RELATIONSHIP OF CANTHOLIMBAL DISTANCE WITH NECK MOVEMENTS AND FACIAL ASYMMETRY AMONG HEALTHY YOUNG ADULTS.

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ABSTRACT

Objectives: The primary objective is to measure the relationship between cantholimbal distance with neck movement and with facial asymmetry among healthy young adults.

Methods: This study recruited 30 participants of either sex, age (Male: 22.00±0.63 and Female: 21.41±1.10). Cantholimbal distance, neck range of motion and facial length were measured in both lateral flexion and rotation of head. Cantholimbal distance and facial length was measured by mm scale and neck range of motion was measured by universal goniometer. Correlation of all variable was calculated through SPSS.

Results: In **males**, facial length shows moderate correlation with cantholimbal distance in cervical rotation, and cervical lateral flexion. However, cantholimbal distance with cervical rotation and lateral flexion show low correlation. In **female**, facial length shows moderate correlation with cantholimbal distance in cervical rotation, and cervical lateral flexion. Moreover, cantholimbal distance shows moderate correlation with cervical lateral flexion. Also in female, cantholimbal distance in cervical rotation shows low correlation.

Conclusion: The study concluded that facial length shows moderate correlation with cantholimbal distance in cervical rotation, and cervical lateral flexion. Moreover, cantholimbal distance shows moderate correlation with cervical lateral flexion. Alternatively, cantholimbal distance in cervical rotation shows low correlation.

Key words: Cantholimbal distance; Neck movements; Facial asymmetry; Goniometer

INTRODUCTION:

Cantholimbal distance is defined as distance between lateral canthus and lateral corneal limbus. It can be used to evaluate the degree of head rotation. This cross sectional study revealed longer the cantholimbal distance , smaller the degree of head rotation involving individual with no squint eyes. The required distance is measured by using 5mm scale.(Ahn and Kim, 2016). In this study several palpebral fissure dimensions were measured and described normal values among healthy individual of black race. The palpebral fissure width which is the distance between medial and lateral canthi were higher in African population than other population (nigeria and turkey) by using 6 m tape measure, this difference of values in one population as compared to other strengthen the effect of race on palpebral dimensions.(Ibraheem et al., 2014) .In some study there is a method of measurement exophthalmolmetry which involve the measurement of the anteroposterior position of the globe in the orbit relative to the orbital rim. It is important because exophthalmos is a typical sign in thyroid eye disease, or Graves ophthalmopathy.(Lam et al., 2009)

In studies abnormal head position manifested with head tilt, face turn ,chin up and chin down is adopted to improve visual acuity in patient with various ocular muscle palsy which may present with head tilt toward unaffected eye, retraction of globe, narrowing of palpebral fissure, also head hilt towards affected eye and may be directed towards or away the side of hyper deviated eye moreover other than ocular there may be tightness of sternocleidomastoid muscle causing head tilt to the affected side turn to opposite side with chin elevation in congenital torticollis patients(Nucci and Curiel, 2009).The abnormal head posture have included in compensation of eyes deviation, visual field deficit and improvement in visual acuity. These head postures were adopted on various ocular condition and link these ocular condition with number of head postures to make effective techniques and planning therapy. Patient with either the presence of chin elevation, depression or vertical and horizontal deviation of eyes may have head tilt to or away to the affected side have head turned to improve the alignment of their eyes with conclusion

based on improvement in eye deviation related with improvement of head posture(Kushner, 1979).

