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In Vivo Facial Tissue Depth Measurements for White British Children*

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ABSTRACT: This paper reports the results of a study of facial tissue depth measurement in White British children of both sexes, aged between 11 and 18 years. The purpose of this research was to increase the information available upon tissue depth data for children, primarily for use in forensic facial reconstruction. Facial tissue depths were measured at 21 anatomical points using ultrasonic echo-location. The mid-philtral, upper lip border and lower lip border points showed consistently larger tissue depths in the males than the females, and the zygomatic attachment showed consistently larger tissue depths in the females than the males. The males showed a general increase in tissue depth with an increase in age at all the mid-line facial points and the cheek points. The females showed increased tissue depth with age at all the points except the infra-orbital, lateral orbital, mid-zygomatic arch and mid-mandibular points. A table of mean tissue depths was developed for males and females divided into two-yearly age groups.

KEYWORDS: forensic science, facial tissue depth standards, ultrasound, juvenile

The aim of this study was to produce a comprehensive set of accurate in vivo facial tissue depth measurements for British children, using ultrasonic technology, for use in forensic facial reconstruction. Facial reconstruction is the scientific art of skull interpretation in order to rebuild the face onto the skull for the purposes of individual identification (1,2) using tissue depth data during the procedure. Although these are only average sets of tissue thickness, and cannot take into account the individuality of each skull, the importance of the tissue depth data as guides cannot be ignored, and these become more important still when dealing with the faces of children.

Although there has been substantial research carried out into the facial tissue depths of adults, there was no data available, until 1980, on juvenile facial tissues. Early measurements from adult cadavers (3–5) used a variety of penetration methods. However, there are many problems with cadaver studies, the most obvious being the change in tissue depth caused by loss of muscle tone and shrinkage. Soft tissue distortion occurs from drying and embalming even in the first few hours after death and putrefaction with bloating may occur rapidly even in temperate climates. Facial movement, skin elasticity, and muscle tone all add bulk to a face, and the horizontal position of the body when the measurements are taken will also create false tissue depth measurements because of the action of gravity. Different and more accurate methods of measuring tissue depth were therefore studied. Imaging techniques such as craniographs, MRI scans and CT scans were employed, but these also suffer from the positional problem of the subjects being supine. Ultrasound has been used for measuring facial tissue depths over the last 15 years and is considered to be the most appropriate, since the patient may be seated in a relaxed position, and many studies into adult facial tissues have been carried out using this ultrasonic technique (6,7). One problem associated with the ultrasonic technique is the accuracy of the determination of the anatomical point over the skull. These points are determined using surface anatomy and palpation and there is some evidence of errors (8). Nelson and Michael (8) suggested that the angle of the pen to the bone will also affect the measurement, but since the pen only records waves which rebound in a path perpendicular to the surface of the bone, this does not seem likely.

Booth et al. (9), Bullen et al. (10), and Stouffer (11) compared ultrasonic, X-ray, needle puncture, electrical conductivity, and caliper methods of subcutaneous fat measurement. They found that the ultrasonic technique was the most reliable with imperceptible differences between measurements at the same site, and ultrasound was found to be comparable to X-rays in accuracy and more accurate than the other techniques. Lauprecht et al. (12) carried out comparisons of ultrasonic measurements with direct measurements of tissue thickness (with a ruler) from slaughtered animals, and found that the ultrasonic measurements were in agreement with the direct measurement.

The majority of studies that exist into the tissue depths of children's' faces either suffer from the positional problem (13) or are often only mid-facial (14–16). Recently Manhein et al. (17) carried out a comprehensive study of 19 facial points on the faces of 515 White, Black, and Hispanic American children using ultrasound technology with the subjects in an upright position. However, there is no existing available tissue depth data for any European children.

