Facial photogrammetry during phases of female sexual cycle and estimation of facial attractiveness as biomarker of ovulation

ABSTRACT

Background: Facial photogrammetry during various phases of female sexual cycle was used to estimate the facial beauty/attractiveness of females at menstruation and ovulation phase of their monthly cycle; in order to form basis of using facial attractiveness as a biomarker of ovulation.

Methods: Thirty-seven (37) volunteered female scholars in an institution in Southern Nigeria were purposively selected to include menstruating females of 17 – 28 years. Photographs of the selected subjects were taken during menstruation and two weeks after menstruation (ovulation period). Afterwards, photogrammetric analysis was performed; 350 males were asked to pick preferred facial picture of each of the subjects.

Results: There was significant differences between the facial proportions measured during the sexual cycle and ideal facial proportion of the subjects $p<0.05$. The estimation of attractiveness was higher in ovulation phase as there was positive significant correlation of facial proportions of the subjects during the various phases of their sexual cycle.

Conclusion: The findings suggests that facial beauty/attractiveness may be used to estimate the sexual cycle of females as enhanced facial beauty/attractiveness could be a biomarker of ovulation.

Keywords: Photogrammetry, Sexual cycle, Ovulation, Facial beauty, Attractiveness.

Introduction

Photogrammetry is the evaluation of qualitative and quantitative features of objects and environments via measuring, recording and interpreting photographic emulsions as well as patterns of electromagnetic radiant imagery etc. [1, 2]. Photogrammetry evolved from plane table type to digital photogrammetry since its invention by Colonel Aime Laussedat in 1851. Digital photogrammetry involves the use of computers to perform photogrammetric analysis and it is also photogrammetry that is applied to digital photographs stored and processed in a computer [3]. Facial photogrammetry gives photographic analysis of the face and this can be used to determine facial beauty and attractiveness of an individual [4, 5].

Facial beauty determined by symmetry and ideal harmony of facial structures (features) consists of underlying facial bone (skeleton), fats compartment (which forms retaining ligaments) and

facial muscles responsible for facial expressions (frowning, smiling, laughing etc.). Facial beauty forms an aspect of attractiveness of an individual [6, 7].

Female sexual cycle plays vital role in human reproductive functionality as it involves menstruation and ovulation phase. Menstruation is the shedding away of unfertilized ovum, thereby giving room for production of more viable eggs, while ovulation is the release of an ovum that is ready for fertilization during the monthly (averagely 28 days) sexual cycle [8, 9]. Several hormones (Follicle stimulating hormone, luteinizing hormone, estrogen) influence the female sexual cycle and hormones like melanin also influence skin coloration which in turn adds to beauty and attractiveness of a person [10, 11].

Reports suggest that females are more attractive in the fertile phase of their sexual cycle [12, 13]: in animals; redness of waist, colourful plumes, etc. are biomarker of ovulation that makes them attractive as well as makes mating possible [14, 15]. In humans reliable indicators of ovulation is not fully explained. Hence, this study was designed to demonstrate the estimation of facial attractiveness as biomarker of ovulation using facial photogrammetry of females during various phases of their sexual cycle.

Materials and Methods

This study carried out in about 3 months was part of a dissertation in Human Anatomy Department, Gregory University, Uturu, Nigeria and it was performed in accordance to principles of ethics; Consent was obtained from volunteers and subjects' confidentiality was maintained. About thirty seven (37) volunteered subjected (17 – 28 years) was purposively selected; subjects with no history of facial surgery, no form of craniofacial anomaly and females with regular 28days menstrual cycle was included for the study. Exclusion criteria were for subjects with history of facial surgery, dental occlusion, allergies, prior facial fracture and craniofacial anomaly. Subjects with irregular menstruation as well as subjects on contraceptives were also excluded.

