IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

# Reproducibility Of Posed & Dynamic Smile- The Unsolved Dilemma

1Dr. Hiba Shahzad, 2Dr Munish Reddy, 3Dr Shalu Jain, 4Dr. Anjali Achantani, 5Dr. Lovely Garg

1JUNIOR RESIDENT-3, MDS orthodontics, 2MDS orthodontics Professor in department of orthodontics and dentofacial orthopedics, 3MDS orthodontics Professor in Department of Orthodontics and Dentofacial Orthopedics, 4JUNIOR RESIDENT-3, MDS orthodontics, 5JUNIOR RESIDENT-2, MDS orthodontics

1Swami Vivekanand Subharti University, Meerut,

2Swami Vivekanand Subharti University, Meerut,

3Swami Vivekanand Subharti University, Meerut,

4Swami Vivekanand Subharti University, Meerut,

5Swami Vivekanand Subharti University, Meerut

## INTRODUCTION

Smile is an important form of facial expression. It is often associated with intelligence, extroversion & attractiveness[1] .It is mainly of two types – Social or posed smile which is voluntary, unstrained & can be sustained as a static facial expression[2] & the other one is enjoyment[2] or duchenne[3] smile which is involuntary, strained & elicited by laughter. They originate from different areas of brain & appear on face through different motor systems. Therefore, are conveyed by different facial muscles which are zygomaticus major muscle in posed smile whereas in duchenne smile along with zygomaticus major muscle orbicularis oculi pars lateralis & depressor anguli oris muscle act. [3]

In Orthodontics, analysis of tooth disposition in occlusion with lip retractors cannot record lip tooth relationship required to identify & analyse anterior teeth & soft tissue relationship. Hence, digital dental photography especially smile photographs have a crucial role in advancement of cosmetic dental procedures along with permitting comparison of treatment progress. However, few major drawbacks are associated with a single smile photography which are, firstly, it captures posed smile which unlike Duchenne smile is non strained & does not show authentic smile expression[4]. Secondly it can be consciously or sub consciously controlled by patient & thus can affect treatment

outcomes[5] . Lastly a photograph taken during initial attack or decay stage, will not show a reliable smile.[6]

Hence, in order to overcome these voids, three dimensional imaging i.e digital videography is emerging as a new diagnostic tool for recording the dynamic lip-tooth relationship.[7] With the advent of technology the dynamic smile recorded in the video clip can be converted into frames[4] using software and measurements could be done after selecting the frame representing the most authentic smile expression.

Till now most of the studies related to smile focused upon the accuracy of various smile parameters rather than the reproducibility among posed and dynamic smile which is essential for a successful treatment outcome. Hence, the aim of this study was to evaluate the reproducibility amongst posed smile & dynamic smile along with the difference between the two after following a standardized natural head position protocol.

## MATERIAL AND METHOD

Subjects in this study were selected from Subharti Dental College, Meerut. An informed consent was signed by the participants, however the aim of the study was not disclosed to them in order to prevent any bias. Fifty subjects were enrolled who matched the inclusion criteria which was- age range of 18-28 years, complete permanent dentition with exception of third molars, esthetically pleasing smile and with no previous history of orthodontic treatment. Any individuals with significant skeletal/dental asymmetry or cleft, missing or malformed teeth causing a tooth-size discrepancy, severe interdental spacing and crowding, restoration, fracture or caries in anterior teeth were excluded.

Two frontal photographs & videos of all subjects were taken separately on different days. Subject was seated at a fixed distance of 5 feet from DSLR camera(CANON 1200D with100mm macro lens) mounted on adjustable tripod stand. The position of lens was kept parallel to the true perpendicular of the face & camera raised to level of subjects lower facial third. A sticking ruler of 1cm marking was placed on the chin of the subject[8]. A horizontal laser light was adjusted such that it coincided with the ala tragus line (Frankfort horizontal plane) of the subject & he/she was asked to wear headband with two laser lights such that the light falls on the grid. The points where this light falls were noted down for reproducing them in subsequent visits. The subject was then instructed to say cheese & photograph was captured by the operator 1. Following the above mentioned procedure, a 5 second video clip was recorded at the rate of 30 frames per second[9] by the operator 2 in next visit. Subsequently on third and fourth visit second frontal photograph and video i.e. posed & dynamic smiles respectively were taken.(Fig. 1 & 2).

