

# Interrelationship between Skeletal and Dental Malocclusion in Unilateral Cleft Lip & Palate Cases based on Goslon Yardstick Scale - A Cross Sectional Observational Study

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**Abstract:** *Introduction:* The Great Ormond Street, London and Oslo, Norway [GOSLON] yardstick scale is an index for evaluating study models to determine the effects of treatment in individuals born with unilateral cleft lip and palate [UCLP]. GOSLON is a tool for ranking study models based on their sagittal, vertical, and transversal planes that requires calibration of the examiner. *Aim:* The aim of the study was to evaluate the interrelation between skeletal and dental malocclusion in unilateral cleft lip &/ palate cases based on Goslon Yardstick Scale. *Materials and methods:* The study scored 80 study models [Mixed = 40, Permanent = 40] using Goslon yardstick scale and their lateral cephalograms were evaluated for interjaw relationship. *Results:* Significant interrater reliability was found for Goslon yardstick scale. Goslon score – 4 was found in 40% of study models of mixed dentition while Goslon score 2 and 3 each were found in 40 % of study models in permanent dentition. Significant correlation was found between Goslon score and skeletal cephalometric parameters.

**Keywords:** Cleft lip and palate, Goslon Yardstick score, Skeletal Malocclusion

## 1. Introduction

There are several types of congenital craniofacial anomalies, most frequent of which are orofacial clefts that encompasses the cleft lip and palate (CLP), which occurs when embryonic facial processes fail to unite.<sup>[1]</sup> The commonest complications associated with CLP are the maxillary growth aberrations in all the 3 planes of space and high occurrence of skeletal Class III malocclusions due to the hypoplastic maxilla.

Children with CLP represent aberrations in number, size, shape, and period of tooth formation.<sup>[2]</sup> Orthodontic abnormalities such as crowding, rotation, malposition of teeth and crossbite in all three planes of space are frequent in patients with CLP.<sup>[3]</sup> This concerns 92.4% of men and 71.4% of women.<sup>[4]</sup> Due to hypoplastic maxilla the intercuspatation and occlusion is disturbed that sets the mandible free to grow that further aggravates the condition.

The problems of growth of the dentofacial complex in patients with cleft lip and palate are generally reflected in the anteroposterior and transversal dental/& skeletal relationship with maxilla.<sup>[5]</sup>

To better understand the factors responsible for the malocclusion; different methods of recording these dental and skeletal relationships have been used. Majority of the scoring methods given for the dental representation in cleft cases are based on the presence of crossbite are (anterior or posterior) (Pruzansky and Aduss, 1964; Matthews et al.,

1970; Crabb and Foster, 1977). While Pruzansky and Aduss (1964)<sup>[6]</sup> classified occlusion into six categories (1 to 6), Matthews et al. (1970)<sup>[7]</sup> used five categories from A over B1 to B3 to C as the standard Angles classification considers maxilla to in one piece which would not be helpful in fragmented maxilla.

Bjork et al., 1964; Huddart and Bodenham, 1972 based their classification on the amount of overjet, overbite, and molar occlusion in numerical terms<sup>[8]</sup>. The Huddart/ Bodenham system was designed for only in primary and permanent dentition, it was further modified for mixed dentition by Mossey et al., 2003.<sup>[9]</sup>

Taking into consideration the drawbacks associated with various methods Mars et al.(1987) published a new and simple method to categorise the UCLP cases and named it GOSLON [Great Ormond Street, London and Oslo] Yardstick.<sup>[10]</sup> This was formulated to score the outcome of treatment in unilateral cleft lip and palate patients. According to Noverraz et al.,1993; the GOSLON score is considered as an useful method for longitudinal assessment of the dental arch relationship which serves as an indicator of the outcome of treatment and is therefore used to compare outcomes between different centers and different surgical treatments.<sup>[11]</sup> Atack et al. later in 1997 introduced the yardstick for 5-yearold children.<sup>[4]</sup>

Most of the UCLP cases are seen with skeletal Class III malocclusion due to the deficient maxilla as discussed earlier.<sup>[12]</sup> But variations are clinically seen with GOSLON

2,3 and 4 where the dental malocclusion may not match the skeletal malocclusion, for eg.; it is not mandatory that GOSLON 2 is always associated with Skeletal Class I/II and GOSLON 3 with skeletal Class III. The variations in skeletal and dental malocclusion may vary the treatment options and modalities thereby.