Photogrammetry procedures

All standardized facial photographs of selected volunteered subjects were taken using Nikon Coolpix A100 digital camera. The photographic set up is made up of a tripod stand which has support to mount digital camera. The height of the tripod stand was adjusted to fit subject's height as well as control the stability of the camera. The subjects stood in an upright and relaxed position, with both hands by their sides in front, a black wig cap covering their head showing their hairline and a graph sheet was pinned to the wall behind them providing a life size measurement. With the aid of the meter rule, the camera was placed exactly 100cm away from the subjects, the camera lens was zoomed as required to suit each subject's head size. Photographs were taken carefully and as accurately as possible to ensure that facial soft tissues were visibly captured. Captured pictures of subjects on the various phases of their sexual cycle was compiled on a power point presentation and presented to 350 males to pick the preferred one.

Facial parameters; the width of the eye, total height of the face, the chin length, width of the face at eye level, mouth width, width of the face at mouth level, height of the visible eye ball were measured on the print outs of the pictures to find the ideal proportions of beauty and differences in morphology. The differences in the width of the eye, the height of the face, the chin length, width of the face at eye level, mouth width, width of the face at mouth level, height of the visible eye ball were measured with a 30cm ruler. Analysis of the facial photographs was done using a computer based software program (SPSS) using the t-test. T-test was used to determine sexual dimorphism using some simplified mathematical relations to show the measures of dispersion. These included the mean, standard error of mean and standard deviation. The ranges and mean ± standard deviations were calculated for each angle and unpaired students t-test was calculated to find out the differences of facial parameters between the females in their different phases of menstrual cycle. A p value < 0.05 was set as statistically significant.

Results

Facial parameters during menstrual and ovulatory phases

Results showed the mean value, standard error mean (SEM), standard deviation (STD) of each of the facial parameters during the menstrual and ovulatory phases. The values of measured parameters showed no significance in all measured groups at $P < 0.05$ (Table 1).

Table 1: **Descriptive statistics and T test for inference of measured facial parameters of females during the phases of their sexual cycle**

Parameters	Phase	Mean	SEM	STD	T	df	Sig.(2-tailed)	Inference
WE	Menstruation	5.01	0.09	0.53	-.108	35	.914	NS
	Ovulation	5.03	0.11	0.68				

WFEL	Menstruation	20.08	0.25	1.48	-.188	35	.852	NS
	Ovulation	20.15	0.39	2.31				
MW	Menstruation	8.07	0.16	0.95	.397	35	.693	NS
	Ovulation	7.97	0.20	1.22				
WFML	Menstruation	16.36	0.26	1.54	-.051	35	.960	NS
	Ovulation	16.38	0.34	2.02				
THF	Menstruation	28.57	0.44	2.67	.417	35	.680	NS
	Ovulation	28.29	0.69	4.12				
CL	Menstruation	4.22	0.13	0.79	-.706	35	.485	NS
	Ovulation	4.32	0.14	0.81				
HVE	Menstruation	1.44	0.06	0.35	.373	35	.711	NS
	Ovulation	1.42	0.07	0.44				

WE= width of eye, WFEL = width of face at eye level, MW = mouth width, WFML = width of face at mouth level, THF = total height of face, CL = chin length, HVE = height of visible eyeball. NS= not significance.

Comparison of Cunningham's proportion for ideal beautiful face with obtained facial proportions

The comparison of Cunninghams proportion for ideal beautiful face with obtained facial proportions of females during phases of their sexual cycle; Pairs 1,2,3 showed differences in the comparison of Cunninghams proportion for ideal beautiful face while pair 4 which is the width of face at mouth level and width of mouth which showed perfect alignment with the postulated proportions at both phases of sexual cycle (Table 2).

