Chapter 5 : Discussion

‘***The pursuit of truth and beauty is a sphere of activity in which are permitted to remain children all our lives’ … Albert Einstein.*** However growth and development never stops, beginning in the foetus and continuing throughout adult life.

Craniofacial growth is a complex interplay of structure and function and involves an interrelationship between all component parts. No part is independent or self contained. Changes in facial shape and form always take place as the face grows into adulthood. In general, human faces show much similarity and the presence of individual variation in facial characteristic is well recognized and gives a great clinical significant. This variability becomes clinically manifest in the individual size and shape of the adult craniofacial complex (Enlow, 1980).

Enlow (1982) suggested mentioned that the face of prepubertal boys and girls are essentially comparable. In females, facial development slows after age of 13 or the skeletal growth changes in the face slows and ceases shortly after puberty. In males, facial development begins to be fully manifested at puberty and continues throughout the adolescent period and into early adulthood. It means that similarities that exist between sexes during childhood are altered markedly during teenage.

The growth from infant into an adult is characterised by increases in height and weight and also by changes in posture and proportions and by maturation of the skeleton and sex organs (Ranly, 1988).

Spalding stated that during post natal growth, the cranial vault growth completes before the cranial base and is then followed by nasomaxilla and finished with the mandible. It means that the mandible has the most delayed growth but the most postnatal growth of all the facial bones (Spalding, 2004).

As the purpose of this cross sectional study was to provide the norm or standard data for the pre-pubertal Malay boys and girls, the differences in growth pattern between these 2 age-groups and gender differences play an important role in influencing the results obtained. In the next discussion, the growth changes that takes place between these 2 age-groups and also the differences between genders will form the basis for discussion to explain the results obtained.

5.1 Craniofacial Anthropometric measurement analysis in Malaysian pre pubertal Malay children age 7 and 12-year-old

Quantitative anthropometric measurements have been proven to be very useful in evaluation of post natal development in the craniofacial region (Farkas & Posnick, 1992). We know that the human growth continues throughout life and as what is expected, the analyzed data in this cross sectional study showed that eighteen out of twenty two linear anthropometric measurements showed a significantly higher measurement in the elder age group for both genders (p<0.05). However the head length (g-op) and head circumference (on-op) showed a significantly higher mean values in the elder female children whereas the head height (v-n) was higher in the elder male children only.

Interestingly the eye fissure height (ps-pi) showed a significantly smaller mean in the 12-year-old as compared to the 7-year-old. This was significant statistically significant for both genders (p<0.05).

From this study, it was found that most proportion indices remained unchanged when comparing the samples of 2 different age groups. Of the seventeen proportion indices, 3 calculations showed a significantly smaller proportion index in the 12-year-old as compared to 7-year-old group. These indices were middle-lower third face depth index (t-sn x 100/t-gn), eye fissure index (ps-pi x 100/ex-en) and upper lip height-mouth width index (go-go x 100/ch-ch). These finding were statistically significant for both genders. The only proportion indices that was significantly higher in the elder children were the nasal tip protrusion-nose width index (sn-prn x 100/al-al). This was statistically significant for both genders (p<0.05).

The lower-upper lip height index (sto-sl x 100/sn-sto) and the mouth-face width index (ch-ch x 100/zy-zy) showed statistically significantly higher indices in the elder male children only. Higher nose-face height index (n-sn x 100/n-gn) was observed in the female children only (p<0.05). Lastly the intercanthal index (en-en x 100/ex-ex) showed a significantly smaller proportion index in the elder age group but this was only observed in the female (p<0.05).

Generally when comparison was made between genders in the same age group, it was noted that the males had a larger measurement than females for both aged group.

For the 7-year-old, the linear anthropometric measurements showed a significant difference ($p<0.05$) between gender in 6 parameters. They were head width (eu-eu), head length (g-op), maxillary depth(t-sn), mandibular depth (t-gn), binocular width (ex-ex) and upper lip height (sn-sto). However most proportion indices remained the same. Significant differences ($p<0.05$) were observed in the upper lip height-mouth width index (sn-sto x 100/ch-ch) and that was higher in males and in the lower-upper lip height index (sto-sl x 100/sn-sto) that was higher in the female.

For the 12-year-old children, generally the male had larger measurements than the female. Linear anthropometric data analysis showed statistically significant difference ($p<0.05$) between gender in 5 parameters namely, the craniofacial height (v-gn), mandibular width (go-go), maxillary depth (t-sn), mandibular depth (t-gn) and upper lip height (sn-sto).