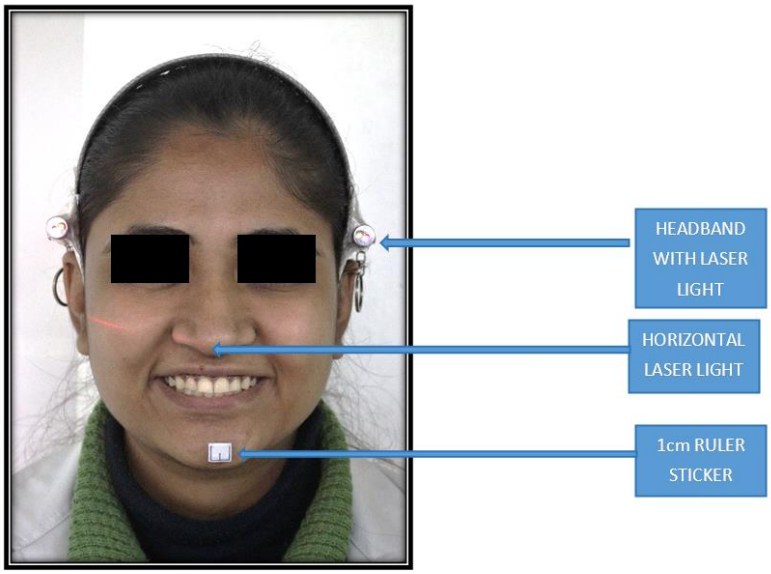


**Fig.1: Subject after placement of various attachments.**

**Fig.2: Armamentarium arrangement for taking photo & video**

Both photographs & videos were transferred to the Computer for their interpretation. With the help of software (free video to Jpg converter),conversion of video was done into individual 150 frames and every 16th frame were separated[10].The frame with pronounced deepening of nasolabial folds & squinting of eyes was selected for this study[2].

### Smile Mesh Measurement

Using Bersoft Image Measurement Software images were calibrated with the help of 1cm ruler placed on chin & a mesh[10] was created consisting of following lines (Fig. 3 & 4)-

