

Table of Contents

Abstract	ii
Acknowledgements	v
List of Tables	
List of Figures	
Chapter 1 Introduction	1
1.1 Facial growth	2
1.2 What is anthropometry	3
1.3 Why this research area	5
Chapter 2 Literature Review	7
2.1 Craniofacial anatomy	7
2.2 Development of the bones	8
2.3 Embryology of the head and face	9
2.4 Basic concepts in growth and development	15
2.5 Craniofacial growth and development	16
2.6 Theories of growth control	17
2.7 How the cartilage and functional matrix theories plays a role in craniofacial growth	19

2.8	The changing features of the growing face	23
2.9	Child versus adult features	25
2.10	Anthropometry	26
2.11	Anthropometry vs. sophisticated technologies	28
2.11.1	Anthropometry vs. Cephalometry	28
2.11.2	Anthropometry vs. Photogrammetry	29
2.11.3	Anthropometry vs. Computer-Assisted Three Dimensional Technique	30
2.11.4	Future Hope for the Anthropometry	
2.12	Craniofacial Anthropometry in clinical practise	
2.13	Anthropometry role in aesthetic of different ethnic	36
Chapter 3	Methodology	40
3.1	Subject	40
3.2	Physical facilities	40
3.3	Anthropometry measurements in selected craniofacial Region	41
3.3.1	Positioning of the subject	41
3.3.2	Instruments	42
3.4	Measuring sequence	45
3.5	Measurements of the craniofacial complex	46
3.6	Craniofacial landmarks	46
3.7	The proportion index	49

3.8	Anthropometric measurement	50
3.9	Statistic analysis	53
Chapter 4		54
4.1	Head	54
4.1.1	Head width (eu-eu)	54
4.1.2	Head length (g-op)	56
4.1.3	Head height (v-n)	57
4.1.4	Craniofacial height (v-gn)	58
4.1.5	Head circumference (on-op)	59
4.1.6	Cephalic index (eu-eu x 100/g-op)	60
4.1.7	Head-Craniofacial Height Index (v-n x 100/v-gn)	61
4.2	Face	62
4.2.2	Mandible width (go-go)	64
4.2.3	Face height (n-gn)	65
4.2.4	Upper face height (n-sto)	66
4.2.5	Mandible height (sto-gn)	67
4.2.6	Left maxillary depth (t-sn)	68
4.2.7	Mandubular depth (t-gn), left	69
4.2.8	Facial Index (n-gn x 100/zy-zy)	70
4.2.9	Mandibular index (sto-gn x 100/go-go)	71

4.2.10	Upper face – face height index (n-sto x 100/n-gn)	72
4.2.11	Mandible–upper face height index (sto-gn x 100/n-gn)	73
4.2.12	Mandible-face width index (go-go x 100/zy-zy)	74
4.2.13	Mandible-lower third face depth index (t-sn x 100/t-gn)	75
4.3	Orbit	76
4.3.1	Intercanthal width (en-en)	76
4.3.2	Biocular width (ex-ex)	77
4.3.3	Eye fissure length	78
4.3.4	Eye fissure height (ps-pi), left	79
4.3.5	Intercanthal index (en-en x 100/ex-ex)	80
4.3.6	Eye fissure index (ps-pi x 100/ex-en)	81
4.4	Nose	
4.4.1	Nose width (al-al)	82
4.4.2	Nose height (n-sn)	83
4.4.3	Nasal tip protrusion (sn-prn)	84
4.4.4	Nasal index (al-al x 100/n-sn)	85
4.4.5	Nasal tip protrusion-nose width index (sn-prn x 100/al-al)	86
4.4.6	Nose-face height index (n-sn x 100/n-gn)	87
4.4.7	Nose-face width index	88

4.5	Lips and mouth	89
4.5.1	Upper lip height (sn-sto)	89
4.5.2	Mouth width (ch-ch)	90
4.5.3	Lower lip height (sto-sl)	91
4.5.4	Upper lip height-mouth width index (sn-sto x 100/ch-ch)	92
4.5.5	Lower-upper lip height index (sto-sl x 100/sn-sto)	93
4.5.6	Mouth-face width index (ch-ch x 100/zy-zy)	94
Chapter 5	Discussion	95
5.1	Craniofacial Anthropometric measurement analysis in Malaysian pre pubertal Malay children age 7 and 12- Year-old	96
5.1.1	Head	99
5.1.2	Face	103
5.1.3	Orbits	111
5.1.4	Nose	117
5.1.5	Lips and mouth	120
5.2	Limitation of this study	122
Chapter 6	Conclusion	124
References		126

Appendix A

Differences between 7 and 12-year-old of both genders

Table A-1 Linear measurements that showed significant differences in both genders age 7 and 12-year-old; elder children had higher measurements ($p < 0.05$)

Table A-2 Linear measurements that showed significant differences only in female between age 7-and 12-year-old, elder female had higher measurements, $p < 0.05$

Table A-3 Linear measurement that showed significant difference only in male between age 7-and 12-year-old, elder male had higher measurement, $p < 0.05$

Table A-4 Linear measurements that showed significant differences in both genders age 7-and 12-year-old; elder children had smaller measurements, $p < 0.05$

Table A-5 Proportion index that showed significant difference between 7-and 12-year-old children of both genders; elder children had higher proportion index, ($p < 0.05$)

Table A-6 Proportion indices that showed significant differences between 7-and 12-year-old children of both genders; elder children had smaller proportion indices, ($p < 0.05$)