For the proportion indices, significant differences between gender were noted only in the mandible-face width index (go-go x 100/zy-zy) and the upper lip height-mouth width index (sn-sto x 100/ch-ch) in which males recorded higher indices. From the findings, it suggests that other proportion indices remained rather constant.

5.1.1 Head

The head region grows and functions in a three-dimensional manner. According to Spalding, the post natal growth of the cranial vault is markedly highest in vertical dimension, the anteroposterior is somewhat less and the transverse is the least (Spalding, 2004).

In this study, the linear measurement of the head width (eu-eu) reflects the transverse growth, the head length (g-op) reflects anteroposterior growth while the head height (v-n) reflects the vertical dimensions of the head. It was found that the male showed the highest growth in head height followed with head length and head width and this agree well with Spalding findings. Interestingly female between 7- year-old and 12-year-old groups showed a highest growth in head length followed with head width and head height. Why female has a different growth pattern at this region remain a question until further studies are undertaken.

A few studies found that the growth of the cranium is related to the developing brain. Foster(1999) found that the cranium has grows rapidly before birth and continues to grow rapidly up to 1 year of age, accommodating the brain. By seven year old, the cranium has reached about 90% of its final volume and then the growth is increases slowly to maturity.

Farkas and Posnick(1992) also found that the cranial vault grows rapidly in the first year of life and with the velocity of the growth plateau in the following 5 years The skull, as cited by Behrents (1985) also grows rapidly from birth to the seventh year and then the growth is slow from the seventh year until the child approaches puberty. Spalding (2004) suggested that the pressures exerted by the developing brain determine the size and shape of the cranium. As the brain expands, the pressure creates tension across the sutures and compression against the cranial bones resulting in intramembranous bone growth by suture and surface apposition.

From the analyzed data of the healthy Malay pre pubertal children, it was noted that the head width (eu-eu), head length (g-op), head height (v-n) and head circumference (on-op) were higher in the elder children (Table B-1). These finding explained the continuous growth of the head region during this pre pubertal period. The continuous growth at this region was most probably due to the continuous growth of the brain. The finding in head width was statistically significant in elder group of both genders (Table A-1). The head length and head circumference were significantly higher in the elder female school children (Table A-2) whereas the head height was only significantly higher in elder group of male only (Table A-3). These finding showed that depending on the areas of the head, the male and female may showed a different rate of growth whereby at some area female had growths that exceeded the male's and vice versa; or both of them achieved a same rate of growth between 7 and 12 year old.

Gender differences showed that the male generally showed a larger measurement than female in the same comparable aged group. This was observed in head width (eu-eu), head length (g-op), head height (v-n) and head circumference (on-op).

It was shown that even though the male had a larger mean value, but it was female who showed a bigger difference in head width (eu-eu) and head length (g-op) when comparing the elder children to the younger groups (Table B-1).

For the head length, again the male had a larger measurement but still the female was found to have bigger difference in head length compared to male when comparing the elder children to the younger ones (Table B-1). However the gender difference was only significant in 7-year-old age group with almost no different in age group of 12-year-old. Apart from the enlargement of the brain due to growth, the increase in head length might be contributed by the continuous enlargement of the frontal air sinuses. Bjork (1955) analysed 243 radiographs of subjects between aged 12 and 20 year old. Tanner cited him to that the forward growth of the forehead at adolescence could indeed by the development of the brow ridges and the frontal sinuses (Tanner, 1962). When relating Bjork's findings to ours it suggest that at 12-year-old the development of the frontal air sinuses and the brow ridges that causes the forward growth of forehead or reflects the head length (anteroposterior) had already occurred at a same time in female and male, hence at the age of 12-year-old there were no significant difference between this genders (Table 4.1.2).

Interestingly our finding suggested that the head height (v-n) of the male had undergone more rapid growth than female (Table B-1). When comparison was made with the finding of Al-Junid on Malay adult aged 18-25years old, it was noted that the male have a continuous rapid growth in the head height as compared to female; (male: 104.4mm and female: 94.8mm) (Al Junid, 2005). However the female showed no statistically significant head height between 7 and 12 years old. The head height in the 12-year-old female of our study was only slightly lower than noted in 18-25 year old. This indicated that rapid growth in head height for female had already occurred before seven and growth occurs rather slows from seven to adulthood.

