio-cervical and cranio-vertical angles are known to get back to approximately the same values that were present before surgery. Accordingly, on comparison between the postural analysis done immediately after surgery and at the time of debonding, showed small amount of discrepancy.

Solow et al 29, claims that this change in the cranio-cervical angulation is to compensate to maintain airway patency. The increased cranio-cervical angulation serves to lift the base of the tongue and soft palate from the posterior pharyngeal wall. Further, Chaithanyaet al30 reported that even the occlusal force distribution has an imbalance in 70% of the patients between their right and left sides following week after prosthesis. This disturbance can probably be one of the reasons for the postural change, as occlusion has a major impact on the body posture.

The surgical correction of the facial asymmetry increases the self-esteem and self-confidence of the patient, also enhances the condylar relationship thereby improving the natural head tilt by re-adaptation of sternocleidomastoid muscle followed by body posture. Number of studies reported that the orthognathic surgery in combination with orthodontic treatment corrects the dentofacial deformity and improves bite force, occlusal contact and thereby gradual redistribution of equal force to the jaw muscles and condyle which in turn alters the unhealthy head posture and brings about esthetic facial alignment.

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