In other study, it was to determine if ocular protrusion, asymmetry of protrusion and lateral interorbital width was dependent upon age. There was a significant reduction in ocular protrusion and lateral interorbital width with increasing age in both females and males. There was a strong correlation between ocular protrusion and lateral interorbital width.(Kaye et al., 1992)

UG, an instrument used most commonly for evaluating joint ROM in the clinical settings, comes out as a simple substitute for worldwide use at low price. Normal cervical spine range of motion is mostly altered by neck disorders. Cervical ROM is regularly measured when patients having neck pain visit the physical therapy clinics.(Farooq et al., 2016)

Facial asymmetry considers to the bilateral difference between location ,shape ,size and arrangement of each facial component about the sagittal plane.The assessment was conducted as patient are sitting comfortably in natural head position.Facial asymmetry results from congenital causes, environmental causes such as trauma, infection, tumor, and functional factors. Asymmetries from a single cause can have various patterns depending on personal characteristics, onset time, muscular compensation, and musculoskeletal development of the face (Choi, 2015). Several investigators conducting various method of examination of face have concluded that right side of neurocranium is larger than left so found that longer measurement on right side in both sexes in all three age group (6,12,18) .Most of the landmarks corresponds to bony landmarks of facial skeleton and measurement considered assymetric when difference between two sides was 2mm or greater. Unequal level of tragion contributed to high influential of physiological asymmetries of face. (Fakas, 1981).

Observational series concluded of facial asymmetries with different types of ocular torticollis with facial compression same side to the head tilt due to eye muscle imbalance.It is suggested that head tilt itself caused asymmetry.The process by which head tilt affect facial remodeling is unknown but it is suggested that continous muscle tension and changes in muscle innervation could play a role but in face turns the

sternocleidomastoid muscle act on side opposite the turn and facial constriction.(Greenberg and Pollard, 2000) Many studies have shown that mean values of facial measurement including canthal distance are race, age and gender sensitive. It has also been known that canthal distance values for an individual differ with age and tend to become consistent in the mid to late twenties. Normal canthal values can serve as a guide for diagnosis of pathology and surgical interventions in cases of craniofacial abnormalities.(Umweni, 2011)

A study was conducted on the normal values of outer intercanthal, inner intercanthal distance, canthal index, head circumference, near and far interpupillary distance in 23-42 years old Igbos. There was no significant diversity of P value ($P<0.05$) between the males and females in the measured parameters. This study has provided a database for this Igbo population and may assist craniofacial surgeons during surgery. Craniofacial measurements should be performed with the same world wide measures. The data achieved provided a guide when making a clinical assessment and in early treatment of craniofacial abnormalities and various syndromes. This information is of great emphasis in forensic investigations, clinicians and craniofacial surgeons during facial reconstruction.(Osunwoke et al., 2010)

Medial canthal distance and lateral canthal distances were necessary for both reconstructive surgery and orthodontic treatment. The study was executed on unrepaired cleft lip and palate patients, who were presented for surgical repair at children hospital in Nigeria before surgery. Results of the measurements were correlated with previously documented normal values in the Nigerian population of the same age group. There is notable difference in the medial and LCDs between CLAP patients and normal Nigerian population(Umweni, 2011).

The ICD was measured in several patients over the age of 14, who were hospitalized for maxillo-facial surgery under general anaesthesia. The distance between the inner canthus and the bony orbit plays an significant role in trauma surgery of the orbit as well as in corrections for increased distance between two medial canthi. Reduction of the ICD should be considered mostly in

patients with bilateral clefts, surgery on the bony structures be more successful than surgery of the soft tissues.(Freihofer, 1980)

The association between eye position and age was analysed in subjects age group 5-20 years and age group 21-80. The study was caused by a previous findings of a 3 mm increase in retraction of eye into the orbit from age of 10 to 18 year. A proposed decrease in orbital width towards old age was persistant, while a related increase in interpupillary distance was unexpected, the whole result being a more differing (relative) eye position with age. Interpupillary distance was measured in mm by an ordinary ruler for distant vision. An increase was evident during childhood and adolescence, along with the growth of the individual, while adult values were quite stable. Both show larger dimensions in the males.(Fledelius and Stubgaard, 1986)

To the best researcher's knowledge, the correlation between cantholimbal distance, neck range of motion, and facial asymmetry has not been documented. Similarly, the correlation between cantholimbal distance and neck range of motion has not been documented in more than one position. So the study will be conducted to determine their correlation. The study will help to find if the neck stiffness causes significant changes in cantholimbal distance and facial symmetry ,and the tightness or strain of ocular muscle associated with altered neck movement and facial changes in the clinical setting for better development of rehabilitation guidelines for such patients in near future. This study will help health professionals in the assessment of the patient with different eye problems e.g eye deviation or squint eyes, neck disorder e.g limited range of movement and facial asymmetry e.g in bell palsy to rule out which possible structures are involved and to direct treatment accordingly.

