M - CODS Photographic soft tissue profile analysis

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ABSTRACT

Objective: To use an indigenously designed photographic soft tissue profile analysis to derive soft tissue norms for the age groups of 9-11 and 12-15 years for the local population ; to establish the normal antero-posterior relationship of mandible to the cranial base and the face ; and to examine the reliability of the four reference planes namely the **SnV , GV , NV, PV.**

Materials and methodology: Standardised right lateral photographs of the subjects were taken in NHP. All these images were transferred to the computer and were resized to real size images. Four lines i.e. Nasion Vertical (NV), Pupil Vertical (PV), Subnasale Vertical (SV), and Glabella Vertical (GV) were used as reference lines and perpendicular distances of various points were measured from each of the four reference lines. Mean and SD was calculated.

Results: Soft tissue photographic norms were generated for children with age group of 9 - 1 1 a n d 12-15 years for class I. Important findings were B' lies on NV for both sexes and Pog' lies on GV for both sexes in the age group of 9-11 years which can be practically implied in routine practice. In the age group of 12-15 years , Pog' lies on NV in girls and is 2 mm behind it , in boys. The Nasion vertical was found to be a reliable reference plane in both the age groups.

Conclusion: The photographic analysis that was devised in this study was found to be a reliable and useful tool in recognising antero-posterior skeletal deviations related to the mandible in the two age groups studied.

Key Words: Photographic ; Glabella ; Nasion ; Analysis ;Vertical

INTRODUCTION

Photographic soft tissue analysis particularly of the profile view can provide a considerable insight into the underlying skeletal jaw relationship and is an invaluable tool particularly when studies are undertaken on an epidemiological scale. Photographic analysis is a screening tool in the very least , when radiography is logistically impractical. It can help to arrive at better treatment goals by studying facial esthetics especially when facial soft tissue can contribute to or detract from the 'attractive stereotype' which is engrained in our culture [1]. Paula-Riviero et al [2]; Epker[3] ;Hambleton et al [4] , etc have conducted photographic soft tissue profile analyses in order to derive soft tissue norms in various age groups. Actually, such quantitative analyses may serve as a powerful method to address craniofacial disorders, help treatment planning , evaluate surgical results and orthodontic outcomes, and study facial growth. Thus, it may be as effective in orthodontics as in several other medical fields.

The cultural, social , geographic and psychological background affects the facial esthetics of an ethnic group. The Caucasian norms that are usually followed may not be appropriate for other racial groups. The orthodontist should consider these variables during treatment planning.

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Hence the purpose of this study was to develop a simple and practical photographic analysis which was then used to analyse 120 subjects with a normal growth pattern in order to establish normative data for the local population in the age groups of 9-11 years and 12-15 years each . The main objective of this study was to develop a co-relation between the relevant soft –tissue landmarks with the reference planes which can be used during a visual clinical assessment of the patient in the initial stages of examination.

MATERIALS AND METHODS

This study was conducted in 120 subjects each of 9-11 and 12-15 year age group with a skeletal and dental Class I with pleasing profiles , in a local population. The sample consisted of 60 males and 60 females in both the groups. A photographic set-up consisting of a digital camera Canon 5100, a tripod to support a digital camera were used to capture profile photographs of the subjects. Adjustment of the tripod height was done to allow the optical axis of the lens to be maintained in a horizontal position during recording; this was adapted to each subject's body height. In a standing position, each subject was asked to relax, with both arms hanging freely beside the trunk. Each subject was positioned on a line marked on the floor, and placed behind the subject was a vertical measurement scale divided into 0.5cm that allowed measurements at life size. A plumb line, suspending a 0.5 kg weight hung from the scale, held by a thick black thread was used to define the vertical plane [true vertical (TV)] on the photographs. One

hundred and twenty centimeters in front of the subject, on the opposite wall a mirror was placed. The subjects were instructed to look into their eyes in the mirror with their lips relaxed so that the right-side profile records were taken in NHP. Before every recording the operator ensured that the subject's forehead, neck, and ear were clearly visible and their lips were in repose. All photographs were taken at same magnification[5].(Fig.1)

Fig.1: photographic set-up

(a) (b)

Fig.2:(a)Image with plumb line, measuring scale and different parameters (b) different planes drawn , marked for female

(a) (b)

Fig.3:(a)Image with plumb line, measuring scale and different parameters (b) different planes drawn , marked for male.

