Israeli cephalometric standards compared to Downs and Steiner analyses

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Cephalometric measurements continue to play an important role as a diagnostic guide in orthodontic treatment planning. Introduced to the orthodontic specialty by Broadbent in 1931,[1] cephalometric radiographs were used by early investigators[2-5] to document changes due to growth and development or orthodontic treatment. When controversy regarding the extraction of teeth returned in the early 1940s, cephalometry acquired an additional dimension as an informative diagnostic procedure.

Downs,[6] Steiner,[7] and Tweed,[8] all developed cephalometric norms and analyses in an attempt to define the skeletal characteristics of a "good face" and "good occlusion." The sample populations always consisted of white North American children and young adults. With time, it became apparent that cephalometric standards for one ethnic group did not necessarily apply to other ethnic groups. The intervening years also witnessed a social revolution where heritage replaced assimilation as a source of pride and people felt less of a need to look alike. Orthodontic thinking followed this trend and cephalometric standards were gradually established in different countries and for different ethnic groups within a given country.[9-14]

The results of these studies indicate that cephalometric "norms" differ for different ethnic groups. The purpose of the present study was threefold: (1) to describe the cephalometric data distribution of Israeli adolescents, using the Downs and Steiner analyses; (2) to compare the data obtained for the Israeli population with standards established for a white North American population by Downs and Steiner; and (3) to produce a graphic representation of the Israeli data for the Downs and Steiner analyses.

Materials and methods

Forty young adolescents, 22 females and 18 males, were selected from the patient pool of the orthodontic department at the IDF Medical Corps, Sheba Medical Center. All were clinically classi-

Abstract

A sample consisting of 40 young Israeli adolescents, 18 males and 22 females, was examined cephalometrically. The subjects were classified as Angle Class I, with less than three millimeters of crowding and an orthognathic profile. Steiner and Downs analyses were performed for all subjects. Each analysis was done both manually and by using a computer. The computerized results were processed and subjected to statistical tests. The Israeli sample is characterized by a convex profile, a retrusive mandible, a steep mandibular plane and protrusive incisors.

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Key Words

Cephalometrics • Ethnic variation • Israeli adolescents

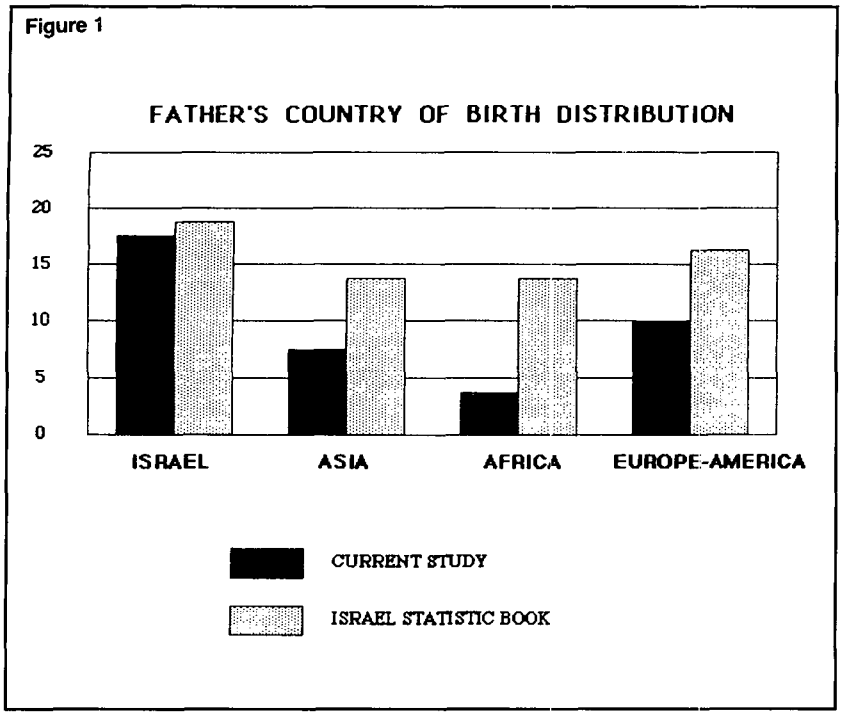


Figure 1
Distribution of the sample according to the fathers' country of origin compared to statistical yearbook data.

fied as Angle Class I with mild crowding (less than three millimeters). All had complete permanent dentition (except for third molars). The mean overjet was 2.38; the mean overbite was 2.5. The profile was determined to be orthognathic — pleasing on a basis of clinical observation.