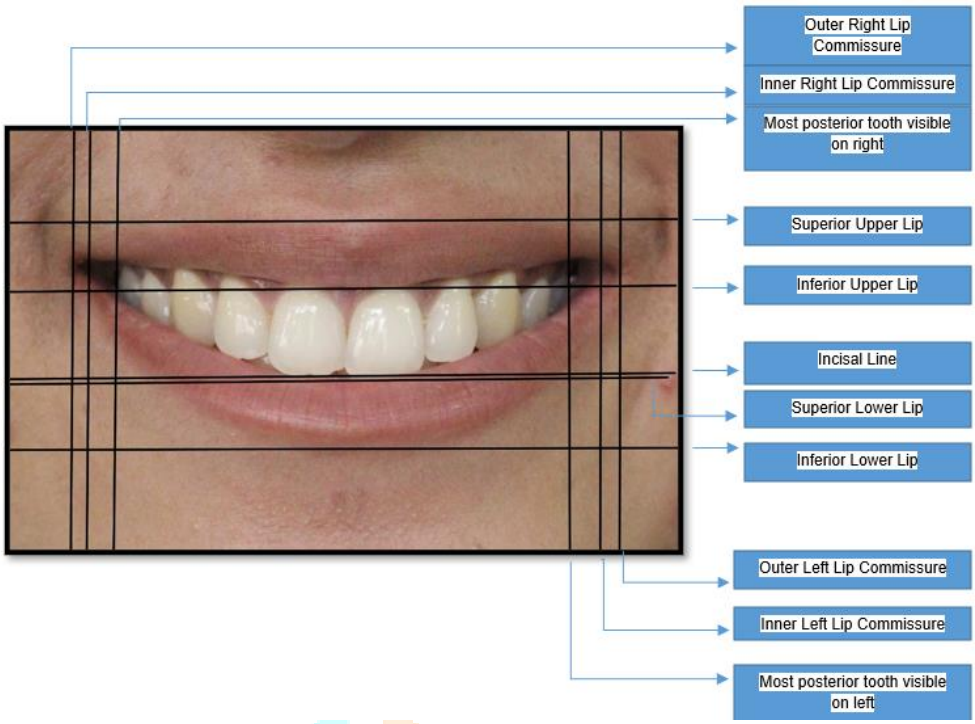


**Fig.3: Smile mesh**

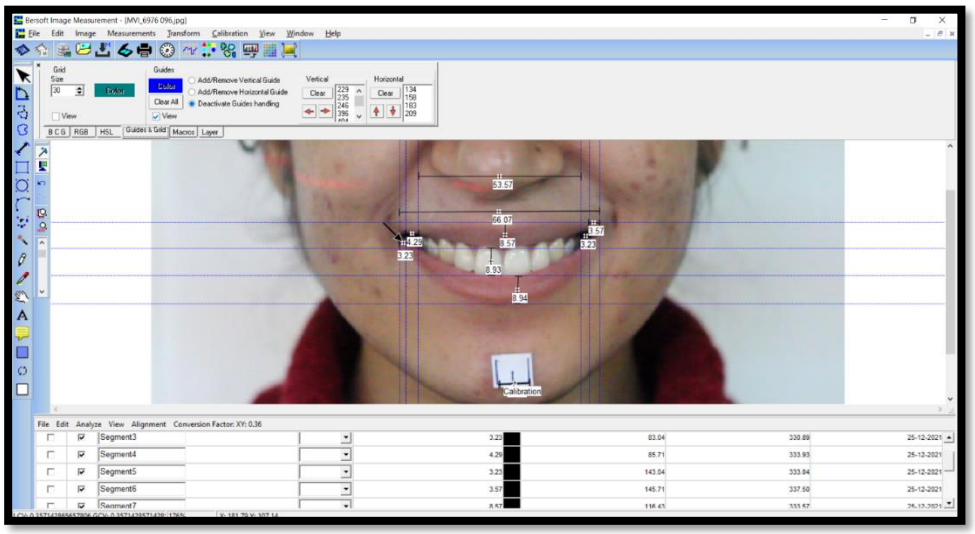

**Fig.4: Bersoft Image Measurement Software with measurement of parameters**

Horizontal lines-

1.) Superior Upper Lip

2.) Inferior Upper Lip

3.) Incisal Line

4.) Superior Lower Lip

5.) Inferior Lower Lip

Vertical Lines-

1.) Outer Left Lip Commissure

2.) Inner Left Lip Commissure

3.) Most posterior tooth visible on left

4.) Most posterior tooth visible on right

5.) Inner Right Lip Commissure

6.) Outer Right Lip Commissure

Hence, by the above mentioned mesh following parameters for both posed & dynamic smile were determined –

1.) Dentogingival display- The distance from the incisal edge of the left maxillary central incisor to the most inferior portion of the tubercle of the upper lip following a vertical line. (Inferior upper lip- incisal line)

2.) Inter Labial Gap- Distance between the most inferior segment of upper lip and the deepest midline point on the superior margin of the lower lip. (Inferior upper lip- Superior lower lip)

3.) Visible posterior teeth width- Distance from the most lateral aspect most posterior tooth visible on left-most posterior tooth visible on right

4.) Smile width- Distance from the right outer commissure to the left outer commissure.