Method

The ultrasonic echo location equipment used was a Siemens Echopan Doppler ultrasound machine with 6 mm diameter pen and 1–4 MHz frequency (7). Echotrack high viscosity ultrasonic scanning gel was used as a transmitter material between the pen and the skin surface. Children were recruited as volunteers from 4 Greater Manchester Schools and all procedures were in accordance with the ethical standards of the University of Manchester ethics com-

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mittee on human experimentation. The schools studied have wide socio-economic catchment areas, which include middle and working class households from majority White ethnic groups. The subjects were all between the ages of 11 and 18 years without a history of facial deformity, injury or plastic surgery and without any skin allergies. No other constraints applied. Each subject was seated with a relaxed facial position. The tissue depth measurements were taken at 21 anatomical points on the face (see Fig. 1), and each measurement was repeated. Care was taken not to deform the shape of the skin surface by pressure from the pen, particularly at the cheeks and lips where the skin is soft and flexible. Where the points were bilateral the measurement was repeated on both sides of the face. An average measurement at each point for each child was calculated and these are the data assessed in the statistical study.

The aim of this research was to study how the tissue depths at each point vary by sex and age. The data were entered into SPSS/PC+ (v.50) and analyzed using SPSS/PC and SPSSWIN (v8.0) (see Tables 1 and 2).

Mean tissue depth measurements were produced for males and females in each biennial age group. These age groups are 11–12 years, 13–14 years, 15–16 years, and 17–18 years (see Table 3).

Results

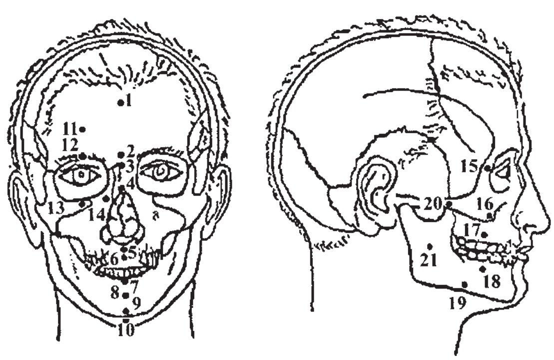
The facial points that showed the greatest standard deviation were the zygomatic attachment, upper 1st molar, lower 1st molar and mid-masseter points and these were consistently high for all sub-groups at these points. In the present study, the females had greater standard deviations than the males at the zygomatic attachment, upper 1st molar, lower 1st molar, zygomatic arch and mid-masseter points. This may be due to the earlier onset of puberty in females, since the greatest female facial changes occur at the cheek region. There was wide variation in the tissue thickness at the cheek region for all the children, which may be due to the wide variation in the onset of puberty.

Several facial points at the cheek area, including the labiomental groove, mental tubercle, mid-infra orbit, zygomatic attachment, mid-masseter muscle, the upper 1st molar and the lower 1st molar points, exhibited tissue depth distributions that suggest two peaks (see Fig. 2). These distributions suggested that within the sample there were two different facial types—thin and fat-faced individuals.

The results suggested that there were age-related and sex-related differences. The mid-philtrum, upper lip border and lower lip border points showed consistently larger tissue depths in the males than the females, and the zygomatic attachment showed consistently larger tissue depths in the females than the males. In the 11–12 year age group, the boys had more tissue at the brow and eye areas, and the girls had fatter cheeks. In the 13–14 year age group, the boys had more tissue at the nose, lip and cheek areas. In the 15–16 year age group, the boys had more tissue at the brow, and the girls had fatter cheeks. In the 17–18 year age group, the boys had more tissue at the brow and lip areas, and the girls had fatter cheeks.

Males showed a general increase in tissue depth with an increase in age at the all the mid-line facial points and the upper 1st molar, lower 1st molar and mid-masseter points. The females showed increased tissue depth with age at all the points, except the infra-orbital, lateral orbit, mid-zygomatic arch and mid-mandibular points. These results suggest that the majority of facial changes associated with puberty occur in males in the 11–16 year age group and in females in the 11–14 year age group.