Head circumference (on-op) is the most frequently reported measurement in the medical literature. It has been used as an indicator of cranial volume and often used in the young infant as a rough measure of brain development (Thilander, 1995). It was noted that head circumference (on-op) of the male was generally larger than female in both aged group. The female showed a bigger difference in head circumference between the 2-age-groups studied. However the difference was not statistically significant ($p>0.05$).

Our study found that there was almost no different in cephalic index between the genders and between age-groups. This means that proportion wise, the proportional quality of the head was constant irrespective of gender and age. The cephalic index gives an idea whether the head is bracycephalic (short wide head) or dolichocephalic (long-narrow head). When the cephalic index measures up to 74.9, the head is considered dolicocephalic and if the index ranges between 75.0 and 79.9 it is called mesocephalic and when the range is between 80.0 to 84.9 then the head is considered brachycephalic (Farkas, 1994). The Malay school-children of both genders and age group in our study was found to have brachycephalic head (Table B-1)

Al-Junid (2005) found that the Malay adult also have a brachycephalic or relatively short wide head (Al-Junid, 2005). Both ours and Al-Junid finding suggested that the brachycephalic type of head in the Malay population had already taken shape during pre pubertal period.

The discussion for the craniofacial height (v-gn) and the head-craniofacial height index will be discussed in the face region because they are inevitably interrelated to each others.

5.1.2 Face

The face is the most important part of the human body. It is often said that **'*beauty is in the eye of the beholder*'** (Margaret Hungerfold), however for a clinician or surgeon, facial beauty arises from symmetry, balanced and harmonious proportions. The normal data that obtained form this study will help us in identifying the symmetry, balanced and harmonious proportion in these2 groups of children.

The facial framework is identified horizontally or transversely by the width of the face and mandible, vertically by the facial heights and laterally by the depths of the maxilla and mandibular region (Farkas, 1992).

In this study the transverse framework are indicated by the measurement of face width (zy-zy) and mandibular width (go-go). The measurement of face height (n-gn), upper face height (n-sto), and mandibular height (sto-gn) gives an idea of the facial framework vertically. The depth of maxilla (t-sn) and mandible (t-gn) shows a lateral framework of the face.

As expected the data obtained in this study showed that the transverse, vertical and depth of the facial framework of 12-year-old group of both genders were significantly larger than 7-year-old group of both genders (Table B-1). This suggested that there was a possible continuous incremental growth that has happened during this period.

Thilander stated the facial skeleton increases in all dimensions during post natal growth period. Facial growth has been reported to end first in width, then in length and finally in height (Thilander, 1995). On contrary, Hellman(1935) noted that the depth of the face increased the most, followed by height and width.

In this study it was found that the most biggest difference in measurement occurred in the mandibular depth and maxillary depth and was followed by differences in vertical height and width measurement. This finding agrees well with Thilander’s statement that of all facial bones the mandible shows not only the largest amount of post natal growth but also the largest individual variation in morphology (Thilander,1995). The finding is also consistent with Hellman's observation where he found that the depth of the face increased the most followed by height and width.

Mandibular depth (t-gn), which is also a measurement of the lower third face depth showed the largest measurement among the facial framework. The theory behind the growth of the mandibular depth is that the mandible grows forward and downward due to displacement of the whole bone. This creates the conditions for a simultaneous growth in the size of the bone in the opposite direction, including a lengthening of the basal arch at the condyle. Together with the backward and upward condylar growth, the ramus is relocated posteriorly. Deposition thus occurs on the posterior margin of the ramus with simultaneous bone resoption along its anterior contours. At the same time the marked lengthening of the alveolar bone may also occasionally occur (Thilander, 1995).

The maxillary depth (t-sn) which is the measurement of the middle third face depth increased consistently with mandibular depth. The 12-year-old group has larger maxillary depth (t-sn) than 7-year old group and this was noted in both genders (Table B-1). The findings were statistically significant ($p<0.05$). The result suggested that there was a continuous growth at this region during this pre pubertal period. The maxillary growth occurs in an antero-inferior or forward-downward direction. The bone deposition occurs on the tuberosity and at adjacent sutures (temporozygomatic and nasomaxillary). The alveolar base elongates during this period and as a result creating space for posterior and late erupting teeth (Thilander, 1995). The resulting forward-downward translation also displaces adjacent bones and permits adequate space for the developing naso pharynx (Spalding, 2004).