STATISTICAL ANALYSIS

Data collected in present study was compiled in Microsoft excel sheet and analyzed by the SPSS software version 2.0. Data comparison was done by applying specific statistical test to find out statistical significance of the results, since the data were of continuous and quantitative type parametric test were used for analysis. Mean and standard deviation of all the parameters mentioned in the study were calculated for males and females.

RESULTS

(A) 9-11 age group

Mean and standard deviation, of perpendicular distance of various parameters are presented in the tables 1 to 8:

Table-1: Mean, standard deviation of all parameter through Nasion Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	pupil	Sn	G'
NV	Mean	22.57	10.02	14.14	10.93	1.2	2.25	-10.10	10.361	2.234
	SD	2.981	3.377	3.649	3.019	3.680	4.035	2.499	3.528	1.572

Table-2: Mean, standard deviation of all parameter through Pupil Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Sn	G'
PV	Mean	32.671	19.959	24.214	21.048	11.606	12.742	10.10	20.460	12.333
	SD	3.561	4.284	3.692	3.353	3.654	3.744	2.499	3.585	2.298

Table-3: Mean, standard deviation of all parameters through Subnasale Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Pupil	G'
Sn	Mean	12.210	-0.452	3.700	0.519	-8.010	-6.659	-10.36	-20.46	-8.126
	SD	1.621	0.625	1.885	2.492	4.145	4.967	3.528	3.585	3.921

Table-4: Mean, standard deviation of all parameters through Glabella Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Pupil	Sn
G	Mean	20.337	7.911	11.913	8.772	-0.706	0.525	-2.234	-12.33	8.126
	SD	3.552	3.933	3.861	3.248	3.310	3.356	1.572	2.298	3.921

Table-5: Mean, standard deviation of all parameters through Nasion Vertical plane for Girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	pupil	Sn	G'
NV	Mean	22.386	9.037	12.642	10.317	0.906	2.273	-10.04	9.504	2.218
	SD	3.066	2.732	3.336	3.113	2.779	2.755	3.395	3.020	1.594

Table-6: Mean, standard deviation of all parameters through Pupil Vertical plane for Girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	nasion	Sn	G'
PUPIL	Mean	32.432	19.299	22.886	20.531	11.062	12.273	10.046	19.550	12.264
	SD	4.569	4.359	5.018	4.840	4.509	4.558	3.395	4.439	3.350

Table-7: Mean, standard deviation of all parameters through Subnasale Vertical plane for Girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Pupil	G'
Sn	Mean	12.882	-0.487	3.396	0.840	-8.012	-6.801	-9.504	-19.55	-7.286
	SD	1.655	0.586	1.640	1.980	3.0155	3.170	3.020	4.439	3.355

Table-8: Mean, standard deviation of all parameters through Pupil Vertical plane for Girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	nasion	Sn	G'
PUPIL	Mean	32.432	19.299	22.886	20.531	11.062	12.273	10.046	19.550	12.264
	SD	4.569	4.359	5.018	4.840	4.509	4.558	3.395	4.439	3.350

(B) 12-15 age group

Mean , standard deviation of perpendicular distance of various parameters are presented in the tables 9 to 16:

Table-9: Mean, standard deviation of all parameters through Nasion Vertical plane for girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	pupil	Sn	G'
NASION	Mean	21.80	5.52	9.10	6.63	-1.41	-0.18	-13.50	6.69	1.91
	SD	2.25	2.94	3.31	3.54	2.65	3.18	2.76	2.83	2.02

Table-10: Mean, standard deviation, median and mode of all parameters through Pupil Vertical plane for girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	nasion	Sn	G'
PUPIL	Mean	33.13	19.87	22.95	19.47	11.51	12.90	14.18	20.72	16.43
	SD	2.28	2.65	2.86	4.03	3.83	3.90	2.79	2.83	2.24

Table-11: Mean, standard deviation of all parameters through Subnasale Vertical plane for girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Pupil	G'
Sn	Mean	14.40	-0.019	2.19	0.16	-8.79	-7.31	-4.99	-14.58	-5.664
	SD	2.37	0.69	1.53	2.25	2.98	4.967	6.02	15.82	2.97

Table-12: Mean, standard deviation of all parameters through Glabella Vertical plane for girls

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Pupil	Sn
G	Mean	19.59	4.04	7.33	4.80	-3.48	-2.29	-1.27	-16.16	4.60
	SD	3.57	2.60	3.46	3.80	3.14	2.47	1.45	2.27	3.23