There are enough differences between facial tissue depths at different ages and between the sexes to justify a different data set for each age group and for each sex (see Table 3).



1. Forehead – most anterior point on midline.
2. Glabella.
3. Nasion.
4. Nasal bone – end of.
5. Mid-philtrum.
6. Upper lip border.
7. Lower lip border.
8. Labiomental groove.
9. Mental tubercle.
10. Gnathion.
11. Lateral forehead – mid between points 1 & 2.
12. Mid-supra-orbital.
13. Mid-infra-orbital.
14. Lateral nose 0n Frankfurt plane.
15. Mid-lateral orbit.
16. Zygomatic attachment.
17. Upper first molar.
18. Lower first molar.
19. Mid-mandibular angle.
20. Mid-zygomatic arch.
21. Mid-masseter muscle.

FIG. 1—*The position of tissue depth points.*

Discussion

These results suggested a great deal of variation in tissue thickness in the cheek region and this result was also found in the recent study carried out by Manhein et al. (17) of ultrasonic facial tissue measurements for children and adults (see Table 4).

The twin-peaked distributions seen at several facial points suggested that within the sample there were two different facial types—thin and fat-faced individuals. All these facial points were areas of the face where fatty tissue develops during childhood—namely, the cheeks and chin. The suggestion that two facial types exist in this sample may be a reflection of the variation in the onset of puberty and facial maturation.

The results suggest that boys have more tissue at the brow and lips and girls have fatter cheeks. The buccal fat pads are most apparent during childhood and especially in young prepubescent girls. The post-pubertal females are more likely to show larger tissue thicknesses at the cheeks, since females retain more fatty tissue over the surface of the facial musculature even in adulthood. Boys differ from girls in that they have a growth spurt in nasal height at puberty, and they also show a growth spurt in soft tissue on the chin at puberty. In contrast, the girls have a decrease in growth of chin tissue after the age of nine. The adolescent growth spurt leads to a great enlargement at the mandible, which is largest in boys, resulting in more projecting and robust jaws. This may explain the increase in tissue depth with age at the jaw, which may accompany this skeletal development.

TABLE 1—*Statistical analysis of the facial tissue depth measurements.*

	Two-way ANOVA			One-way ANOVA (Between Age Groups)			Kruskal-Wallis (Between Age Groups)			Mann-Whitney (Between Sexes)	T-test (Between Sexes)
Points	By Age	By Sex	By Sex/ Age	Mixed Sex	Male	Female	Mixed Sex	Male	Female	All Ages	All Ages
1	0.008*	0.499	0.641		0.205		0.003*		0.020*	0.638	
2	0.010*	0.218	0.529		0.570		0.007*		0.013*	0.209	
3	0.001*	0.020*	0.740		0.030*		0.001*		0.025*	0.023*	
4	0.188	0.130	0.116		0.521		0.150		0.033*	0.125	
5	<0.001*	0.003*	0.088		0.001*		0.002*			0.003*	
6	<0.001*	<0.001*	0.451	<0.001*	0.005*	<0.001*				<0.001*	
7	<0.001*	<0.001*	0.037*		0.024*	<0.001*	<0.001*			0.003*	
8					<0.001*		<0.001*		<0.001*	0.421	
9						0.004*	0.001*	0.010*		0.226	
10	<0.001*	0.261	0.140			<0.001*	<0.001*	<0.001*		0.256	
11	0.183	0.093	0.038*			0.020*	0.070	0.058		0.065	
12	0.001*	0.131	0.046*		0.097	<0.001*	0.001*			0.196	
13				0.223				0.006*	0.157	0.073	
14	0.206	0.973	0.049*	0.198		0.034*		0.215		0.921	
15	0.599	0.113	0.284		0.407	0.437	0.443				0.161
16					0.177		<0.001*		<0.001*		0.010*
17					0.032*		<0.001*		0.002*		0.058
18						0.007*	0.002*	0.262			0.582
19	0.083	0.301	0.210	0.069	0.310	0.052					0.342
20	0.815	0.322	0.163				0.944	0.363	0.380	0.225	
21							<0.001*	<0.001*	0.002*	0.556	

* Indicates statistically significant at the $p < 0.05$ level.