There are very less to negligible studies in the literature where the skeletal malocclusion is correlated with the dental malocclusion in cleft based on Goslon Yardstick. The following study was planned.

## 2. Materials

The following study was conducted in Department of Orthodontics & Dentofacial Orthopedics, Sharad Pawar Dental College in collaboration with Department of Oral Medicine and Radiology, S.P.D.C, DMIMS [DU], Sawangi [M], Wardha.

### Sample Selection

By using the Power estimation formula for 95% and  $\alpha$  level is 0.01. The minimum sample size required for the study was 38 for each group (sample size calculation by Lamort's test power calculation, Boston University Research) The samples were randomly selected from the Cleft unit of the Department [under smile train].

The samples were collected into 2 groups.

- 1) Group 1 – 40 Unilateral Cleft Lip/Palate cases with Mixed dentition.
- 2) Group 2 – 40 Unilateral Cleft Lip/Palate cases with Permanent dentition.

## 3. Method

Pretreatment Lateral cephalograms and study models of the UCLP cases under Smile train [South East Asia Region] were collected for respected groups. To avoid the bias, the Lateral cephalograms and Study models were randomly numbered.

All the teaching staff (Professors, Readers and Lecturers of the Department) were sensitized about the Goslon yardstick scale. The study models were placed on the table numerically where the staff categorised each study model by ranking them under Goslon yardstick scale.

Lateral cephalogram of each UCLP cases were assessed for anteroposterior interjaw relationship by 2 observers, where the following evaluations were done:

- 1) ANB Angle
- 2) Wits appraisal
- 3) Beta angle
- 4) A-B plane angle
- 5) Saddle angle

Based on the lateral cephalogram analysis the cases were classified into skeletal Class I, II and III.

All the results were subjected to statistical analysis to evaluate the correlation of skeletal and dentoalveolar malocclusion.

## 4. Results

Statistical analysis was done by using descriptive and inferential statistics using Students Pear T- Test and Pearson's Correlation coefficient and software used in the analysis was SPSS 22.0 version and  $p < 0.05$  was considered to be significant.

**Table 1:** Evaluation and categorization of dental study models based on GOSLON Yardstick scale in UCLP cases

GOSLON Yardstick Scale	Mixed Dentition	Permanent Dentition
1	4[10%]	4[10%]
2	4[10%]	16[40%]
3	8[20%]	16[40%]
4	16[40%]	0[0%]
5	8[20%]	4[10%]
Total	40[100%]	40[100%]
Mean $\pm$ SD	3.50 $\pm$ 1.21	2.60 $\pm$ 1.03

Goslon Yardstick Scale Score "1" was found in 10% of mixed and permanent dentition each, score "2" in 10% of mixed and 40% of permanent dentition, score "3" in 20% of mixed and 40% of permanent dentition, score "4" in 40% of mixed dentition and score "5" in 20% of mixed dentition and 10% of permanent dentition.

**Table 2:** To evaluate maxillo – mandibular relationship in UCLP cases.

	Mixed Dentition		Permanent Dentition		t-value	p-value
	Mean	Std. Deviation	Mean	Std. Deviation		
ANB	-3.5	2.13	-2.97	1.39	1.3	0.19,NS
Wits Appraisal	-4.67	2.1	-4.22	0.86	1.25	0.21,NS
Beta Angle	35.5	2.53	32.35	20.98	0.94	0.34,NS
A-B Plane	-3.6	1.37	-3.02	1.62	1.7	0.09,NS
Saddle Angle	129.2	4.36	128.8	4.85	0.38	0.69,NS

No significant correlation was found between maxillo - mandibular relationship in cleft cases.

**Table 3:** Association between Skeletal and Dental Malocclusion based on Goslon Yardstick scale in UCLP cases

	Mixed Dentition		Permanent Dentition	
	Correlation 'r'	p-value	Correlation 'r'	p-value
ANB	-0.689	0.0001,S	-0.51	0.754,NS
Wits Appraisal	-0.864	0.0001,S	-0.846	0.0001,S
Beta Angle	0.316	0.047,S	-0.767	0.0001,S
A-B Plane	-0.551	0.0001,S	0.166	0.307,NS
Saddle Angle	-0.275	0.056,NS	-0.187	0.061,NS

Significant correlation was found between Goslon score and ANB angle [ $r = -0.689$ ,  $p\text{-value} = 0.0001$ ], Wits appraisal [ $r = -0.864$ ,  $p\text{-value} = 0.0001$ ], Beta Angle [ $r = 0.316$ ,  $p\text{-value} = 0.047$ ] and A-B plane angle [ $r = -0.551$ ,  $p\text{-value} = 0.0001$ ] in mixed dentition.