The country of birth for each subject and each subject's father was recorded. The age range for females was 11 to 14 and for males 12 to 16.5. The sample mean age was 13.5.

Study casts, facial photographs, panoramic radiographs and lateral cephalometric head films were gathered for each subject. The radiographs were taken in standard position with the teeth held lightly together in centric (habitual) occlusion with lips relaxed.

Tracings were completed and verified by two orthodontists, independently, for all lateral head films. Each tracing was made by encoding 52 points by means of an electronic cursor and passing the data into the computer. To verify the points transferred to the computer, a transparent printout was prepared for each tracing which reproduced the traced points. This transparency was placed over the tracing to verify the readings. After verification, two analyses (Downs and Steiner) were performed with the aid of computer as well as manually.

Data from the 40 subjects were statistically analyzed as follows:

1. It was tested whether the subjects differed in countries of origin from the general population as represented in the Israel Statistical Yeabook.[15]
2. The distribution of various cephalometric parameters (used in Downs and Steiner analyses) was analyzed.
3. Mean values, range, standard deviation and confidence interval were calculated for each gender separately and for the entire group.
4. Student's *t*-test and Manova analysis were performed, the latter to test possible gender differences — according to the Downs and Steiner analyses — and each variable tested separately.
5. The student's *t*-test was used to compare the Israeli sample data with the data of Riedel[16] (which were included in the Steiner analysis) and Downs.

Results

1. The distribution of the sample according to fathers' country of birth closely followed the Statistical Yearbook data.[15] This is shown by the graph in Figure 1.
2. The cephalometric parameters were found to be normally distributed.
3. The cephalometric data were found to be similar for the two genders, except for the Y-axis which was significantly larger in males. Females 59.8° ± 3.1, males 62.4° ± 3.9 ($p<0.05$).
4. Table 1 shows the distribution of the Downs data for the Israeli and the Downs groups and a comparison between the cephalometric data of the Israeli and the Downs samples.
5. Table 2 shows the distribution of the Steiner data for the Israeli and the Steiner groups and a comparison between the cephalometric data for the Israeli and the Steiner groups. A student's *t*-test could only be performed for the Riedel data.

Discussion

Orthodontists in Israel, as elsewhere, use cephalometry as part of the diagnostic process for treatment planning. The analyses are based on cephalometric norms established for populations of other countries. We consider these norms to be unsuitable for the Israeli orthodontic patient. The Israeli population originates from heterogeneous ethnic backgrounds and may well differ from the white population for which Steiner and Downs had set their standards.

Researchers world-wide have paid attention to the ethnic factor and tried to establish cephalometric values for various groups. The results of their studies demonstrate that those groups do, indeed, differ in several parameters.[9-13]

Taylor and Hitchcock[14] asserted that differences due to varying backgrounds were also found among a white American population. They argued that the ethnic background of the white population in the U.S. South differs from that of the

Table 1
Distribution of the Downs data for the Israeli and the Downs groups.