5.) Commissure Corridor Left- Horizontal distance between the left inner and outer commissure.

6.) Commissure Corridor Right- Horizontal distance between the right inner and outer commissure.

7.) Buccal Corridor Left- Horizontal distance between the lateral aspect of the left most posterior visible tooth and left inner commissure.

8.) Buccal Corridor Right- Horizontal distance between the lateral aspect of the right most posterior visible tooth and right inner commissure.

9.) Upper Lip Height- Vertical distance from the most superior margin of the upper lip to the most inferior segment of the tubercle of the upper lip. (Superior upper lip- inferior upper lip)

10.) Lower Lip Height- Vertical distance from the deepest midline segment of the superior margin of the lower lip to the most inferior segment of the lower lip. (superior lower lip- inferior lower lip)[2]

**Statistical analysis**

Standard descriptive statistics (means and standard deviations) were calculated for the Smile Mesh measurements. Reproducibility amongst posed and dynamic smile was assessed using intraclass correlation coefficient. Intergroup comparison between posed and dynamic smiles was done using independent t test.

## RESULT

Table 2 and Fig. 5 shows Intraclass correlation coefficient test to assess the reproducibility in posed group. It was observed that measurements of dentogingival display showed substantial agreement whereas interlabial gap, visible posterior teeth width, smile width, upper lip height, lower lip height showed almost perfect agreement between two measurements. Moderate agreement between two measurements was observed in commissure corridor left width, buccal corridor right width, buccal corridor left width whereas a slight agreement in measurements of commissure corridor right width.

**TABLE-2 Assessment of reproducibility within posed smile groups**

| Variable | Cronbach α | ICC | 95% CI | | p value |
|---|---|---|---|---|---|
| | | | Lower | Upper | |
| **Dentogingival display** | 0.796 | 0.799 | 0.645 | 0.886 | 0.001* |
| **Interlabial gap** | 0.899 | 0.900 | 0.824 | 0.943 | 0.001* |
| **Visible posterior teeth width** | 0.919 | 0.919 | 0.857 | 0.954 | 0.001* |
| **Smile width** | 0.867 | 0.865 | 0.762 | 0.923 | 0.001* |
| **Commissure corridor right** | 0.117 | 0.119 | -0.573 | 0.504 | 0.333 |
| **Commissure corridor left** | 0.516 | 0.502 | 0.141 | 0.714 | 0.006* |
| **Buccal corridor right** | 0.441 | 0.440 | 0.019 | 0.681 | 0.022* |
| **Buccal corridor left** | 0.429 | 0.424 | -0.003 | 0.671 | 0.026* |
| **Upper lip height** | 0.876 | 0.878 | 0.785 | 0.931 | 0.001* |
| **Lower lip height** | 0.924 | 0.923 | 0.865 | 0.956 | 0.001* |

Intraclass correlation coefficient test; * indicates significant correlation at p≤0.05