This reflects the reason for the increment in the maxillary depth because the subjects in this study were still at the stage of mixed dentition (7 year old) and at the age of preparing to have fully permanent teeth (12 year old). The increment also indicated the development of the naso pharynx over this period of time.

The vertical dimension of the face is represented by the facial height. The upper anterior face height is primarily correlated with growth changes in the cranial base while the dimensions of the lower face height is dependent on muscle function, environmental factors as well as airway functional space and head posture (Thilander, 1995).

The measurement from nasion to stomion (n-sto) represents the upper face height. The vertical growth of the middle face occurs as a result of displacement of the maxilla antero-inferiorly to create space for an expansion of the nasal cavity and orbits. At the same time the vertical growth of the alveolar process is rapid during tooth eruption (Thilander, 1995).

Alternatively Spalding (2004) explained in detail that the increase in vertical facial height or more precisely in middle face is consistent with the growth of the maxilla. The downward and forward displacement of the maxilla is due to the continous growth of the brain and cranial base. Further vertical growth of maxilla continues with contributions from frontomaxillary, frontonasal, frontozygomatic, eithmoidalmaxillary sutures and possibly the nasal septum. The vertical descent of maxilla is also further increased by remodelling with resorption on the nasal surfaces and simultaneous apposition on the oral surfaces. The maxillary growth also depends on various functional matrix such as the influence of respiration to enlarging the nasal cavity, the influence of oral function in determining the oral structures and the role of surrounding facial soft tissues. The vertical growth of the maxillary alveolar process is rapid during dental eruption and this contributed to the vertical height of the face. (Spalding, 2004). This fact was reflected in the upper face height of our subjects since their age is consistent with the stage of eruption of permananet dentition.

The mandible height (sto-gn) or also considered as lower third face height measures the lower vertical face anteriorly. The result showed a statistically significant difference with a 12-year-old of both genders showing higher measurement than the 7-year-old. This again suggested of a continuous growth of the lower vertical dimension of the face during pre pubertal period as what happened to the upper and middle face height. The growth of the condylar cartilage contributes most of the total ramus height which will be reflected in the vertical face height. During childhood the inclination of condyle is more vertical as compared to at birth where the inclination of the condyles is more horizontal. This vertical inclination results in greater increase in height than length. The alveolar process also contributes a great portion of the vertical height of the lower face. Their development is entirely dependent on the presence and eruption of the primary and permanent dentition (Splading, 2004). Thus the eruption of the mandibular teeth enhances the vertical growth of the mandible and contributes to the height of the face as what we infer from our samples here.

The face height (n-gn) is represented by the measurement from nasion (point of nasal root) to gnathion (chin point). As expected the face height of the 12-year-old children was significantly larger than the 7-year-olds (Table B-1) since the facial height was a total of the upper and lower facial height. The increase in vertical face height thus was likely a result of the vertical growth of the maxillary and mandibular bone.

The 12-year-old had higher craniofacial height (v-gn) than 7-year-old in and this finding was significant. The craniofacial height represents the total height of the vertical dimension of the head and face. It is not a surprise to see the significant increase in this region because all the other measurements that represents the vertical head-face height (head height, upper face height and lower face height) was consistently larger in the elder group. It indicates that consistent growth of the head, upper face and lower face had occurred within this period of time.

The face width (zy-zy) represents the upper face width. The face width in the 12-year-old observed to be significantly higher in both genders. It suggested that there was a continuous growth in this transverse dimension of the face. The face width or the transverse growth of the face is contributed by the zygomaticomaxillary sutures and it also consistent with the growth of maxillary bone. The enlargement of the maxillary sinuses also contributes to the transverse growth in facial region (Spalding, 2004).

Generally we found that the facial width of the male was always larger in both age groups. Thus from this finding it can be suggested that large facial width is a feature of male that would continue into adulthood.

The mandible width (go-go) is a bigonion diameter that represented lower face width. It was noted that both genders of 12-year-old had higher mandible width ($p<0.05$). The mandible experiences the most delayed growth and the most postnatal growth of all the facial bones. Initially at birth, the mandible is in retrognathic position relative to the maxilla however rapid growth after postnatal corrects this discrepancy. It has been found the mandible growth continues longer to the end of adolescent growth. The peak in rate of mandibular growth at puberty usually results in the final correction of the mandibular position relative to the maxilla (Spalding, 2004).