METHOD:

- Subjects were recruited from Shalamar school of allied health sciences on the basis of inclusion and exclusion criteria by purposive sampling. The purpose and procedure of study will be explained to the participant. Then consent form will be provided to each participant.

- After signing the consent ,the subjects will be asked for sitting with their back straight and strapped to the back of the wooden chair. Subject's ankles, knees and hips were positioned at right angle and arms were folded across the chest to minimize thoracic movement .The subjects will be asked to turn their head to the left and to fixate their eyes on a target 3 m away. The degree of head turn was measured with a goniometer to see two-points (3 m away) at 90 degree on both side perpendicular to the head position perform neck rotation(right and left) with the head being straight in sitting position. Neck ROM was measured in a standardized sitting position to remove errors and movement compensation.

- We will measure the cantholimbal distance of eyes(right and left) by mm scale with standard point of measurement was lateral corner of eye to the lateral outer part of eyeball and simultaneous neck rotation on both sides with goniometer same procedure apply for lateral flexion(right and left) except the individual will be asked to see two points(3 m away) at 60 degrees on both side. Then we will measure cantholimbal distance of eyes(right and left) by mm scale with a goniometer for lateral flexion(right and left) measurement and it will be recorded. Same and uniform verbal instructions were given to all subjects to take these measurements.

- The standard point of measurement for cervical rotation while performing with goniometer was:
  - Axis: Placed over center of top of the head
  - Stationary arm: Placed in line with acromion process
  - Moving arm: Placed in line with tip of nose.
- The standard point of measurement for cervical lateral flexion while performing with goniometer was:
  - Axis: Placed over spinous process of C7.
  - Stationary arm: Placed along thoracic spinous processes.
  - Moving arm: Placed over external occipital protuberance.

- Simultaneously with cantholimbal distance measuring in both lateral

flexion and rotation facial length will be measured along with these movements on both sides(right and left) and measurement will be taken by plastic millimeter scale in standardized sitting position. The landmarks will be marked in ink on skin to help in precise measurement which is the lateral corner of the orbital area and tragion also called tragus (orbito-tragion).The standard point of measurement was lateral corner of eye to the tragion area of ear.This distance will be measured during rotation and lateral flexion as mentioned above to find its correlation with cantholimbal distance and neck movements(rotation and lateral flexion).

- All the measured values are compared with the baseline to check the limitation and restrictions. All these measurements are recorded on the proforma. All this procedure on an individual will take 5 minutes.

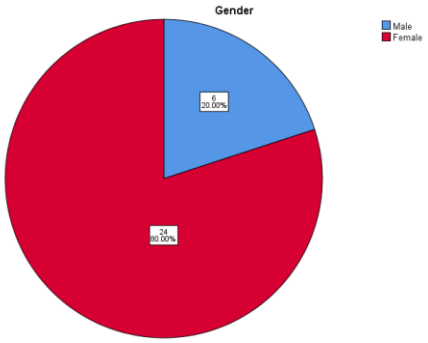
RESULT:

Frequencies

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	6	20.0	20.0	20.0
	Female	24	80.0	80.0	100.0
	Total	30	100.0	100.0	