Table 2: Comparison of Cunningham's proportion for ideal beautiful face with obtained facial proportions of females during phases of their sexual cycle

Variables	**Paired Parameters**	**Measured Parameters**		**Cunninghams Ideal proportion**	**Obtained Proportion**	**Difference**	**Inference**
	PAIR 1	WFEL	WE	Three-tenth			

Menstruation	WFEL	20.08	5.01	6.02	One-fourth	1.01	Strong
Ovulation	&WE	20.15	5.03	6.05	One-fourth	1.02	Strong
	PAIR 2	THF	CL	One-fifth			
Menstruation	THF & CL	28.57	4.22	5.71	One-seventh	1.49	Strong
Ovulation		28.29	4.32	5.66	One-seventh	1.34	Strong
	PAIR 3	THF	HVE	One-fourteenth			
Menstruation	THF&	28.57	1.44	2.04	One-twentieth	0.6	Strong
Ovulation	HVE	28.29	1.42	2.02	One-twentieth	0.6	Strong
	PAIR 4	WFML	WM	50%			
Menstruation	WFML	16.36	8.07	8.18	50%	0.11	Perfect
Ovulation	&WM	16.38	7.97	8.19	50%	0.11	Perfect

WE =width of eye, WFEL = width of face at eye level, MW= mouth width, WFML = width of face at mouth level, THF = total height of face, CL = chin length, HVE = height of visible eyeball.

Correlation of facial proportions of females during the menstrual phase of their sexual cycle

Table 3 shows the correlation of facial proportions of females during the menstrual phase of their sexual cycle. All facial parameters showed a likely hood of correlation but certain parameters showed positive significance. These parameters are the width of eye and width of face at eye level, mouth width and width of face at eye level, width of face at eye level and width of face at mouth level, width of face at mouth level and chin length that are significant at $p < 0.01$ while the width of face at eye level and total height of the face, width of eye and total height of face, mouth width and width of face at mouth level, mouth width and total height of face and total height of face with height of visible eyeball are significant at $p < 0.05$.

Table 3: Correlation of facial proportions of females during the menstrual phase of their sexual cycle

Parameters		WEm	WFELm	MWm	WFMLm	THFm	CLm	HVEm
Wem	Pearson Correlation	1	.602**	.411*	.204	.481**	.027	.310
	Sig.(2-tailed)		.000	.013	.232	.003	.877	.066
WFELm	Pearson Correlation	.602**	1	.595**	.562**	.734**	.076	.418*
	Sig. (2-tailed)	.000		.000	.000	.000	.662	.011
MWm	Pearson Correlation	.411*	.595**	1	.494**	.514**	.246	.118
	Sig. (2-tailed)	.013	.000		.002	.001	.148	.493
WFMLm	Pearson Correlation	.204	.562**	.494**	1	.377**	.631	.299
	Sig.(2-tailed)	.232	.000	.002		.023	.000	.076
THFm	Pearson Correlation	.481**	.734**	.514**	.377*	1	.210	.458**
	Sig.(2-tailed)	.003	.000	.001	.023		.219	.005
CLm	Pearson Correlation	.027	.076	.246	.631**	.210	1	.148
	Sig.(2-tailed)	.877	.662	.148	.000	.219		.389
HVEm	Pearson Correlation	.310	.418*	.118	.299	.458**	.148	1
	Sig.(2-tailed)	.066	.011	.493	.076	.005	.389	
	N	36	36	36	36	36	36	36

** Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

WE = width of eye, WFEL width of face at eye level, M W = mouth width, WFML = width of face at mouth, THF = total height of face , CL = chin length, HVE = height of visible eyeball. Values are expressed as Mean, ** Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)

Correlation of facial proportions of females during the ovulation phase of their sexual cycle

Table 4 shows the correlation of facial proportions of females during the ovulation phase of their sexual cycle. All facial parameters showed a likely hood of correlation but certain parameters showed positive significance. These parameters are the width of eye and width of face at eye level, width of eye and mouth width, width of eye and total height of face, width of face at eye level and width of face at mouth level, width of face at eye level and total height of face, mouth width and width of face at mouth level, width of face at mouth level and total height of face and width of face at mouth level and chin length are significant at $p < 0.01$ while the width of eye and width of face at mouth level, width of eye and height of visible eyeball, mouth width and total height of face are significant at $p < 0.05$.