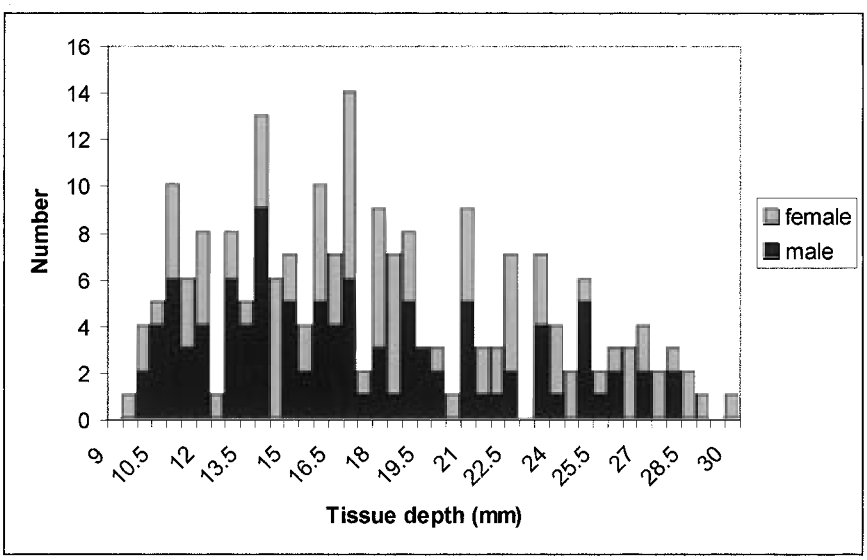


FIG. 2—*Tissue depth distribution at the upper first molar point.*

TABLE 2—*Statistical analysis of*

	Multiple Comparisons (Post Hoc											
	Mixed Sex Between Ages						Male Between Ages					
Points	1/2	1/3	1/4	2/3	2/4	3/4	1/2	1/3	1/4	2/3	2/4	3/4
1	0.001*	0.097	0.037	0.015	0.134	0.468	0.315	1.000	0.861	0.333	0.787	0.853
2	0.004*	0.075	0.003*	0.194	0.994	0.171	0.779	0.988	0.672	0.933	0.999	0.878
3	0.004*	0.022	<0.001*	0.420	0.231	0.064	0.219	0.861	0.031*	0.693	0.967	0.371
4	0.232	0.249	0.465	0.034	0.088	0.682	0.526	0.917	0.888	0.902	0.918	1.000
5	0.209	0.156	0.004*	0.022	<0.001*	0.191	0.631	0.994	0.052	0.812	0.003*	0.041*
6	0.548	0.564	0.017*	0.061	<0.001*	0.397	0.992	0.303	0.035*	0.246	0.031*	0.817
7	0.286	0.004*	0.008*	<0.001*	0.001*	0.704	0.998	0.731	0.044*	0.859	0.112	0.452
8	0.077	<0.001*	<0.001*	<0.001*	<0.001*	0.329	0.104	0.675	0.006*	0.009*	<0.001*	0.193
9	0.448	0.072	0.001*	0.033	0.001*	0.150	0.350	0.010*	0.001*	0.272	0.247	0.892
10	0.900	0.005*	<0.001*	<0.001*	<0.001*	0.207	0.028	0.585	0.002*	0.035	<0.001*	0.056
11	0.345	0.045	0.646	0.293	0.172	0.014	0.361	0.971	0.023	0.386	0.134	0.016
12	<0.001*	0.014	0.219	0.024	0.020	0.330	0.409	0.812	0.894	0.917	0.144	0.430
13	0.359	0.886	0.400	0.809	0.999	0.854	0.055	0.130	0.232	0.002*	0.235	0.008*
14	0.469	0.991	0.946	0.677	0.222	0.849	0.176	0.031	0.519	0.896	0.412	0.298
15	0.940	0.802	0.147	0.883	0.169	0.262	0.425	0.799	0.911	0.933	0.827	0.994
16	0.001*	0.489	0.895	<0.001*	<0.001*	0.395	0.204	0.748	0.542	0.789	0.910	0.992
17	0.665	0.002*	0.052	0.001*	0.002*	0.339	0.508	0.654	0.669	0.084	0.085	1.000
18	0.477	0.023	0.042	0.001*	0.002*	0.462	0.585	0.627	0.198	0.195	0.038	0.695
19	0.270	0.974	0.654	0.141	0.914	0.424	0.412	0.698	0.547	0.968	0.997	0.993
20	0.797	0.709	0.816	0.966	0.643	0.587	0.751	0.186	0.629	0.082	0.394	0.356
21	0.378	0.028	<0.001*	0.011*	<0.001*	0.004*	0.394	0.309	<0.001*	0.295	0.002*	0.002*