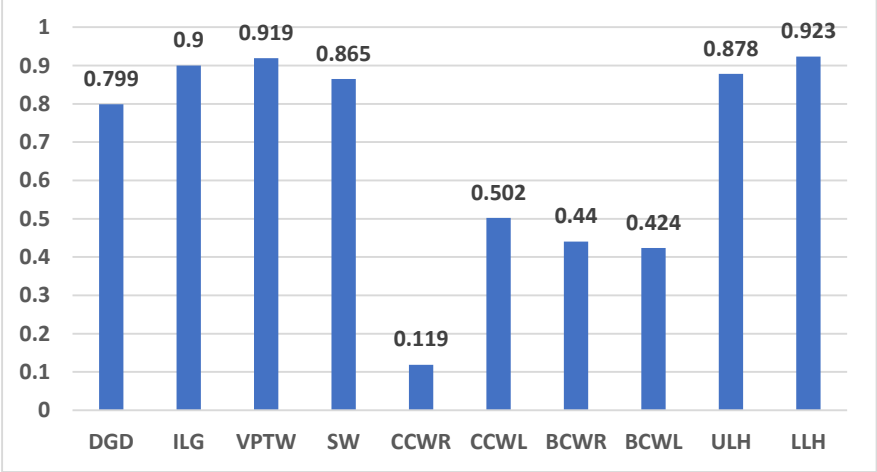


**Fig.5: Assessment of reproducibility within posed smile groups**

Table 3 and Fig. 6 shows Intraclass correlation coefficient test to assess the reproducibility in dynamic group. It was found that measurements of dentogingival display, interlabial gap, visible posterior teeth width, smile width, buccal corridor right width, upper lip height, lower lip height showed almost perfect agreement whereas substantial agreement in commissure corridor left width, buccal corridor left width & moderate agreement commissure corridor right width was observed between two measurements.

**TABLE-3 Assessment of reproducibility within dynamic smile groups**

| Variable | Cronbach α | ICC | 95% CI | | p value |
|---|---|---|---|---|---|
| | | | Lower | Upper | |
| **Dentogingival display** | 0.927 | 0.926 | 0.869 | 0.958 | 0.001* |
| **Interlabial gap** | 0.946 | 0.944 | 0.900 | 0.968 | 0.001* |
| **Visible posterior teeth width** | 0.980 | 0.980 | 0.965 | 0.989 | 0.001* |
| **Smile width** | 0.967 | 0.966 | 0.941 | 0.981 | 0.001* |
| **Commissure corridor right** | 0.538 | 0.536 | 0.188 | 0.736 | 0.004* |
| **Commissure corridor left** | 0.706 | 0.706 | 0.484 | 0.833 | 0.001* |
| **Buccal corridor right** | 0.856 | 0.857 | 0.749 | 0.919 | 0.001* |
| **Buccal corridor left** | 0.761 | 0.764 | 0.583 | 0.866 | 0.001* |
| **Upper lip height** | 0.931 | 0.932 | 0.880 | 0.961 | 0.001* |
| **Lower lip height** | 0.970 | 0.971 | 0.949 | 0.983 | 0.001* |

Intraclass correlation coefficient test; * indicates significant correlation at p≤0.05

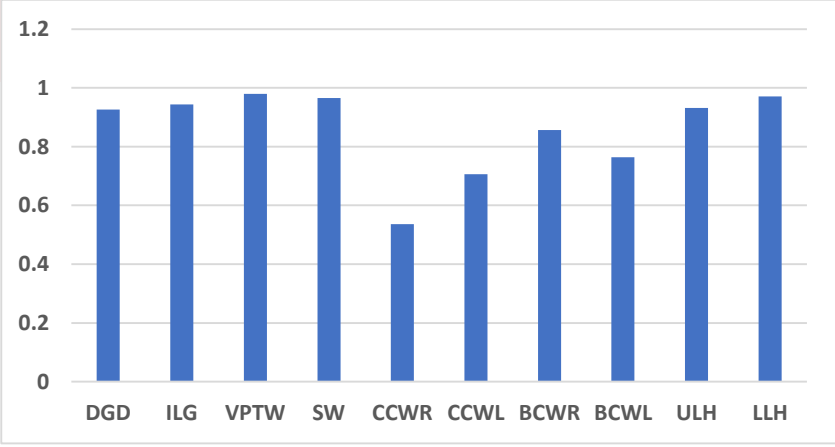


**Fig.6: Assessment of reproducibility within dynamic smile groups**

Table 4 and Fig. 7 shows comparison of smile assessment between posed and dynamic. It was observed that there was a significant difference in commissure corridor width on right side (p=0.003), commissure corridor width on left side (p=0.001), buccal corridor width on right side (p=0.013) and buccal width on left side (p=0.001).