Table A-7 Proportion indices that showed significant differences between 7-and 12-year-old only in male; elder male had higher proportion indices, $p < 0.05$

Table A-8 Proportion index that showed significant difference between age 7 and 12-year-old in female only; elder female had higher proportion index, $p < 0.05$

Gender differences of age 7-year-old

Table A-9 Linear measurement in children age 7-year-old that showed significant difference between genders; all the measurement showed that male had a larger measurement than female, $p < 0.05$

Table A-10 Proportion indices in age 7-year-old that showed a significant differences between genders ($p < 0.05$)

Gender differences of age 12-year-old

Table A-11 Linear measurement in children age 12-year-old that showed significant difference between genders; all the measurement showed that male had a larger measurement than female, $p < 0.05$

Table A-12 Proportion indices in age 12-year-old that showed a significant differences between genders, all the measurement showed male had a higher proportion indices than female ($p < 0.05$)

Appendix B

Table B-1 Craniofacial anthropometric norms on the head, face, orbit, lips and mouth of the Malay children age 7 and 12 years old

Table B-2 Proportion indices of Craniofacial anthropometric norms on the head, face, orbit, lips and mouth of the Malay children age 7 and 12-year-old

Appendix C Data Entry Form

List of Figures

Figure 2.3.1	(From Sadler TW, Medical Embryology, 7 th edn. pg 318, 1995)	10
Figure 2.3.2	(From Henry Gray, 2000; Anatomy of the human body, 20 th edn.)	11
Figure 2.3.3	(From Ten Cate's; Oral Histology, 6 th edn. pg 33, 2003)	11
Figure 2.3.4	(From Henry Gray, 2000; Anatomy of the human body, 20 th edn.)	12
Figure 2.3.5	(From Ten Cate's : Oral Histology, 6 th edn. courtesy H. Nishimura pg. 38)	13
Figure 2.3.6	(From Sadler TW, Medical Embryology 7 th edn. pg 334)	14
Figure 3.3.2a	Sliding caliper	42
Figure 3.3.2b	Spreading caliper	43
Figure 3.3.2c	Modified sliding callipers with a bubble level	44

List of Tables

Table 3.6.1	Craniofacial landmarks of the head	47
Table 3.6.2	Craniofacial landmarks of the face	47
Table 3.6.3	Craniofacial landmark of the orbit	48
Table 3.6.4	Craniofacial landmark of the nose	48
Table 3.6.5	Craniofacial landmark of the lips and mouth	48
Table 3.8.1	Head measurement	50
Table 3.8.2	Facial measurement	51
Table 3.8.3	Orbital measurements	52
Table 3.8.4	Nasal measurement	52
Table 3.8.5	Lips and mouth measurements	53
Table 4.1.1	Head width (eu-eu)	54
Table 4.1.2	Head Length (g-op)	56
Table 4.1.3	Head height	57
Table 4.1.4	Craniofacial height (v-gn)	58
Table 4.1.5	Head circumference (on-op)	59
Table 4.1.6	Cephalic Index (eu-eu x 100/g-op)	60
Table 4.1.7	Head-Craniofacial Height Index	61
Table 4.2.1	Face width (zy-zy)	62
Table 4.2.2	Mandible width (go-go)	64
Table 4.2.3	Face Height (n-gn)	65

Table 4.2.4	Upper face height (n-sto)	66
Table 4.2.5	Mandible height (sto-gn)	67
Table 4.2.6	Left maxillary depth (t-sn)	68
Table 4.2.7	Mandibular depth (t-gn), left	69
Table 4.2.8	Facial Index (n-gn x 100/zy-zy)	70
Table 4.2.9	Mandibular index (sto-gn x 100/go-go)	71
Table 4.2.10	Upper face – face height index (n-sto x 100/n-gn)	72
Table 4.2.11	Mandible – upper face height index (sto-gn x 100/n-gn)	73
Table 4.2.12	Mandible – face width index (go-go x 100/zy-zy)	74
Table 4.2.13	Middle – lower third face depth index (t-sn x 100/t-gn)	75
Table 4.3.1	Interchantal width (en-en)	76
Table 4.3.2	Biocular width (ex-ex)	77
Table 4.3.3	Eye fissure length (ex-en), left	78
Table 4.3.4	Eye fissure height (ps-pi), left	79
Table 4.3.5	Intercanthal index (en-en x 100/ex-ex)	80
Table 4.3.6	Eye fissure index (ps-pi x 100/ex-en)	81
Table 4.4.1	Nose width (al-al)	82
Table 4.4.2	Nose height (n-sn)	83
Table 4.4.3	Nasal tip protrusion (sn-prn)	84
Table 4.4.4	Nasal index (al-al x 100/n-sn)	85

Table 4.4.5	Nasal tip protrusion length – nose width index (sn-prn x 100/al-al)	86
Table 4.4.6	Nose – face height index (n-sn x 100/n-gn)	87
Table 4.4.7	Nose – face width index (al-al x 100/zy-zy)	88
Table 4.5.1	Upper lip height (sn-sto)	89
Table 4.5.2	Mouth width (ch-ch)	90
Table 4.5.3	Lower lip height (sto-sl)	91
Table 4.5.4	Upper lip height – mouth width index (sn-sto x 100/ch-ch)	92
Table 4.5.5	Lower – upper lip height index (sto-sl x 100/sn-sto)	93
Table 4.5.6	Mouth – face width index (ch-ch x 100/zy-zy)	94