* Indicates statistically significant.

TABLE 3—*Tissue depths (mm) in*

	11–12 years						**13–14 years**					
	Male (n=30)			Female (n=28)			Male (n=21)			Female (n=23)		
Points	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
1	4.6	0.97	3–7	4.3	0.83	3–6	5.0	0.89	4–7	5.0	0.88	3–6
2	4.9	0.89	4–7	4.5	0.63	3–6	5.2	0.89	4–7	5.2	0.86	4–7
3	4.7	0.88	3–7	4.3	0.72	3–6	5.2	0.89	4–7	4.7	0.95	3–7
4	2.7	0.73	1–4	2.2	0.40	1–3	2.4	0.84	1–4	2.2	0.61	1–4
5	11.0	1.60	7–13	9.9	1.91	6–13	10.3	2.20	7–15	9.6	2.14	6–13
6	10.7	1.56	7–13	10.0	1.53	7–13	10.6	1.78	8–17	9.2	1.66	6–12
7	12.1	1.79	9–15	11.4	1.48	8–14	12.2	2.13	5–12	10.5	1.74	6–13
8	10.2	1.54	7–14	9.8	1.44	7–13	8.9	2.09	7–13	9.4	2.29	5–14
9	9.8	2.08	6–16	10.2	2.10	7–15	10.1	1.98	5–8	8.9	1.94	6–12
10	6.7	1.23	5–10	6.0	1.08	4–8	6.0	0.94	7–13	6.0	1.22	4–9
11	5.7	1.00	4–8	4.7	0.81	3–6	5.4	0.95	4–8	5.4	0.93	4–7
12	6.1	0.96	4–8	5.4	0.90	4–8	6.6	0.98	5–8	6.5	0.91	4–8
13	7.6	1.12	6–10	7.0	1.04	5–9	8.3	1.30	6–10	7.3	1.20	5–9
14	6.9	1.37	4–10	6.3	1.33	4–10	6.4	1.79	4–10	5.9	1.25	4–10
15	6.9	1.08	5–9	7.4	1.97	5–15	7.1	1.12	5–8	7.4	1.15	5–10
16	12.3	3.12	8–3	13.0	3.89	7–21	10.7	2.48	7–16	10.2	1.81	8–15
17	16.7	5.46	10–28	17.4	6.76	10–30	14.7	3.31	10–21	16.2	3.15	11–22
18	16.0	4.46	10–27	15.5	4.66	9–27	14.6	2.28	9–20	14.5	2.84	9–20
19	10.2	2.59	7–22	9.8	2.05	7–14	9.1	1.84	7–13	9.1	1.87	6–15
20	8.0	1.53	5–11	8.0	2.05	6–10	8.4	1.63	6–12	7.9	1.87	5–12
21	18.4	4.73	7–28	17.3	4.85	9–25	17.4	4.94	9–25	16.6	4.97	8–23

the facial tissue depth measurements.