**TABLE-4 Comparison between posed smile and dynamic smile groups**

| Variable | Posed smile | | Dynamic smile | | Difference | p value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| **Dentogingival display** | 7.74 | 0.90 | 7.88 | 1.07 | -0.14 | 0.500 |
| **Interlabial gap** | 8.27 | 1.24 | 8.67 | 1.31 | -0.38 | 0.121 |
| **Visible posterior teeth width** | 48.54 | 3.15 | 49.47 | 3.30 | -0.97 | 0.150 |
| **Smile width** | 62.03 | 3.35 | 62.96 | 3.49 | -0.93 | 0.177 |
| **Commissure corridor right** | 3.25 | 0.31 | 3.53 | 0.29 | -0.28 | 0.001* |
| **Commissure corridor left** | 3.44 | 0.31 | 3.60 | 0.30 | -0.16 | 0.009* |
| **Buccal corridor right** | 3.44 | 0.34 | 3.21 | 0.40 | 0.23 | 0.002* |
| **Buccal corridor left** | 3.45 | 0.27 | 3.23 | 0.36 | 0.22 | 0.001* |
| **Upper lip height** | 7.15 | 1.05 | 7.15 | 1.07 | 0.00 | 0.967 |
| **Lower lip height** | 9.61 | 1.35 | 9.43 | 1.53 | 0.18 | 0.540 |

Independent t test; * indicates significant difference at p≤0.05

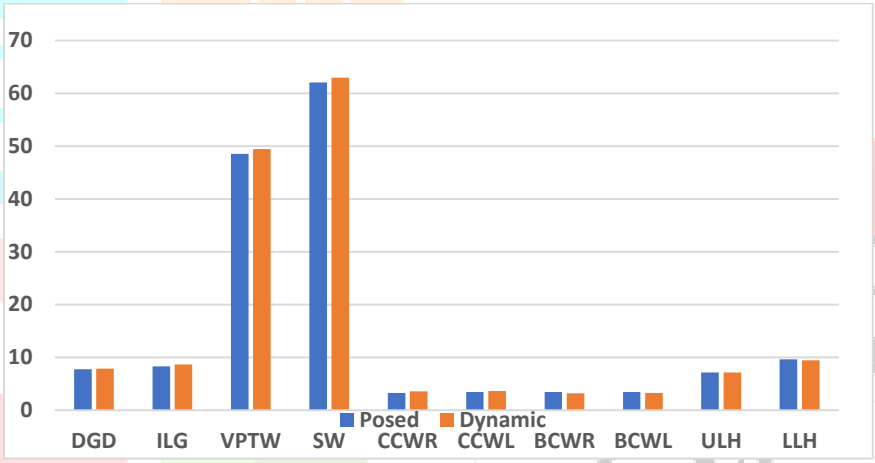


**Fig.7: Comparison between posed smile and dynamic smile groups**

## DISCUSSION

Often clinician faces a situation where the desired outcomes are not achieved & one of the possible reason for it can be unfavourable growth & morphologic changes in soft tissues pertaining to age, so as a measure to remove this discrepancy the current study evaluated smiles of individuals from 18 years i.e. when changes in lips are no more noticeable[11] upto 28 years of age i.e. the age after which a decrease is observed in the resting tonus & elasticity as well as in the activity and function of muscles involved in smiling[8].

Ackerman et al[3] and Sarver & Ackerman[9] were the pioneers in the use of videography to analyze smiles, according to them a video (about 30 frames per second) produces a more predictable & standardised smile. Thus, measurement errors could be reduced by extracting the frame with widest smile or dynamic smile i.e the smile which bursts forth & does not sustain & is accompanied by pronounced deepening of nasolabial folds and squinting of eyes[3]. Hence, in the current study 5 second video clips were recorded at a rate of 30 frames per second, out of them every 16th

frame were selected since smile changes after every 15 consecutive frames[10] & the one representing dynamic smile was chosen according to Ackerman et al[2]. A 100mm macrolens mounted on Canon 1200D camera was used on an adjustable tripod stand placed at a distance of 5 feet from the subject to produce images with a ratio of 1:1[12] thereby evaluating & measuring different parameters from sharp & focused image at their original magnification[13]. Along with that a sticker was fabricated of 1cm marking & placed on subject's chin in each session for calibration and elimination of any magnification errors[8].