The width of the mandible in this study was less than the facial width thus it suggests that the sample subjects in this study had not reached the puberty where the peak growth of the mandible should occur. It also noted that the width increases to be less than vertical changes (Snodell et al., 1993; Bishara et al., 1995). Similar to this, we found that the mean facial height mean was higher than the facial width.

As the male has a larger mandible width as compared to the female in both age groups, it may form a basis on why male has a more prominent jaw than female.

When further analysis was done from the gender point of view, it was noted that male showed a larger mean than female in the comparable age group for all dimensions of facial region (Table B-1). Taking the larger mean into consideration, the data suggested that male had more prominent angle of the jaw, broader face and more vertical height to start with during pre pubertal period. If these gender related differences continuous into adult life, then it gives a reason as why male has a manly look and female has a feminine look.

However it was found that at some area of the face, markedly in vertical facial height(n-gn); upper facial height (n-sto) and mandible height (sto-gn) and facial width (zy-zy) showed there were no significant differences between genders in the same comparable age-group. This suggests that the growth at this region are rather constant regardless their age and gender. The gender-related differences is markedly noticeable in the mandible width, maxillary and mandibular depth. This explains the difference in features between male and female; with male having more prominent and broader jaw. These features had already started to form during their pre pubertal age.

Proportion wise, the middle-lower third face depth index (t-sn x 100/t-gn) of the elder group of both gender was smaller than younger group. This findings was statistically significant. The smaller mean in this index was related to the higher mean value in mandible than maxilla.

Mandible-face width index (go-go x 100/zy-zy) shows proportion index of a mandibular width in relation to the facial width. There was no significant different between gender at age 7-year-old and a significant difference of about 2.5mm in age 12-year old, with the male's index was larger than female. The larger mandibular width and face width in male may have contributed to this. It suggests that by 12-year-old, the male had a manly look with a broader face and more prominent jaw while the female may retain some of their pre pubertal proportion.

Five parameters namely the facial index (n-gn x 100/zy-zy), the mandibular index (sto-gn x 100/go-go), the upper face-face height index (n-sto x 100/n-gn), the mandible-upper face height index (sto-gn x 100/n-gn) and head craniofacial height index(v-nx100/v-gn) showed no significant difference when comparing the two age groups and genders. As a result, these finding suggested that generally these proportion remain unchanged or rather constant irrespective of age and gender difference during period.

5.1.3 Orbits

The eyes play a major role in human communication. They have been often described as the *'window of the soul'* and perhaps the most capable part of the face to express human emotions.

Orbital measurements in children and orbital growth development have been reported by several authors (Juberg & Touchstone, 1975; Farkas, 1992; MacLachlan & Howland, 2002). It is a generally accepted fact that the position of the eyes is useful for the diagnosis of a large number of syndromes. Ocular adnexal changes and somatometric traits of the face such as epicanthus, telecanthus, flat nasal bridge, widely spaced eyebrows and blepharophimosis may create an illusory error in the identification of certain craniofacial syndromes. Therefore the normal value of the inner-canthal distance, outer canthal distance, interpupillary distance may help in the evaluation of telecanthus, ocular hypotelorism and hypertelorism (Evereklioglu, 2001). The study in the orbital region in Chinese Taiwan children revealed that the inner canthal distance (en-en) is wider than the palpebral fissure length (ex-en) while this result is the reverse in Caucasian children. From the finding it was suggested that it is not correct to diagnose hypertelorism in Chinese children in Taiwan base on the western data. It was suggested that the measurements should be adjusted with a normal standards specific for race (Wu et al, 2000).

From this study we have established our own data for the Malaysian children at age of-7 and 12-year-old. Hopefully these normals mean value can help us to differentiate hyper telorism from the normal eye position. It was found that the intercanthal width (en-en), binocular width (ex-ex) and eye fissure length (ex-en) was significantly higher in elder age group as compared to younger group (Table B-1). This gives evidence to a continuous growth at this region during this period of time. Interestingly it was noted that the eye fissure height (ps-pi) was significantly smaller in elder age group ($p<0.05$).

