European Journal of Orthodontics 27 (2005) 340–348
doi:10.1093/ejo/cji042
© The Author 2005. Published by Oxford University Press on behalf of the European Orthodontics Society.
All rights reserved. For permissions, please email: journals.permissions@oupjournals.org.

Ranking facial attractiveness

Helen Knight* and Olly Keith**
*Department of Orthodontics, Royal United Hospital NHS Trust, Bath, **Maxillofacial Unit, Royal Lancaster Infirmary, Lancaster, UK

SUMMARY The first aim of this investigation was to assemble a group of photographs of 30 male and 30 female faces representing a standardized spectrum of facial attractiveness, against which orthognathic treatment outcomes could be compared. The second aim was to investigate the influence of the relationship between ANB differences and anterior lower face height (ALFH) percentages on facial attractiveness. The initial sample comprised standardized photographs of 41 female and 35 male Caucasian subjects. From these, the photographs of two groups of 30 male and 30 female subjects were compiled. A panel of six clinicians and six non-clinicians ranked the photographs.

The results showed there to be a good level of reliability for each assessor when ranking the photographs on two occasions, particularly for the clinicians (female subjects $r = 0.76–0.97$, male subjects $r = 0.72–0.94$). Agreement among individuals within each group was also high, particularly when ranking facial attractiveness in male subjects (female subjects $r = 0.57–0.84$, male subjects $r = 0.91–0.94$). Antero-posterior (AP) discrepancies, as measured by soft tissue ANB, showed minimal correlation with facial attractiveness. However, a trend emerged that would suggest that in faces where the ANB varies widely from 5 degrees, the face is considered less attractive. The ALFH percentage also showed minimal correlation with facial attractiveness. However, there was a trend that suggested that greater ALFH percentages are considered less attractive in female faces, while in males the opposite trend was seen.

Either of the two series of ranked photographs as judged by clinicians and non-clinicians could be used as a standard against which facial attractiveness could be assessed, as both were in total agreement about the most attractive faces. However, to judge the outcome of orthognathic treatment, the series of ranked photographs produced by the non-clinician group should be used as the 'standard' to reflect lay opinion.

Introduction

Attractiveness, and particularly facial attractiveness, is a very desirable physical attribute for all members of society. Evidence would suggest that people with attractive faces are likely to be regarded as more competent, likeable and in a broad sense 'better' than those who are not considered facially attractive (Alley and Hildebrandt, 1988). To have an attractive facial appearance confers a greater variety of positive social responses (Baldwin, 1980; Howells and Shaw, 1985). This can have a profound effect on self-esteem and social adjustment. Patients requesting orthognathic surgery often present with a dislike of one or more aspect of their facial appearance. Inherent in their request for treatment is a wish to improve facial appearance (Wictorin *et al*., 1969; Laufer *et al.*, 1976; Kiyak *et al.*, 1981). The measurement of improvement rather than change in facial appearance is not only difficult, but imprecise and can often only be described in terms of relative change or change in relation to another face or group of faces.

To assemble a group of ranked facial photographs showing a range of facial attractiveness would be a useful tool in counselling such patients about to undergo orthognathic surgery.

Previous studies that have employed photographs to rank facial attractiveness have found a high level of agreement between examiners (Iliffe, 1960; Udry, 1965; Shaw, 1981; Patzer, 1985; Lundström *et al.*, 1987; Kerr and O'Donnell, 1990). However, the photographs used in many of these studies have not been standardized, e.g. lighting conditions, identical background and film batch consistency. The methods of rating have also varied (Lundström *et al*., 1987; Cochrane *et al.*, 1999).

The aims of this study were to assemble a group of facial photographs, comprising 30 males and 30 females, to represent a standardized spectrum of facial attractiveness and to investigate the relationships, if any, between facial attractiveness and sagittal discrepancies as measured by ANB and the percentage of anterior lower face height (ALFH).

Subjects

Fifty-seven male and 41 female Caucasian dental students between the ages of 19 and 23 years were invited to attend one of four photographic sessions at the University of Bristol Dental School, UK. Forty-one male and 35 female subjects participated in the investigation. The aim of the study was explained and informed consent obtained from each participant.

During these sessions, standardized full-face, right profile and three-quarter colour photographs were taken using a Nikon FM2 SLR camera (Nikon UK Ltd, Kingston, Surrey, UK) with a 70 mm lens and a Metz 45 flashgun (Metz International, Elstree, Hertfordshire, UK). Fuji Reala film was used and all the photographs were taken against a standard grey background. The distance between the photographic equipment components and the subjects was 2 m.

The subjects were positioned such that the inter-pupillary line and Frankfort plane were horizontal. All were requested not to wear makeup, earrings, or glasses, and long hair was held back.