Scheffe or Mann-Whitney Tests)

Female Between Ages						**T-test or Mann-Whitney** Between Sexes			
1/2	1/3	1/4	2/3	2/4	3/4	Age 1	Age 2	Age 3	Age 4
0.006*	0.044	0.064	0.067	0.259	0.913	0.164	0.737	0.635	0.972
0.004*	0.029	0.013	0.254	0.949	0.362	0.075	0.956	0.530	0.965
0.046	0.009*	0.012*	0.707	0.385	0.589	0.084	0.088	0.781	0.317
0.992	0.008*	0.054	0.037	0.163	0.630	0.004*	0.459	0.695	0.955
0.933	0.117	0.318	0.036*	0.123	0.967	0.018	0.254	0.619	0.002*
0.410	0.067	0.363	0.001*	0.013*	0.867	0.083	0.014	0.322	0.014
0.354	0.011*	0.666	<0.001*	0.039*	0.244	0.096	0.005*	0.741	0.003*
0.579	0.002*	0.001*	0.007*	0.007*	0.544	0.326	0.447	0.586	0.016
0.141	0.993	0.479	0.252	0.004*	0.340	0.543	0.035	0.072	0.819
1.000	0.008*	0.004*	0.008*	0.013*	0.995	0.034	0.863	0.450	0.263
0.184	0.030*	0.279	0.915	0.995	0.804	<0.001*	0.774	0.868	0.761
0.001*	0.099	0.023*	0.416	0.787	0.935	0.004*	0.772	0.158	0.356
0.397	0.043	0.090	0.239	0.494	0.430	0.034	0.009*	0.059	0.234
0.716	0.530	0.561	0.094	0.109	1.000	0.155	0.241	0.029	0.587
0.948	0.853	0.447	0.996	0.811	0.902	0.469	0.142	0.303	0.106
0.004*	0.215	0.373	<0.001*	<0.001*	0.414	0.458	0.437	0.005*	0.002*
0.684	0.008*	0.192	<0.001*	0.054	0.228	0.692	0.124	0.041	0.557
0.864	0.091	0.602	0.016*	0.216	0.730	0.656	0.825	0.164	0.775
0.748	0.412	0.988	0.069	0.913	0.273	0.548	0.976	0.054	0.668
0.436	0.351	0.352	0.155	0.172	0.897	0.976	0.348	0.033	0.211
0.636	0.034	0.004*	0.012*	0.001*	0.365	0.384	0.607	0.382	0.702

White children aged 11–18 years.