The overall intercanthal widths (en-en) in Chinese subjects in the Republic of Singapore are 34.4mm ± 2.7 in male and 34.0mm ± 2.3 in female aged 6-year-old. The intercanthal width was 37.5mm ± 2.8 in male and 35.6mm ± 2.9 in female for the 12 year old (Farkas, 1994) Our overall result was slightly lower than theirs (Table B-1). In comparison with the data of the 7- and 12-year-old Caucasian North America children (Farkas, 1992) our mean value was slightly higher than their results (7 year old male; 30.2 ± 2.5; 7 year old female; 30.1 ± 1.9 and 12 year old male; 32.0 ± 2.1; 12 year old female; 31.6 ± 2.6). This finding suggested that the intercanthal width (en-en) of the Malay population at this age group was in between the Chinese children and the Caucasian children. Therefore we should establish, confirm and use our own data in making a diagnosis for the orbital region. This data could also be used as a guide during reconstruction or as an evaluation for the success of reconstruction post operatively.

For the eye fissure length (ex-en), the measurement for the 12-year-old-group was statistically significantly larger than 7-year-old group (Table B-1). Our study showed that the eye fissure length was wider than intercanthal width. This is in contrast with the finding among the Chinese children in Taiwan whereby the intercanthal width was wider than the eye fissure length and caused the look of hypertelorism in their age group. Our finding was consistent with that of the Caucasian children where they have a wider in eye fissure length than intercantal width (Farkas, 1994).

The biocular width (ex-ex) is the measurement of the distant between the right and left outer commisure of the palpebral fissure. As expected it was shown that the 12-year-old manifested a higher measurement than 7-year-old. This finding was statistically significant ($p<0.05$). The increment in the biocular width gives rise to a question as whether the increment was due to the increase in intercanthal width or the eye fissure length. Farkas's (1992) observation in the 1 to 18 years old group showed that the intercanthal width gained 57.7% from its total growth increment from age 1 to 5 years old in contrast to the 16% of the total growth increment achieved in biocular width. The increase in intercanthal width was consistent with the growth in the interorbital spaces in infancy and early childhood. It suggested that the continuous, gradual annual increment occurs in binocular width (84%) is greater than intercanthal width (43.7%) after 5 year old (Farkas 1992). Based on Farkas's finding, it can be suggested that the increase in binocular width (ex-ex) at the age of seven and twelve were contributed much by the growth in palpebral fissure. It is a known fact that the development of the eye makes a major contribution to the induction of the orbit. Alternatively factors influencing the growth of the globe may influence the development of the orbit. Biometric study shows that the palpebral fissure developed more rapidly than the eye (Daniele, 1998). It shows that these inter related factors influences the growth in the orbital region.

Interestingly eye fissure height (ps-pi) showed that the elder groups were 0.59mm smaller in females and 0.75mm in males. These findings were significant. It is a wonder why the eye fissure height decrease in elder age group. Generally the eyes appear large in young children but appear smaller in proportion in adults. A young children appears to have a larger eye than adults because the orbit and its soft tissue matured earlier than the nasal and jaws (Enlow & Hans, 1996). Behrents (1985) suggested that with age the thickness of eyelid is reduced due to deposit of lipid. The eyes also appear sunken with drooping bags and deep supraorbital creases. It is suggested that since the eyes matured earlier than the nose and jaws, the orbit showed a minimal increment in relation to the face that increases more rapidly. This is therefore reflected in the size of the orbit that looked smaller. Since the soft tissue around the orbit also matured earlier, aging around the orbital soft tissue may occur at the early age as indicated in our finding.

Gender-wise showed that male generally had higher intercanthal width (en-en), binocular width (ex-ex) and eye fissure length(ex-en) but the reverse was true for eye fissure height (ps-pi).

There were no statistically significant difference in intercanthal width, eye fissure length and eye fissure height between genders of both age groups. This suggest that both genders may have the same growth rate for this region between age 7 and 12-year-old.

The difference between gender in binocular width was only significant in 7-year-old group whereas there was no significant different in twelve years old. We are unable to postulate a reason for this finding.

The intercanthal index (en-en x 100/ex-ex) is the relationship of the intercanthal width to the biocular width and it has a great influence in the visual judgement of the proportions of the orbits. The elder male and female showed a smaller intercanthal index but it was statistically significant only in the female. The smaller in intercanthal index might due to early maturation of the intercanthal width. It has been suggested earlier the increment for the intercanthal width is less than the length of the eye in older children. This suggestion was based on Farkas (1992) finding that the biocular width shows a more continuous, gradual annual increment after 5 years old than intercanthal width. Hence on a mathematical calculation of the intercanthal index, the figures become smaller in older samples. Alternatively at the beginning of the fetal life the face shows a relative hypertelorism. This is related to the lateral position of the ocular cups during the embryonic period. However this relative hypertelorism progressively diminishes during foetal life leading to a decrease in intercanthal width to biocular distance ratio. This process continues after birth until adult age (Daniele et al, 1998).