Gender Distribution



T-Test

	Male	Female	P – value
Age	22.00±0.63	21.41±1.10	0.226
Cantholimbal distance in right side rotation	4.50±0.54	4.25±0.84	0.500
Cantholimbal distance in left side rotation	5.00±0.00	4.13±0.90	0.026*
C.ROM in right side rotation	61.67±2.58	62.71±3.89	0.542
C.ROM in left side rotation	63.33±2.58	61.04±2.07	0.028*
Face length in right side rotation	8.30±0.28	8.18±0.46	0.562
Face length in left side rotation	7.93±0.42	7.95±0.36	0.924
Cantholimbal distance in right lateral flexion	8.17±1.32	7.13±1.72	0.181
Cantholimbal distance in left lateral flexion	8.33±1.96	8.29±1.51	0.955
C.ROM in right lateral flexion	25.83±2.04	24.38±3.98	0.397
C.ROM in left lateral flexion	24.17±2.04	24.79±4.03	0.718
Face length in right lateral flexion	8.56±0.41	8.24±0.47	0.142
Face length in left lateral flexion	8.11±0.37	7.93±0.39	0.323

Independent Samples Test, p-value significant at 0.05

Table showing the mean,standard deviation and significance of all the variable present in the study. Only the variable cantholimbal distance in left side rotation and cervical range of motion in left side rotation in both male and female show significant difference while all the other variables show no significant difference.

TABLE OF CORRELATION

Correlation between cantholimbal distance , neck movements(rotation and lateral flexion) and face length.

Gender		Right side	Left side	P-value	R
Male	Cantholimbal distance in rotation	4.50±0.54	5.00±0.00	0.076	.000
	C.ROM in rotation	61.67±2.58	63.33±2.58	0.363	-.250
	Face length in rotation	8.30±0.28	7.93±0.42	0.018*	.807

	Cantholimbal distance in lateral flexion	8.17±1.32	8.33±1.96	0.849	.281
	C.ROM in lateral flexion	25.83±2.04	24.17±2.04	0.175	.200
	Face length in lateral flexion	8.56±0.41	8.11±0.37	0.015*	.712
Female	Cantholimbal distance in rotation	4.25±0.84	4.13±9.00	0.450	.585
	C.ROM in rotation	62.71±3.89	61.04±2.07	0.088	-.095
	Face length in rotation	8.18±0.46	7.95±0.36	0.001*	.793
	Cantholimbal distance in lateral flexion	7.13±1.72	8.29±1.51	0.001*	.533
	C.ROM in lateral flexion	24.38±3.98	24.79±4.03	0.732	-.076
	Face length in lateral flexion	8.24±0.47	7.93±0.39	0.001*	.686

Paired Samples Test, p-value significant at 0.05

This table shows the Correlation between cantholimbal distance with neck movements and face length. In **males**, facial length shows moderate correlation with cantholimbal distance in cervical rotation, and cervical lateral flexion. However ,cantholimbal distance with cervical rotation and lateral flexion show low correlation. In **female**, facial length shows moderate correlation with cantholimbal distance in cervical rotation, and cervical lateral flexion. Moreover, cantholimbal distance shows moderate correlation with cervical lateral flexion. Also in female, cantholimbal distance in cervical rotation shows low correlation.

RESULT(CORRELATION TABLE):

In Males:

1. Face length in right side rotation was 8.30±0.28mm and in left side rotation was 7.93±0.42mm the difference was statistically significant(0.018).
2. Face length in right lateral flexion was 8.56±0.41mm and in left lateral flexion was 8.11±0.37mm the difference was statistically significant(0.015).

In Female:

1. Face length in right side rotation was 8.18±0.46mm and in left side rotation was 7.95±0.36mm the difference was statistically significant(0.001).
2. Cantholimbal distance in right lateral flexion was 7.13±1.72mm and in left lateral flexion was 8.29±1.51mm the difference was statistically significant(0.001).
3. Face length in right lateral flexion

was 8.24±0.47mm and in left lateral flexion was 7.93±0.39mm the difference was statistically significant(0.001).