In Permanent dentition significant correlation was found between Witts appraisal [r= - 0.846, p-value=0.0001] and Beta Angle [r= -0.767, p-value=0.0001]

**Table 4:** Association between Skeletal and Dental Malocclusion based on Molar relationship in mixed and permanent dentition on right and left side in UCLP case.

Right side	Mixed Dentition		Permanent Dentition	
	Correlation 'r'	p-value	Correlation 'r'	p-value
ANB	-0.229	0.065,NS	0.225	0.062,NS
Witts Appraisal	-0.098	0.547,NS	0.363	0.051,NS
Beta Angle	0.245	0.051,NS	0.297	0.062,NS
A-B Plane	-0.228	0.011,NS	0.218	0.052,NS
Saddle Angle	-0.24	0.052,NS	-0.204	0.206,NS

Left side	Mixed Dentition		Permanent Dentition	
	Correlation 'r'	p-value	Correlation 'r'	p-value
ANB	-0.091	0.069, NS	0.229	0.064,NS
Witts Appraisal	-0.246	0.126,NS	0.469	0.058,NS
Beta Angle	0.025	0.879,NS	0.597	0.041,NS
A-B Plane	-0.823	0.0001,NS	0.318	0.021,NS
Saddle Angle	-0.249	0.062,NS	-0.204	0.206,NS

No significant correlation was found between ANB angle, Witts Appraisal, Beta Angle, A-B plane angle and Saddle angle of right and left side of mixed and permanent dentition.

**Table 5:** Association between Goslon Yardstick scale and Molar relation of mixed and permanent dentition. On right and left side in UCLP cases

Goslon Yardstick Scale	Mixed Dentition : Right Side			Total
	Class I	Class II	Class III	
1	0[0%]	4[100%]	0[0%]	4
2	4[100%]	0[0%]	0[0%]	4
3	0[0%]	0[0%]	8[100%]	8
4	16[100%]	0[0%]	0[0%]	16
5	0[0%]	0[0%]	8[100%]	8
Total	20[50%]	4[10%]	16[40%]	40
Mixed Dentition: Left Side				
1	0[0%]	4[100%]	0[0%]	4
2	4[100%]	0[0%]	0[0%]	4
3	8[100%]	0[0%]	0[0%]	8
4	16[100%]	0[0%]	0[0%]	16
5	0[0%]	0[0%]	8[100%]	8

Goslon Yardstick Scale	Permanent Dentition : Right Side			Total
	Class I	Class II	Class III	
1	0[0%]	4[100%]	0[0%]	4
2	4[25%]	12[75%]	0[0%]	16
3	8[50%]	8[50%]	0[0%]	16
4	0[0%]	0[0%]	0[0%]	0
5	4[100%]	0[0%]	0[0%]	4
Total	16[40%]	24[60%]	0[0%]	40
Permanent Dentition: Left Side				
1	0[0%]	4[100%]	0[0%]	4
2	4[25%]	12[75%]	0[0%]	16
3	8[50%]	8[50%]	0[0%]	16
4	0[0%]	0[0%]	0[0%]	0
5	4[100%]	0[0%]	0[0%]	4
Total	16[40%]	24[60%]	0[0%]	40

In mixed dentition out of the 4 cases having Goslon Yardstick Scale score of “1”, all were class II on right side,

out of 4 patients having Goslon Yardstick scale score of “2”, all were class I on right side, of 8 cases with Goslon Yardstick Scale score of “3”, all were class III on right side, out of 16 patients with Goslon Yardstick Scale Score “4” all were class I on right side and out of 8 patients with “5” Goslon Yardstick Scale Score all were class III on right side.

In mixed dentition out of the 4 patients having Goslon Yardstick Scale score of “1”, all were class II on Left side, out of 4 patients having Goslon Yardstick scale score of “2”, all were class I on left side, of 8 patients with Goslon Yardstick Scale score of “3”, all were class I on left side, out of 16 patients with Goslon Yardstick Scale Score “4” all were class I on left side and out of 8 patients with “5” Goslon Yardstick Scale Score all were class III on left side.