Since natural head position is a stable & reproducible extracranial reference at various long & short intervals[14] which can be determined by two methods- firstly by keeping the head upright with one's eyes focused at infinity & secondly by asking the patient to look into his/her eyes in mirror[15]. Thus, in the current study subject was made to sit in an upright position wearing a headband containing two laser lights on either side of head and looking into his/her eyes in mirror consisting of a plane mirror on one side and a grid on the other side. The points on the grid where the 2 laser lights falls were noted which thereby helps to reposition the head in subsequent appointments & minimise the errors in roll & yaw. Deviation in pitch was minimized by using Horizontal laser beam coincident to FH plane of subject[16] as Frankfort Horizontal Plane relates closely to Natural Head position & thus could be recommended as its alternate[17]

The samples collected were then reviewed and the one which showed any discrepancy pertaining to head movements were eliminated. After thorough evaluation it was found that the subjects in eliminated samples had a discrepancy in the position of horizontal reference i.e. horizontal laser beam. Thus, in order to obtain reliable images horizontal reference play a key role.

Many aspects of smile have been addressed in literature, however reproducibility is evaluated only in a few studies. In the current study, reproducibility of posed smile at two intervals was analysed. It was found that a statistically significant correlation existed amongst nine out of ten parameters which were anterior dentogingival display, interlabial gap, visible posterior teeth width, smile width, commissure corridor left, buccal corridor left and right , upper lip height & lower lip height which shows that posed smile is reproducible & consistent which is in accordance to Hulsey[18], Rigsbee[19], Rubin[20] and Walder[21].

While evaluating the reproducibility of dynamic smile, a statistically significant correlation was found between all the ten parameters, thus concluding that dynamic smile is highly reproducible. Till now reproducibility of dynamic smile was not evaluated, thus making this study unique.

On analysing difference between posed & dynamic smile a positive correlation was found between the two. Out of the various parameters evaluated a significant difference was found in commissure corridors & buccal corridors, the possible reason for such a difference could be the two dimensional structure of buccal corridor in frontal view in which even a minor change or difference in light conditions can cause variation in right & left side this was in accordance to Schabel et al.[10] Amongst the various muscles involved in smile, lifting of cheek muscles & corners of mouth is

influenced by orbicularis oris muscle which influences the commissure corridor. It has been found that this muscle can voluntarily controlled by most of the people [22]. Since one of the side of buccal corridor is the commissure, thus any variation in the orbicularis muscle activity of individual can also influence the buccal corridor.

## LIMITATIONS

The limitations of the current study include-

1. Use of ambient light in the study can be one of the factors for producing a significant difference in the buccal corridor thus standardization pertaining to light is a lacunae in the current study.

2. Use of same headband for all head sizes and improper repositioning of the it can increase the chances of errors.

## CONCLUSION

1. The overall reproducibility of posed smile at two intervals had statistically significant correlation between nine out of ten parameters.
2. The overall reproducibility of dynamic smile at two intervals had statistically significant correlation between all ten parameters.
3. On comparing posed and dynamic smile, statistically significant difference was found between buccal corridors and commissure corridors.

Hence, it can be concluded that both posed and dynamic smiles can be reliably reproduced. However, the added benefit with a dynamic smile is that the orthodontist can select the frame which shows the best & widest smile.