Female had a higher intercanthal index for the 7-year-old but in contrast, elder male had a larger intercanthal index. This observation might be explained by possible early maturation in intercanthal width in female.

The eye fissure index (ps-pi x 100/ex-en) of elder group was significantly smaller than younger group. The smaller mean value in this index might due to the overall decrease in eye fissure height. Female generally had a larger eye fissure index than male but this finding was not statistically significant ($p>0.05$).

5.1.4 Nose

The nose is the central focus and aesthetic unit of the face. It can be further subdivided into 5 subunit; dorsum, side, tip, ala and soft triangles. The border of the subunit allows for scar camouflage when reconstructing nasal defects (Ridley, 1992).

The nasal growth plays an important contribution to changes in the overall facial profile. The nasal growth occurs mostly over the first five years of life and includes growth of the bony and cartilaginous regions. Peaks in growth coincides with the development of the nasal airway complex (Farkas, 1992).

It was found that the nasal width (al-al), nose height(n-sn) and nasal tip protrusion were significantly higher in elder group of both genders and this suggested that continuous growth in the nasal region still happened by the time the children reach age 12-year-old.

The nasal width is proportional to the width of one eye at the nasal base (Ridley, 1992). However Epker and Fish (1986) stated that the normal alar base width is generally several millimetres wider than the intercanthal distance. Our finding is in agreement with their statement (Appendix- B). Alternatively an increase in nasal size has been reported whereby Burke and Hughes-Lawson (1989), using stereophotogrammetry and Snodell et al. (1993) using lateral cephalometry, showed a greater change in alar width. They concluded that the greater change in alar width is corresponding with the increase in intercanthal width due to orbital growth.

The nose height (n-sn) showed a statistically significantly higher in height in the elder group of both sexes (Table B-1). The increase in nose height has been explained by

Behrents (1985) in a study through cephalometric technique. He stated that the most anterior point on the nose continues to move forward and downward direction in all ages. The increases in nose height are also explained by the enlargement of nasal airway (Behrents, 1985).

The measurement for the nasal tip protrusion (sn-prn) was significantly higher in the elder group as compared to younger group (2.34mm in males and 2.59mm in females). Chaconas (1969) while studying the cephalometric radiographs found that the tip of the nose grew forward with the anterior positioning of the nasal bone. He also found that the nose grews concomitantly with the maxilla and mandible.

In this study, it was noted that male generally was larger than female in all region of the nose except in nasal tip protrusion where the 12-year-old female showed a slightly larger mean than male. Behrents also shows that the males have a larger nose as compared to female.

The differences between genders for both aged group in nasal width showed a minimal differences by 0.82mm in the 7-year-old and 0.95mm in the 12-year-old. A few researchers noted that the nasal width has generally been found to be quite small in pre pubertal period with the male's nose being up to 1mm larger than the female (Farkas, 1981; Nanda et al,1990; Snodell et al, 1993). However our findings were discovered to be not statistically significant.

The gender differences for both aged group in nasal height and nasal tip protrusion were not statistically significant, thus it suggested that these region may have undergone similar growth among male and femaleby the time the children reach age 12-year-old.

The nasal index (al-al x 100/n-sn) was significantly larger in the elder group; by 2.83mm in males and 3.72mm in females. The higher in nasal index might correlate with the increased in nose width and nose height. Generally male has a higher index than female. This finding was consistent with the higher mean value in nasal width and nasal height in male.

The nasal tip protrusion-nose width index (sn-prn x 100/al-al) showed that the elder group had a significantly higher index and this observed for both genders. This is consistent with the higher mean in nasal tip protrusion and nasal width in the elder group for both genders as compared to younger group.

The remaining of the indices, namely the nose-face height index (n-sn x 100/n-gn) and nose-face width index (al-al x 100/zy-zy) did not show any statistically significant difference irrespective of age and genders.