Parameters	Israeli (n=40) Minimum	Maximum	Mean	SD	Confidence Interval	Downs (n=20) Minimum	Maximum	Mean	SD	Significance
Facial angle	78.9	93.2	86.1	3.48	84.9- 87.2	82	95	87.8	3.57	n.s.
Angle of convexity	-4.0	15.0	6.0	4.88	4.5- 7.6	-8.5	10	0	5.09	*
A-B plane	-11.8	0.6	-5.6	3.03	4.6- 6.5	-9	0	-4.6	3.67	*
Mandibular plane	20.2	39.4	29.9	4.66	28.4- 31.4	17	28	21.9	3.24	*
Y axis	53.4	68.4	60.9	3.65	59.8- 62.1	53	66	59.4	3.82	n.s.
Occlusal plane	3.6	18.2	10.4	3.53	9.2- 11.5	1.5	14	9.3	3.83	n.s.
1/to/1	110.9	136.7	124.3	6.62	122.2-126.5	130	150.5	135.4	5.76	*
/1 to mandibular plane	-6.7	12.5	3.1	4.79	1.6- 4.6	-8.5	7	1.4	3.78	n.s.
/1 to occlusal plane	12.3	34.6	22.6	5.02	21.0- 24.2	3.5	20	14.5	3.42	*
1/to A-POG	2.8	12.3	7.6	2.30	6.9- 8.4	-1	5	2.7	3.05	*

* $p<0.05$
n.s. — No statistically significant difference

Figure 2

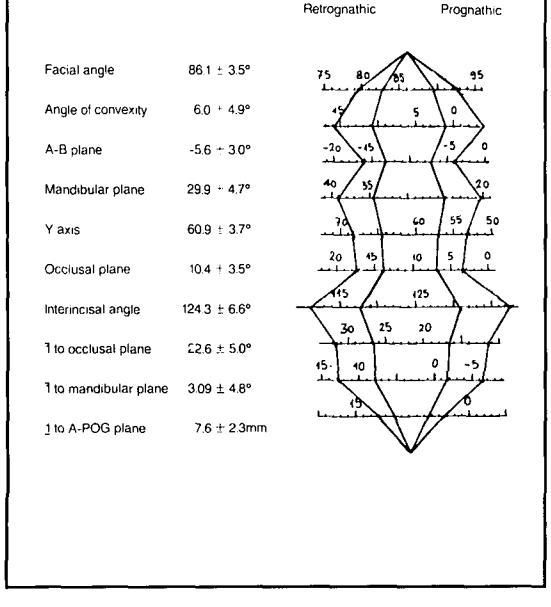


Figure 3

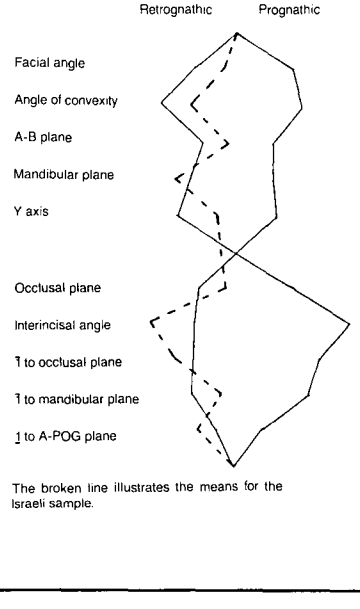


Figure 2
Polygon representation of the Israeli sample using means and standard deviation, based on Downs analysis.

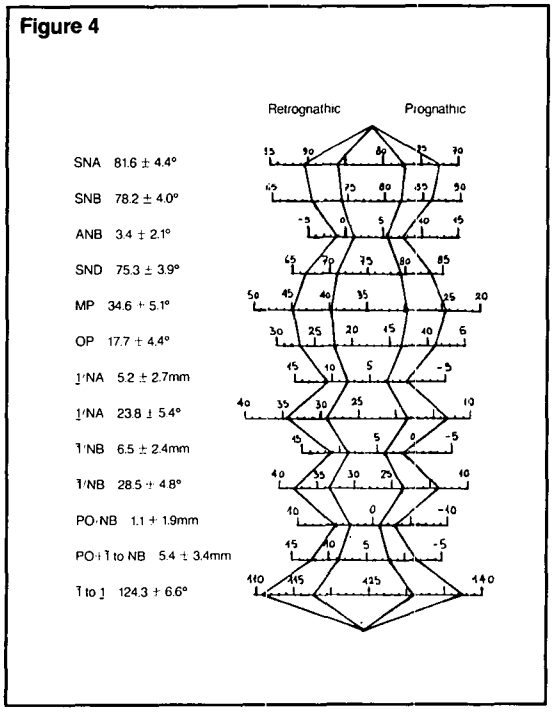
Figure 3
Israeli means compared to Downs standards.