15–16 years						**17–18 years**					
Male (n=23)			Female (n=26)			Male (n=25)			Female (n=24)		
Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
4.6	0.66	3–6	4.7	0.64	3–6	4.8	0.77	3–6	4.8	1.04	3–7
5.0	0.89	4–6	4.9	0.66	4–7	5.2	0.74	4–7	5.2	1.20	3–8
4.9	1.03	3–7	4.8	0.76	3–7	5.3	0.87	2–4	5.0	1.31	2–9
2.5	0.66	1–4	2.6	0.62	2–4	2.5	0.61	9–16	2.5	0.82	1–4
10.9	1.97	6–14	11.2	1.83	7–16	12.5	1.86	9–18	10.9	1.49	7–13
11.6	1.42	8–14	11.2	1.54	8–15	12.1	1.85	9–20	10.8	1.62	8–14
12.8	2.19	9–19	13.0	2.03	8–17	13.8	2.40	9–16	12.0	1.59	9–16
10.8	2.12	6–14	11.1	1.65	7–13	11.9	1.30	9–13	11.1	1.02	9–13
10.9	1.40	8–13	10.0	1.84	6–13	10.9	0.97	6–10	11.0	1.92	7–15
6.9	1.48	4–11	7.2	1.18	5–9	7.7	1.06	4–8	7.3	1.39	5–10
5.6	0.76	4–7	5.6	0.95	4–8	5.2	1.23	4–8	5.3	1.34	3–8
6.4	0.73	5–8	6.0	0.90	4–8	5.9	1.23	6–11	6.2	1.16	4–8
7.2	0.69	6–9	7.8	1.61	5–10	7.9	1.17	5–10	7.5	1.21	4–10
6.1	0.96	5–9	6.9	1.51	5–10	6.7	1.52	5–9	6.9	1.35	4–10
7.2	1.28	5–10	7.5	1.36	5–10	7.4	1.16	7–14	7.8	1.52	4–11
11.5	2.27	7–15	13.6	2.71	9–20	11.3	1.79	10–27	13.2	2.33	9–19
18.4	4.75	12–25	20.9	3.41	14–27	18.3	4.83	12–24	19.2	5.32	9–28
16.6	4.33	11–25	18.4	4.26	12–29	16.7	3.36	6–16	17.0	4.41	10–27
9.4	1.90	6–14	10.9	3.06	8–22	9.3	2.38	6–11	9.6	2.19	6–13
7.5	1.05	6–10	8.3	3.06	6–10	7.9	1.28	11–24	8.4	2.19	5–12
18.8	4.50	8–24	20.2	4.04	11–25	21.9	3.37	6–11	21.5	3.91	11–31

TABLE 4—*Tissue depths (mm) in White American*

Points	3–8 years						9–13		
	Female (n=43)			Male (n=36)			Female (n=51)		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Glabella	3.9	0.98	2–7	4.0	0.83	3–6	4.4	1.08	2–7
Nasion	5.0	0.94	3–7	5.7	0.96	3–8	5.5	1.03	2–8
End of nasals	1.7	0.52	1–3	1.8	0.67	1–4	1.5	0.54	1–3
Lateral nostril	7.0	1.86	4–12	7.2	1.75	4–11	7.7	2.00	4–15
Mid-philtrum	8.3	1.35	6–12	9.0	1.59	6–12	9.4	1.54	6–13
Chin lip fold	7.6	1.51	5–12	8.1	1.79	6–12	9.0	1.45	6–13
Mental eminence	7.4	1.81	4–11	8.3	2.14	4–12	8.8	1.98	5–14
Beneath chin	4.2	1.19	2–8	4.6	1.13	3–7	5.5	1.64	2–11
Supraorbital	4.4	1.15	3–7	4.6	0.84	3–6	5.1	0.92	3–8
Suborbital	5.6	1.12	3–8	5.5	0.94	4–8	5.6	1.08	4–8
Supracanine	8.4	1.29	6–11	9.4	1.98	6–14	9.8	1.68	7–14
Subcanine	7.9	1.44	5–11	8.4	1.40	6–13	9.2	1.61	6–13
Posterior maxilla	22.7	33.48	14–30	23.3	3.73	14–31	24.3	2.88	19–32
Sup mid mandible	18.9	3.59	8–24	20.7	3.64	13–31	20.8	3.63	13–29
Inf mid mandible	10.5	3.33	4–18	10.4	2.80	6–15	11.7	3.24	4–18
Lateral eye orbit	4.0	0.89	3–6	4.1	0.91	2–6	4.6	1.09	3–9
Anterior zygoma	8.4	2.44	5.15	8.4	2.29	5–15	9.5	2.24	5–14
Gonion	13.9	3.27	7–22	13.7	2.89	8–20	14.4	2.90	8–19
Root of zygoma	4.6	1.51	3–10	4.8	1.02	3–7	5.2	1.58	3–10

* Indicates n = 44.