Table-13: Mean, standard deviation of all parameters through Nasion Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	pupil	Sn	G'
NASION	Mean	21.53	8.00	11.61	8.37	-1.38	-1.87	-12.73	8.32	2.38
	SD	2.59	3.122	3.88	3.80	4.32	4.42	3.49	2.64	1.79

Table-14: Mean, standard deviation of all parameters through Pupil Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	nasion	Sn	G'
PUPIL	Mean	33.93	20.70	24.28	20.97	11.46	11.56	12.97	20.82	15.41
	SD	3.53	4.47	4.91	4.51	5.46	5.59	3.44	3.43	2.96

Table-15: Mean, standard deviation of all parameters through Subnasale Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Pupil	G'
Sn	Mean	13.25	0.48	3.45	0.28	-9.77	-9.35	-8.00	-20.24	-6.29
	SD	1.20	1.81	2.76	2.39	3.09	3.46	2.12	3.04	2.33

Table-16: Mean, standard deviation of all parameters through Glabella Vertical plane for boys

		Nasal tip	A'	ULA	LLA	B'	Pog'	Nasion	Pupil	G'
Sn	Mean	13.25	0.48	3.45	0.28	-9.77	-9.35	-8.00	-20.24	-6.29
	SD	1.20	1.81	2.76	2.39	3.09	3.46	2.12	3.04	2.33

DISCUSSION

In 1931, Broadbent introduced roentgenographic cephalometrics, which integrated craniometrics and radiography [6]. After the standardization of the radiographic technique by him along with Hofrath , the importance of soft tissue facial analysis was downplayed, and dentoskeletal relationships became the deciding factor in diagnosis and treatment planning. However, some authors such as Downs

began to incorporate the soft tissue facial profile into their cephalometric analyses. The objective was to establish a relationship between the soft tissue and the underlying dentoskeletal profile , as anomalies in the hard tissues could be masked or exaggerated by the soft tissues [7].

Subtelny used linear measurements to describe the soft tissue profile. Steiner's S- line , Burstone's angle of convexity , Merrifield's Z-angle , Rickett's E-plane and Holdaway's H-line were all attempts to define the soft tissue .The Powell analysis used the nasofrontal , nasofacial ,naso-mental and mento-cervical angles to define the ideal facial profile .

In 1981, Farkas standardised the photographic technique by taking the records in NHP [8]. Epker [3] and Bass [9] obtained records in NHP using the TV and the TH as the reference line respectively .Arnett and Bergmann described an analysis of soft – tissue facial profile of photographic records in NHP.

Cephalometrics is the gold standard for characterising skeletal and dental morphology in clinical practice but it is impractical for large –scale epidemiological studies. It also poses a risk of radiation exposure especially when serial records are needed in young patients. It would be beneficial to have a low-cost , low-technology method to assess craniofacial morphology. Standardising facial photos might be a useful alternative for both frontal and profile facial analyses.

The photographic method has proven to be a repeatable and reproducible tool for linear and angular measurements for characterizing facial morphology provided that a standardized protocol is followed [2,10,11]. Therefore, it may be considered a feasible and practical diagnostic alternative , particularly if there is a need for a low- cost and noninvasive method. The only concern remains is to get image to real size so that correct linear measurements can be recorded.

The photographic technique has some shortcomings, such as distortion due to the distance between the lens and the subject [12,13].However, this factor is only critical when comparing structures located in different planes of space . Most landmarks currently studied are at the midline, so this issue should minimally affect the measurements [13].

Most of the earlier analysis of soft tissues were designed for adults. The present soft tissue photographic analysis was designed with a target group of 9- 11 and 12-15 years.

Care was taken to choose reference planes that were least influenced by growth. Bishara et al showed that the glabella and the nasion were least variable in their 9 years study of facial dimension change between 4-13 years of age [14,15]. Also the cephlocaudal growth gradient implies that the reference points in the upper one third of the face would be more reliable in growing individuals. According to Nanda et al, at 7 years of age, nasal and labial growth is already 80% to 90% completed, and the assessment of children in this age group can provide useful information for their orthodontic treatment [16].

The reason for selecting this age group was that majority of the pubertal growth spurt is still remaining in these individuals and the facial pattern seen at this age is likely to more or less continue in the same trend.

A skeletal deficiency or excess detected at this time tends to follow the same pattern in the adult. In India, routine dental check-ups for children are not conducted at timely intervals. Dental opinion is sort only in situations associated with pain due to dental infection or in the presence of very severe malocclusion resulting in esthetic concerns. Very often developing skeletal deviations are misinterpreted as simple dentoalveolar malocclusions and deferred for management in the permanent dentition stage. This scenario leads to a large number of developing malocclusions being overlooked and missed. A good percentage of these patients would have benefitted immensely from timely intervention and growth modulation, so diagnosing a malocclusion at that age is very important.