The photographs were developed in a single batch. Photographs of 11 male and five female subjects were discarded due to a lack of clarity of one or more images. The final size of each group was therefore 30 male and 30 female subjects. Three photographic views for each individual were mounted as 11 × 17 cm colour prints on a display board. The display boards were randomly re-ordered after each ranking procedure was completed.

As an indication of sagittal discrepancy, ANB was calculated for each profile photograph. Soft tissue cephalometric points N, A and B were identified and ANB angle was measured using a protractor. The ALFH proportion has been described as a contributory factor to the attractiveness, or otherwise, of facial appearance (Poulton, 1967; De Smit and Dermaut, 1984). The ALFH percentage was therefore calculated as follows: the total anterior face height (TAFH) was measured from soft tissue nasion to soft tissue menton and ALFH from soft tissue columella to soft tissue menton (Barnett, 1975):

$$ALFH/TAFH \times 100 = ALFH\ \%$$

Assessors

Two panels of assessors were invited to participate in the ranking procedure.

The first group comprised six clinicians (three males, three females), with an age range of 25–48 years, specializing in orthodontics in the hospital service and dental practice environment. The second group comprised six non-clinical staff (three males, three females), with an age range of 24–57 years, working in administrative and management posts in a hospital environment. Each assessor worked independently using the following guidelines to instruct them on how to carry out the ranking procedure.

Guidelines.

1. There are two groups of photograph display boards to be ranked
   Group A Female
   Group B Male
2. Take the photographs of the first 10 subjects in group A and spread them out. Rank them from left (most attractive) to right (least attractive).
3. Take each of the remaining photographs. Insert them among and around the first 10 cards wherever you feel they belong in terms of their comparative facial attractiveness.
4. Collect all 30 boards in a pile, with your selection for most attractive on the top and least attractive on the bottom.
5. Repeat steps 2, 3 and 4 for group B.

The assessors were asked not to spend longer than 30 minutes on the procedure.

The exercise was repeated 4 weeks after the initial ranking to determine the reliability of the assessors.

Statistical methods

The photographic display boards were scored according to the rank assigned by each assessor: the most attractive being given a score of 1 and the least attractive a score of 30.

Pearson correlation coefficients were performed for each assessor to determine the reliability between the first and second scoring of the photographs.

An intra-class correlation (ICC) was then calculated on the scores for each group of assessors to determine the level of agreement/association within the group when ranking the photographs.

Finally, the scores for each photograph were summed and the photographs ranked again according to the summed scores.

Measurement reliability

All cephalometric points and measurements were carried out by one author (HK) and repeated after 6 months to calculate the method error. Single ICCs were performed for male and female subjects for ANB (male 0.987, female 0.968), ALFH (male 0.985, female 0.902) and TAFH (male 0.995, female 0.960) and showed a high level of agreement.

Results

Sagittal discrepancies ranged from an ANB difference of 2–12 degrees in the female group and 3–12 degrees in the male group.

ALFH percentages of TAFH ranged from 50 to 61 per cent for females and 49 to 67 per cent for males.

Correlations between the first and second ranking procedures were high particularly for the clinicians (Table 1). However, the highest correlation was found with male non-clinician 4. This judge gave identical ranking positions to seven subjects.

Examination of the ICC showed high levels of agreement, particularly when judging facial attractiveness in male subjects (Table 2). Interestingly, there was less agreement when ranking female faces. This was particularly true for the male assessor (0.63) and non-clinician (0.57) groups.

On the basis of a high level of agreement within individuals and between individuals when assigned to their respective groups, the scores for each photograph were summed and the photographs re-ordered according to the total score (Tables 3 and 4).

Correlations between groups of assessors were carried out on the summed data and found to be high, particularly when male faces were considered (Table 5).

ANB distribution using ranked summed scores: clinician and non-clinician assessors

For female subjects, the distribution of ANB using ranked summed scores from both the clinician and non-clinician groups demonstrated a very low correlation with perceived facial attractiveness (Figure 1a). However, a trend was seen in the faces considered least attractive, with ANB measurements deviating widely from those considered attractive.

For male subjects there was a similar finding but with the trend emerging of less attractive faces having greater ANB differences (Figure 1b). The face considered most attractive had an ANB of 5 degrees, those at the other end of the spectrum had ANB differences of 8 degrees and above.

ALFH percentage distribution using ranked summed scores: clinician and non-clinician assessors

The scattergrams for both female and male subjects demonstrated a low correlation between ALFH percentage and facial attractiveness (Figure 2a, b). For female subjects, when judged by clinicians, there appeared to be no correlation between the ALFH percentage and perceived facial attractiveness. However, it would appear that for non-clinician judges there was a trend for female faces to be considered less attractive the greater the ALFH percentage, while for male subjects the opposite trend occurred.

Table 1 Correlation between the first and second rankings of photographs for each assessor.