DISCUSSION:

This study recruited 30 participants, age 18-25 years (21.41±1.10) .After obtaining the consent from the participants who were fulfilling the inclusion criteria, cantholimbal distance, cervical ROM and face length are measured. Each reading was taken once at each position to prevent the fatigue.

The present study correlates cantholimbal distance with cervical ROM and facial asymmetry in both cervical rotation and lateral flexion.,this study also calculates the difference of correlation between cantholimbal distance with cervical ROM and facial asymmetry in male and female in different neck position.

In previous study, patients with comorbidities, such as hearing loss, visual field defects, spine and neck abnormalities, or atlantoaxial instability were excluded. This study involved measurement of head rotation on both left and right side and recorded the degree of head rotation when cantholimbal distance was 0, 5mm and 10mm .The result of this study revealed the longer the cantho-limbal distance, the smaller the degree of head turn.($p < 0.01$)

This study shows that as the cantholimbal distance decreases ,the degree of head rotation increases and found significant correlation between these two variables with cantholimbal distance measured by 5mm scale and degree of head position by simple goniometer. (Ahn and Kim, 2016).

In our study shows that cantholimbal distance have higher correlation with cervical lateral flexion then the cervical or head rotation in both right and left side performed in standardized sitting position. Our study tells us that changes in cantholimbal distance are more significant in cervical lateral flexion limitation then the cervical rotation restriction.

Another study involved abnormal head tilts due to many ocular pathology and the palsies of nerve supplying ocular muscles. The abnormal head postures were acquired by these patient in order to improve their visual acuity. This study told us about different ocular muscles were involved in various palsies that caused deviation of eyeball with accompanied abnormal head tilts which alter

the normal cantholimbal distance in these individuals.(Nucci and Curiel, 2009)

But our study checked the changes in normal cantholimbal distance is correlated with changes in normal C.ROM in rotation and lateral flexion in population with no significant diagnosed pathology. Our results shows that cantholimbal distance changes are more correlated with change in range of normal cervical lateral flexion than rotation which tells us that restriction in muscle involved in lateral flexion can cause more deviation of eyeballs which in turn changes cantholimbal distance.

Another study calculated normative data for palpebral fissure dimensions, it included horizontal and vertical palpebral fissure, lateral and medial canthal distances, inter-outer canthal distance and inter-inner canthal distance were measured in African population in neutral head position .The differences in these values among the studied population compared with other population further reinforce the effect of race and tribe on palpebral dimensions. This study did not correlated the changes with these distance with cervical range of movement .But this study indicated that changes in these value may be linked with facial asymmetry that is not detected due to lack of advanced equipments.(Ibraheem et al., 2014)

But our study shows that facial length have moderate correlation with cantholimbal distance in cervical rotation and lateral flexion which tells us that changes in normal value of cantholimbal distance are linked with facial asymmetry on the involved side so it provide true connection of changes in these values with face asymmetrical condition.

Another study measured medial and lateral canthal distance in patient with craniofacial abnormality ,the results of these measurement showed that these distances were higher in patient with these abnormalities and these normal values assisted the surgeon in planning the surgical intervention for these abnormalities with possible diagnosis. However these normal values were different in different population, gender and age. (Umweni, 2011)

But in our study we have examined the changes in normal cantholimbal distance is correlated with changes in facial symmetry in both rotation and lateral flexion. This tells us that the facial symmetry changes in any facial abnormality causes deviation in eye ball position. Also facial muscle tightness due to any unknown cause can result in change in eyeball position which will be evident on

appearance. So our study may provide link that the change in eye ball may be due to underlying facial muscle pathology so will help in effective diagnosis.

CONCLUSIONS

It is concluded that facial length shows moderate correlation with cantholimbal distance in cervical rotation, and cervical lateral flexion. Moreover, cantholimbal distance shows moderate correlation with cervical lateral flexion. Alternatively, cantholimbal distance in cervical rotation shows low correlation.

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