Table 2
Distribution of the Steiner data for the Israeli and the Steiner groups.

Parameters	Steiner Mean	Steiner SD	Israeli Minimum	Israeli Maximum	Israeli Mean	Israeli SD	Israeli Confidence Interval	Significance
SNA (R)	82.01	3.89	74.4	96.5	81.63	4.43	80.2- 83.1	n.s.
SNB (R)	79.97	3.60	70.2	89.5	78.20	4.01	76.9- 79.5	*
ANB (R)	2.04	1.81	-2.9	7.1	3.43	2.08	2.8- 4.1	*
SND	76		67.2	86.6	75.31	3.87	74.1- 76.6	
1/to NA (DEG)	22		13.5	36.1	23.80	5.44	22.0- 25.5	
1/to NA (MM)	4		0.1	11.5	5.2	2.65	4.4- 6.1	
/1 to NB (DEG)	25		18.2	38.2	28.46	4.78	26.9- 30.0	
/1 to NB (MM)	4		2.1	11.8	6.46	2.37	5.7- 7.2	
POG to NB	Not established		-4.5	5.3	1.08	1.93	0.5- 1.7	
POG & 1/to NB	Varies		-1.1	12.8	5.38	3.43	4.3- 6.5	
1/to/1 (R)	130.98	9.24	109	136.7	124.34	6.63	112.2-126.5	*
OCC to SN	14		8	30.3	17.68	4.40	16.3- 19.1	
GOGN to SN (R)	31.73	5.19	24.7	46.1	34.63	5.11	33.0- 36.3	*

* $p<0.05$
n.s. — No statistically significant difference
R — Riedel

Figure 4
Israeli polygon based on Steiner's analysis, using means and standard deviation.



population of other parts of the U.S. — a difference justifying separate cephalometric standards to be used by local orthodontists. The examination of 40 Israeli children with normal occlusion revealed significant differences in several cephalometric parameters.

Since the purpose of the present study was to establish cephalometric norms for Israeli adolescents, we had to verify that the sample selected represented Israeli adolescents. The subjects were all born in Israel. Their fathers' country of birth was recorded and compared to the Statistical Yearbook data.[15] The distributions were found to be similar. Therefore, the subjects were representative of Israeli adolescents at the age when orthodontic treatment is usually performed.

The next step was to establish cephalometric norms for Israeli adolescents using Downs and Steiner analyses. Those norms were compared with standards established by Downs and Steiner (Tables 1 and 2). Downs analysis resulted in a significant difference in six parameters (Table 1).

The anatomic porion was used in the present study while Downs used the ear rod porion. Ricketts[17] stated that the ear rod porion does not coincide with the anatomic porion and that the discrepancy can be more than one centimeter.

This circumstance has a bearing on the findings of the present study for all measurements relating to the Frankfort plane. Even if the mandibular plane is disregarded. our findings differ in five of the Downs parameters. A polygon representation of our sample according to Downs is shown in Figure 2 (using means and SD),[18] while Figure 3 shows the Israeli sample cephalometric values superimposed on Downs' original polygon.

Steiner analysis (Table 2) shows that most values for the Israeli sample differ from Steiner's original values. However, it was only possible to subject five parameters (Riedel) to a statistical test. The remaining parameters are incomplete with no values for standard deviation. Riedel's data,[16] which Steiner included in his analysis, refer to adults over 18 years old. A polygon representation of the Israeli sample based on the Steiner parameters is illustrated in Figure 4. Figure 5 is a cephalometric comparison of the Israeli and the Steiner means, superimposed on SN and registered on S. Based on comparisons with the Downs and Steiner means, the Israeli sample population is characterized by a more convex profile, a steeper mandibular plane, and more protrusive incisors, with the tendency for a more retrusive mandible.