The need of the hour is routine screening of young children in the age group of 9-11 years to detect developing skeletal malocclusions . 12-15 age group was selected because it is very important to identify patients lagging behind in growth as at this age mandibular growth is still remaining and is amenable to growth modulation.

The present study was carried out on subjects in the age group of 9-11 and 12-15 years in Davangere population with the aim of generating photographic soft tissue norms for these age groups so that it can be used as a diagnostic tool.

Nine linear measurements were studied from each of the four reference planes, all in the antero-posterior direction. The purpose was to establish the normal relation of these standard landmarks to each of the reference planes, such that any deviation can be easily detected. . A special effort was made to relate cranial landmarks to more caudal ones in order to detect deviations from the normal. Growth excess or deficiency is most effectively detected in the antero- posterior plane, therefore simple linear measurement are very effective in this respect.

For 9-11 years age group:

A close observation of the normative data highlights certain points. In boys of this age group , the soft-tissue point Glabella was equidistant from point B' in relation to the PV and SnV . On the other hand, in girls G' was equidistant from Pog' in relation to the PV and NV and G' is equidistant from B' from SnV.

From this it can be inferred that Glabella point is reliable for evaluation of the lower face in children of both these sexes in this age group . Hence , if the distance between the B' and Pog' is increased as compared to the G' , the lower jaw is considered to be deficient and if it is reduced then the mandible can be considered excess.

In a normally growing 9-11 year old boy or girl, the soft tissue point B' lies on NV and soft tissue chin

Pog' on GV. A mandible falling short of or in excess of either of these reference planes should be a cause of concern and should be closely monitored. These candidates should be considered for growth modulation therapy. No numerical values need to be remembered which makes this a useful and significant finding.

(C) For 12-15 year age group:

A close observation of the normative data highlights certain points. In girls the chin point or soft tissue Pog' was situated on the NV where as in boys the point was found to be 2 mm behind the NV. This finding suggests that mandibular growth lags behind in males as compared to their female counterparts at this age, however at later ages , it equals and eventually surpasses that of females.

The correlation between Glabella and points Pog' and B' was lost in this age group.

The NV is a reliable reference plane and has been used to generate soft-tissue norms for both the age groups for the following reasons:

1. The point Nasion is easily identifiable even in photographic profile analysis.
2. Unlike other points like the Sn , it does not depend upon the dentoalveolar structures.
3. It does not depend upon the soft-tissue for a given individual.
4. Growth ceases relatively early as compared to the maxilla and mandible.

Hence the Nasion Vertcal was selected as a reference plane to derive soft-tissue norms of both the sexes in groups A and B. The norms are summarized in Table 17

	PARAMETER		Nasal tip	A'	ULA	LLA	B'	Pog'	Pupil	Sn	G'
9-11 YEARS	BOYS	MEAN	22.57	10.02	14.14	10.93	1.2	2.25	10.10	10.36	2.234
		SD	2.981	3.37	3.649	3.019	3.680	4.035	2.49	3.528	1.572
	GIRLS	MEAN	22.38	9.03	12.64	10.317	0.906	2.273	10.04	9.504	2.218
		SD	3.06	2.73	3.336	3.113	2.779	2.755	3.395	3.020	1.594
12-15 YEARS	GIRLS	MEAN	21.80	5.52	9.10	6.63	-1.41	-0.18	-13.50	6.69	1.91
		SD	2.25	2.94	3.31	3.54	2.65	3.18	2.76	2.83	2.02
	BOYS	MEAN	21.53	8.00	11.61	8.37	-1.38	-1.87	12.73	8.32	2.38
		SD	2.59	3.12	3.88	3.80	4.32	4.42	3.49	2.64	1.79

CONCLUSION

1) In 9-11 year age group Pog' was found to lie on GV wheare as in 12-15 year age group it lies on NV in girls and is 2mm behind the NV in boys.

2) The NV is a reliable reference plane from which soft-tissue norms can be derived in both the age groups.

3) B' lies on NV in boys and girls of 9-11 age group and Pog' lies on NV in girls of 12-15 year age group.

4) The point G' can be used to assess the lower face in both sexes in the 9-11 year age group. Point G' is equidistant from point B' in relation to the PV and SnV in boys . In girls, G' was equidistant from Pog' in relation to the PV and NV and G' is also equidistant from B' from SnV.

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