In permanent dentition out of the 4 patients having Goslon Yardstick Scale score of “1”, all were class II on right side, out of 16 patients having Goslon Yardstick scale score of “2”, 4 were class I and 12 were Class II on right side, of 16 patients with Goslon Yardstick Scale score of “3”, 8 were class I and 8 were class II on right side, and out of 4 patients with “5” Goslon Yardstick Scale Score all were class I on right side.

In Permanent dentition out of the 4 patients having Goslon Yardstick Scale score of “1”, all were class II on Left side, out of 16 patients having Goslon Yardstick scale score of “2”, 12 were class II and 4 were Class I on left side, of 16 patients with Goslon Yardstick Scale score of “3”, 8 were class I and other 8 were Class II on left side, and out of 4 patients with Goslon Yardstick Scale Score of “5” all were class I on left side.

### 5. Discussion

The aim of the study was to evaluate an interrelation between skeletal and dental malocclusion in unilateral cleft lip &/ palate cases based on Goslon Yardstick Scale.

The evaluation of the reliability of the Goslon scoring system showed that examiners had a significant intrarater reliability [Cronbach Alpha= 0.783, p-value=0.0001]. These results are in line with the results reported by Mars M et al and Shapira Y et al.<sup>[13][14]</sup>

Among mixed dentition , most cases were classified into GOSLON Groups 4[ 40%] , 3[20%] and 5[ 20%] while in permanent dentition , most cases were classified into GOSLON Groups 2[40%] and 3[40%][Table 1]. Goslon has suggested that an edge-to-edge incisor relationship with a minimal crossbite tendency should be classified in GOSLON Group 2 when the patient is 5 years old as edge-to-edge bite is normal in the primary dentition. As the study models in our study are of mixed dentition and permanent dentition, taking skeletal growth into consideration , the results come in line with Mars et al and Y. Almuhihi et al.<sup>[15]</sup>

The ANB Angle, Witts Appraisal, Beta Angle, AB plane angle and saddle angle showed insignificant difference [Table 2]. The results come in line with Agarwal et al.<sup>[16]</sup> Relwani et al found significant correlation between FH to

AB plane angle (FABA) and beta angle followed by FABA and palatal plane to AB plane angle (PABA), YEN and beta.

It is important to analyse maxillo-mandibular skeletal relationships in all the plane along with dentition to assess treatment outcomes of surgical management in cleft lip and palate cases.

The present findings observed that, as the Goslon Score increased as ANB Angle, Witts Appraisal, Beta Angle, A-B Plane Angle also increased significantly in mixed dentition while in permanent dentition Witts appraisal and beta angle increased significantly [Table 3]. Significant correlation was found between the Goslon yardstick and cephalometric parameters for sagittal maxillomandibular relation. Daskalogiannakis et al.<sup>[17]</sup> assessed the cephalometric validity of Goslon Yardstick using three angular parameters and found a significant negative correlation between Goslon rating and ANB angle [ $r = -.607$ ,  $p.0.001$ ]. In the present study, significant correlation was found to exist between the Goslon yardstick and cephalometric parameters form axillomandibular relation.

In the present study, no significant correlation was found between Angles molar relation and the cephalometric angular parameters on both right and left side in mixed as well as permanent dentition [Table 4]. This may be because of the altered dentofacial growth in cleft cases. Our results are in disagreement with Shrikant et al who found a significant correlation of ANB angle and WITS appraisal when compared with Angles Class I,II and III.<sup>[18]</sup>

Furthermore, the Goslon score and the molar relationship did not show any significant association with each other, the molar relationship on right and left side of mixed and permanent dentition did not represent skeletal or growth pattern associated with the respective molar relation [Table5]. Moreover, the characterizes associated with particular goslon score did not avow to the molar relationship. Thus our results are in line with Zhou et al<sup>[19]</sup>, who stated that Angles molar classification of dental arch relationship alone will not reveal the true picture of dentofacial deformity.

## 6. Conclusion

- 1) The study revealed no significant association of Angles Molar relation with Skeletal jaw base relation and Goslon score.
- 2) Goslon score demonstrated significant statistical correlation with skeletal parameters revealing more detailed information about the malocclusion.
- 3) We can conclude that one should not attempt towards Class I molar and skeletal relation while treating cleft.
- 4) Achieving an acceptable esthetic profile along with proper occlusion and function in collaboration with prosthetic rehabilitation and orthognathic surgery wherever required is of utmost importance while treating cleft cases.

## 7. Future Scope

- a) The cleft cases evaluated could not be segregated for right and left side of cleft.
- b) Children with cleft were not sorted by severity before correlating specific treatment variables with outcome.

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