In general, juvenile faces are smaller than adult faces, and this is reflected in the smaller tissue depths at the majority of facial points. In addition, the child's face tends to be relatively larger at the cheek area and over the bridge of the nose. Since the variation in tissue depth at the cheek region appeared to be consistently large, and there was a suggestion of two separate facial types at some of the points, it may be necessary to include a much larger sample size in future studies, so that any patterns may become more apparent.

These data can be compared with those collected in previous studies related to White children. Manhein et al. (17) carried out tissue depth measurements of 148 White American children between the ages of 9 and 18 years (see Table 4). They showed similar facial tissue distribution to the present study, with the thickest tissue at the cheeks and mouth, and the thinnest at the forehead, nose and eyes. However, larger tissue depths than the present study were recorded at the upper 1st molar (>8), lower 1st molar (>6) and mid-mandibular (>2) points. The measurement variation at these points is wide in both studies. The present study showed two separate facial types (fat and thin) at the upper 1st molar, lower 1st molar and mid-mandibular points. The fatter cheeked group appears to correspond more closely with the results from Manhein et al. (17) and this may be a reflection of national or nutritional variation.

Current evidence suggests that 20% of American children are overweight (18), as opposed to 11% of British children (19). Manhein et al. (17) found that the cheek tissue depths showed consistently larger results than in all other comparable studies, and suggested that the previous studies may be flawed. They state by way of proof that reconstruction practitioners often find that these measurements lead to cheek regions that appear gaunt. However, Gerasimov (20) suggested that these reconstructions appear gaunt because of a lack of knowledge regarding facial anatomy, so that the resulting reconstructed face has a flat skin surface between marker points, rather than the natural contours seen on the surface of the real face.

Further research needs to be carried out into the facial tissue depths within this age group, since the variation between subjects appears very large, and further studies may illuminate differences with regard to facial constitution and age.

Results of these studies should not only benefit the facial reconstruction field, but may also be useful for plastic and reconstructive surgery and pediatric dental treatment.

The results of this study suggested that there were significant differences in tissue thickness between sexes, and that there was a significant relationship between tissue thickness and age in White British children. The results also suggested differences in facial fatness between British and North American White children.

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children aged 3–18 years (Manheim et al, 2000).

years			**14–18 years**					
Male (n=45)			Female (n=35)			Male (n=27)		
Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
4.6*	1.04	3–7	4.6	0.98	3–6	5.0	0.73	3–7
4.7*	1.09	3–8	5.4	0.88	4–8	6.3	1.07	4–8
1.6	0.53	1–3	1.8	0.51	1–3	2.0	0.44	1–3
7.4	1.71	5–12	7.7	1.78	5–12	7.8	1.96	5–12
9.7	1.50	7–14	9.4	1.46	7–12	11.2*	1.98	7–15
9.6	1.75	7–14	9.7	1.25	8–13	10.4	1.28	7–13
8.7	2.93	4–17	8.7	1.75	5–14	9.3	1.90	7.14
5.5	1.44	4–10	5.5	1.36	4–9	6.0	1.57	4–11
5.2	0.82	3–7	5.7	1.47	4–12	5.7	0.83	4–7
5.9	1.14	4–9	6.0	1.25	3–9	5.3	1.23	4–9
10.0	1.77	7–15	10.3	3.22	7–26	11.7	2.33	8–19
9.6	1.70	6–13	9.8	2.40	6–21	10.6	2.32	7–17
24.7	4.30	18–34	26.8	4.96	5–34	27.4	3.38	22–35
21.6	3.71	15–30	23.2	4.58	5.30	23.2	3.48	15–31
12.1	3.99	6–22	13.4	2.76	9–19	12.3	4.49	6–24
4.4	0.87	3–7	4.5	0.85	3–6	4.3	0.86	3–7
9.1	2.46	5–15	9.5	1.85	6–16	8.0	1.76	6–13
15.4	3.63	9–24	17.0	2.67	12.22	18.1	3.04	14–24
5.4	1.79	2–10	6.8	1.88	4–12	6.0	2.07	4–12

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