Kowalski[19] found an ANB value of four in a white population in Philadelphia. He stated that the difference between his data and Steiner's was due to the type of sample — his normal as opposed to Steiner's ideal. In the present study, the sample population was found to have an ANB value of 3.4. The cephalometric value of the incisor inclination in the Israeli sample, however, exceeds that of Riedel,[16] Kowalski,[19] Downs[6] and Steiner.[7]

1. The ethnic distribution of the adolescent sample conforms with the ethnic distribution in the general population.
2. The value distributions were similar for both genders, except for the Y-axis which was higher in the males.
3. Differences were demonstrated between the Israeli sample values and those of the Steiner and Downs samples. The differences were expressed in both skeletal and dental values.

The Israeli sample is characterized by a convex profile, a retrusive mandible, a steep mandibular plane and protrusive incisors. In view of the findings in this study, it is recommended that specific cephalometric values be established for the Israeli population, to serve in diagnosis and to help in determining the course of treatment.

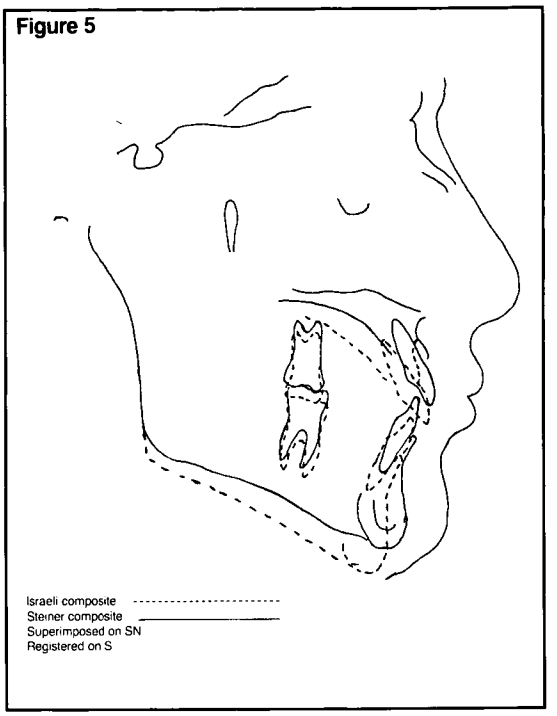


Figure 5
Cephalometric tracings comparing the Israeli and Steiner means, superimposed on SN and registered on S.

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Commentary

The authors have attempted to compare a sample of Israeli adolescents to cephalometric statistics produced (or used) by Downs and Steiner. They found that the Israeli sample "is characterized by a convex profile, a retrusive mandible, a steep mandibular plane and protrusive incisors."

A very important item to be considered when attempting any statistical comparison is the selection of the sample to be compared. Eighteen males (probably still undergoing growth changes) and 22 females (possibly more nearly adult) is indeed a relatively small sample. The characteristics required to be included in the sample are rather vague, to wit: Class I (Angle), less than three millimeters of crowding (with no indication of how such crowding was measured), and an "orthognathic" profile determined by clinical observation. This could be called a "normal sample," if all the qualifiers are identified and quantified (which they are not). It is important to note the nature of the samples used for comparison in this study. Downs' sample contained only subjects which exhibited "ideal occlusions." Downs excluded prognathic facial profiles. Steiner's sample consisted chiefly of measurements recorded by Riedel taken from a sample of 52 adults with "normal" occlusions and modified with measurements from one female whose profile Steiner liked. From that single individual, Steiner added several measurements to enhance his analysis such as SND and upper incisor to NA in both millimeters and angularly. PO to NB measurements were given to Steiner by Riedel and were taken from a sample of 30 adult males and 30 adult females with normal occlusions. Measurements of lower incisor to NB were also provided from the same 60 subjects.

Critical to utilizing information taken from the Israeli sample is the "clinical observation" of orthognathism. Certainly incisor protrusion and facial convexity would be affected by this judgment qualification.

Several statistical tests were mentioned such as Manova analysis, "*t*"-tests, etc., but one must remember that the total sample consisted of a heterogenous mix of only 40 adolescents. It is doubtful that this paper identified "specific cephalometric values to be established for the Israeli population."

The significance of the "Fathers Country of Birth Distribution" is completely lost in the context of the paper.

—Richard A. Riedel
Poulsbo, WA