## REFERENCES

1. Otta E, Folladore Abrosio F, Hoshino R. Reading a smiling face: messages conveyed by various forms of smiling. Percept Mot Skills 1996;82:1111-21.
2. Ackerman JL, Ackerman MB, Brensinger CM, Landis JR. A morphometric analysis of the posed smile. Clin Orthod Res. 1998;1(1):2-11.
3. Frank MG, Ekman P, Friesen WV. Behavioral markers & recognizability of the smile of enjoyment. J Pers Soc Psychol. 1993;64(1):83-93.
4. Van der Geld P, Oosterveld P, Van Waas MA, Kuijper-Jagtman AM. Digital videographic measurement of tooth display and lip position in smiling and speech: reliability and clinical application. Am J Orthod Dentofacial Orthop. 2007;131(3):301-8.

5. Moskowitz M, Nayyar A. Determinants of dental esthetics:a rationale for smile analysis & treatment. Compend Contin educ Dent 1995;16:1164-6.

6. Tarantili VV, Halazonetis DJ, Spyropoulous MN. The spontaneous smile in dynamic motion. Am J Orthod Dentofacial Orthop. 2005;128(1):8-15.

7. Ackerman JL, Ackerman MB. Smile analysis and design in the digital era. J Clin Orthod. 2002;36(4):221-36.

8. Rao A, Badavannavar A, Acharya A. An orthodontic analysis of the smile dynamics with videography. J Oral Biol Craniofac Res. 2021;11(2):174-9.

9. Sarver DM, Ackerman MB. Dynamic smile visualization and quantification: part 1. Evolution of the concept and dynamic records for smile capture. Am *J* Orthod Dentofacial Orthop. 2003;124(1):4-12.

10. Schabel BJ, Baccetti T, Franchi L, McNamara JA. Clinical photography vs digital video clips for the assessment of smile esthetics. *Angle* Orthod. 2010;80(4):678-84.

11. Mamandras AH. Growth of lips in two dimensions: a serial cephalometric study. Am *J* Orthod Dentofacial Orthop. 1984;86(1):61-6.

12. Stutts WF. Clinical photography in orthodontic practice. Am *J* Orthod Dentofacial Orthop. 1978;74(1):1-31.

13. Kalpana D, Rao SJ, Joseph JK, Kurapati SK. Digital dental photography. Indian J Dent Res. 2018;29(4):507-12.

14. Üşümez S, Orhan M. Inclinometer method for recording and transferring natural head position in cephalometrics. Am *J* Orthod Dentofacial Orthop. 2001;120(6):664-70.

15. Cooke MS, Wei SH. The reproducibility of natural head posture: a methodological study. Am *J* Orthod Dentofacial Orthop. 1988;93(4):280-8.

16. Suresh G, Anil C, Chakravarthy VG, Vizia M, Kishore T. Device to take facial photographs in Frankfort horizontal plane in a standardized manner at repeated intervals. J Indian Orthod Soc. 2018;52(1):17-21.

17. Shetty D, Bagga DK, Goyal S, Sharma P. A cephalometric study of various horizontal reference planes in Natural Head Position. J Ind Orthod Soc. 2013;47(3):143-7.

18. Hulsey CM. An esthetic evaluation of lip-teeth relationships present in the smile. Am *J* Orthod Dentofacial Orthop. 1970;57(2):132-44.

19. Rigsbee OH, Sperry TP, BeGole EA. The influence of facial animation on smile characteristics. *Int J Adult* Orthodon Orthognath Surg. 1988;3(4):233-9.

20. Rubin LR. The anatomy of a smile: its importance in the treatment of facial paralysis. Plast Reconstr Surg. 1974;53(4):384-7.

21. Walder JF, Freeman K, Lipp MJ, Nicolay OF, Cisneros GJ. Photographic and videographic assessment of the smile: objective and subjective evaluations of posed and spontaneous smiles. Am *J* Orthod Dentofacial Orthop. 2013;144(6):793-801.

22. Ekman P. Darwin and facial expression: A century of research in review. New York: Academic Press;1973.p.169-222.