Table 4: Correlation of facial proportions of females during the ovulation phase of their sexual cycle

Parameters		WEo	WFELo	Mwo	WFMLo	THFo	Clo	HVEo
WEo	Pearson Correlation	1	.669**	.652**	.527**	.582**	.231	.465**
	Sig.(2-tailed)		.000	.000	.001	.000	.176	.004
WFELo	Pearson Correlation	.669**	1	.622**	.845**	.732**	.399*	.266
	Sig.(2-tailed)	.000		.000	.000	.000	.016	.117
Mwo	Pearson Correlation	.652**	.622**	1	.665**	.459**	.276	.142
	Sig.(2-tailed)	.000	.000		.000	.005	.103	.407
WFMLo	Pearson Correlation	.527**	.845**	.665**	1	.578**	.575**	.117
	Sig.(2-tailed)	.001	.000	.000		.000	.000	.497
THFo	Pearson Correlation	.582**	.732**	.459**	.578**	1	.321	.392*
	Sig.(2-tailed)	.000	.000	.005	.000		.056	.018
Clo	Pearson Correlation	.231	.399**	.276	.575**	.321	1	.157
	Sig.(2-tailed)	.176	.016	.103	.000	.056		.361
HVEo	Pearson Correlation	.465**	.266	.142	.117	.392*	.157	1
	Sig.(2-tailed)	.004	.117	.407	.497	.018	.361	
	N	36	36	36	36	36	36	36
** Correlation is significant at the 0.01 level (2-tailed)								
*Correlation is significant at the 0.05 level (2-tailed)								

WE =width of eye, WFEL = width of face at eye level, MW = mouth width, W FML = width of face at mouth level, THF = total height of face, CL = chin length, HVE = height of visible eyeball. Values are expressed as Mean. ** Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed)

Men's perception of facial beauty of females during their sexual cycle and test for significance

Table 5 shows the descriptive statistics for men's perception of facial beauty of females during their sexual cycle and test for significance using ANOVA which showed that the comparison between the mean frequencies of the perception of females in the phases of their sexual cycle was 95%significant at $p < 0.05$ suggesting that men prefer females in their ovulatory phase.

Table 5: Descriptive statistics of Men's perception of facial beauty of females during their sexual cycle and test for significance using ANOVA

Parameters	N	Frequency	%Frequency	Mean Frequency	SEM	STD	df	F	Sig.	Inference
Menstruation	350	170	48.57	17.99	0.40	3.37	5	3247	.000	**

							3	.019		
Ovulation	350	180	51.43	19.00	0.40	3.39	6 9			

** indicates significant, SEM=standard error of mean STD= standard deviation

Discussion

Photogrammetry has been used over the years in obtaining measurement of objects in a photograph which has evolved from plane table photogrammetry to digital photogrammetry. Its application has been found useful in fields like archaeology, art, medicine where it is used in diagnosis and treatment of human conditions, biomedical research, production of planes of large or complex sites and neuroanatomical sections [1-5, 16].

In this study, photogrammetry was applied in order to evaluate facial attractiveness of females during menstruation and ovulation phases of their sexual cycles. This is to ascertain whether facial beauty/attractiveness maybe deduced as an indicator for ovulation; since unlike other animals that has visible signs of ovulation [14, 15], visible indicators of ovulation is not fully elucidated. Considering the preference of the males which tilts towards the facial picture during the ovulatory phase in this study, it was suggested that enhanced facial beauty/attractiveness could be a biomarker of ovulation as there was positive significant correlation of facial proportions of the subjects during the various phases of their sexual cycle. This corresponds to reports [12, 13] that suggest females are more attractive in the fertile phase of their sexual cycle.

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