5.1.5 Lips and mouth

The lips are contained within the lower third of the face. It is a dynamic and expressive aesthetic unit of the face. Fullness and strong definition of the philtrum are associated with youth whereas the loss of lip highlights and flatness are associated with aging (Ridley, 1992).

It has been found that the rapid growth observed in transverse dimension follows vertical growth in the lips and mouth region. The vertical growth of lower lip was noted to be more than the upper lip.

Again in this region the elder group of both genders were significantly higher (Table B-1) in upper lip height (sn-sto), mouth width (ch-ch) and lower lip height (sto-sl). As a result it suggests the continuous growth in this region between 7 and 12-year-old.

Proffit stated that although the vertical height of the lips rarely is considered an important part of the growth pattern but the height of the centre part of the lips (philtrum) trails behind the vertical height of the face. This explains why the 12-year-old children of both genders were significantly higher than 7-year-old in upper (sn-sto) and lower lip height (sto-sl) because earlier finding in the face region had already found that the vertical dimension of the facial height was always higher in elderchildren. If the upper and lower lips follow the vertical dimension of the facial height then once the facial height increases the vertical height of the lips also follows. Proffit further stated that the lips grow earlier in girls than boys.

The mouth width (ch-ch) in elder children was statistically significantly higher than younger children If we take into consideration that the mouth also grows as the face grows, then the higher mouth width at this study group is consistent with the higher in nose width and facial width.

The upper lip height-mouth width index (sn-sto x 100/ch-ch) showed that the elder group was smaller than younger group and this was statistically significant (Table 4.5.4). The decrease in this index can be explained by the significant increase in mouth width as compared to upper lip height. The sex differences in upper lip height-mouth width index vary from 2.99mm in the 7-year-old group to 2.19mm in twelve years old group and this finding were statistically significant. It showed that the proportion or the ratio of upper lip height to mouth width is different in this range of age group for both genders. It indicates to us that further study needs to be done in this region for individual age of children between seven to twelve (i.e 8yearold, 9 year old, 10 year old and 11 year old).

The lower-upper lip height index (sto-sl x 100/sn-sto) was statistically significantly higher in elder male only. The significant difference in male can be explained by the larger lower lip height in male than female but similar rate of increases in upper lip height in both sexes. There was a significant difference between genders (5.18mm) at age of seven only. It suggests that the difference in proportion only occurred at the age of seven at age of twelve, the proportion for this region almost the same irrespective of genders. As with the upper lip height-mouth width index, further study need to carried on children of different individual ages to ascertain when the differences between gender stops.

The mouth-face width index (ch-ch x 100/zy-zy) showed a statistically significance only in male (1.42mm, larger in the elder children). The index is higher due to the more obvious increase in mouth width as compared to face width in male.

5.2 Limitation of this study

Anthropometry is a direct measurement that uses standard landmarks and instrumentation to compare populations. By applying anthropometric, the facial sizes and proportions are gain and the surgeon uses this data to reproduce normal proportion for their patients when performing reconstructive surgery. It is well accepted now that the so-called ‘standard measurement’ should not applied to the whole race on earth (Rogers, 1974).

Although new technologies are developed and available in our daily clinical practise, it has been proven that anthropometry offers a cheaper, non-invasive, simple and provides a complete set of data for the studied age-group. Moreover the measurement taken is comparable between genders.

In this study, the methodology was adapted from the study done by Hajnis et al (1994). However there is always the possibility of human error when performing the measurement. Difficulty in identifying landmarks will result in poor repeatability and inconsistent measurements. As pointed out by Ward & Jamison (1991), the linear measurement of small magnitude leads to poor reliability because any given error would produce a greater percent deviation from the true distance. During measurement, high cooperation from the subjects is required. The use of high quality measurement tools also advisable. Contributing the difficulty in this study was the full cooperation from the subject in the age group of seven, as they get bored and tired very easily.

Even though the subjects chosen were of convenient sample and included students from the selected primary school but the time constraints due to the tight school time and the number of volunteer from the children table enables us only to select certain age group and small sample size.

The small samples size in this study contributes to the limitation in this study whereby it is not representing the norms for the whole population in Malaysia. The other factors that need to be considered when evaluating the changes in the growth pattern is as environment, diet, genetic and socioeconomic status of the subjects.

It is best if this study can be extended further by undertaking the craniofacial measurement from birth to eighteen years old. By doing so, the percentile of growth pattern for the Malay population can be obtained. A norms also can be derived for this population.