Assessor	Female subjects	Male subjects
Female clinician 1	0.93	0.86
Female clinician 2	0.91	0.83
Female clinician 3	0.80	0.94
Male clinician 4	0.92	0.87
Male clinician 5	0.93	0.93
Male clinician 6	0.78	0.83
Female non-clinician 1	0.84	0.80
Female non-clinician 2	0.82	0.84
Female non-clinician 3	0.92	0.70
Male non-clinician 4	0.97	0.94
Male non-clinician 5	0.78	0.72
Male non-clinician 6	0.76	0.74

Table 2 Average measure of intra-class correlation (non-summed data).

	Female subjects	Male subjects
Female assessors	0.84	0.93
Male assessors	0.63	0.91
Clinicians	0.90	0.94
Non-clinicians	0.57	0.94

Discussion

The primary aim of this study was to assemble a group of facial photographs of 30 male and 30 female subjects to represent a spectrum of facial attractiveness. The photographic views selected for the stimulus material were full-face, three-quarter and profile views of each Caucasian subject mounted on a single board. Howells and Shaw (1985) have shown that there is a moderately high correlation between ratings assigned to live subjects and photographs of the same subject. Glass *et al.* (1981) also described a close relationship between judgements made from live stimuli and those from viewing colour photographs of the same subject. Phillips *et al.* (1992) found that the perception of attractiveness is affected by the view presented, with no one view consistently favoured. They recommended using multiple views of subjects presented simultaneously, supporting the presentation of the material used in this investigation.

The subjects selected for this study were all dental students ranging in age from 19 to 22 years and of a middle/high socio-economic status. Phillips *et al.* (1992) recommended that if photographs are to be used in an orthognathic study, then the age of the subjects should be in the same age range as the patients under treatment. They also suggested that both the age and socio-economic status of the judges should match the stimulus photographs. Howells and Shaw (1985) and Peerlings *et al.* (1995) also considered that the socio-economic status of both judges and subjects should match, but did not consider the age of judges to be significant in rating facial attractiveness. The age range of the photographic subjects in this investigation matched the orthognathic patient group. The age range of the judges was wide but socio-economically closely matched that of the photographed subjects.

In this study, a ranking procedure was undertaken to produce two groups (male and female) representing a spectrum of facial attractiveness. Many other investigators have used visual analogue scales (VAS), which have certain advantages. They are a rapid method of obtaining scores on a large number of stimuli by a panel of judges. They are easily understood by judges and readily accepted. However, they can introduce a level of precision beyond the discriminatory ability of the judges (Phillips *et al.*, 1992). Aitkin (1969) also described a limitation of the VAS – comparable positioning of lines by two observers does not necessarily imply the same feeling. Tulloch *et al.*

Table 3 Summed scores for female subjects.

Position	Clinician assessors		Non-clinician assessors		Female assessors		Male assessors	
	Photograph	Score	Photograph	Score	Photograph	Score	Photograph	Score
1	1	15	1	18	1	21	1	12
2	5	36	8	67	5	36	8	57
3	3	68	17	98	3	68	18	70
4	18	88	5	99	8	88	5	98
5	8	95	10	108	17	95	17	110
6	20	106	3	114	13	106	3	116
7	19	113	7	116	10	113	7	121
8	17	121	18	118	7	121	19	134
9	7	132	22	141	18	132	20	140
10	13	144	13	145	20	144	10	149
11	12	145	4	160	22	145	22	156
12	11	146	26	163	19	146	12	166
13	10	159	20	172	4	159	21	170
14	22	166	19	180	11	166	11	171
15	21	166	21	196	9	166	13	178
16	9	175	14	200	12	175	4	184
17	4	200	9	203	21	200	9	189
18	30	213	27	206	26	213	14	196
19	15	219	12	210	27	219	2	198
20	2	219	11	213	2	219	15	208
21	14	246	2	220	25	246	30	220
22	25	260	23	237	15	260	26	241
23	6	276	15	239	14	276	6	263
24	24	278	28	270	30	278	27	264
25	26	283	30	274	23	283	23	271
26	28	288	6	279	24	288	28	272
27	27	289	29	280	29	289	25	293
28	23	303	25	282	28	303	24	309
29	16	304	24	301	6	304	16	316
30	29	327	16	332	16	327	29	333

(1993) used ranking procedures in their study to reduce the problem of comparing scores from judges whose relative assessments may differ only because different sections of the rating scales were used. This problem can be overcome, however, by logarithmic transformation.

Correlations between first and second ranking procedures for each judge were high, particularly for clinicians (Table 1). Howells and Shaw (1985), in their study investigating the validity and reliability of ratings, also found a high correlation by each panel member between first and second ratings of photographs. Roberts-Harry and Stephens (1992) reported a similar finding. Agreement within groups of judges in this study was examined using ICC and found to be high, particularly when judging male faces (Table 2). Peerlings *et al.* (1995) reported high levels of agreement among the judges in the three panels used in their investigation. Tedesco *et al.* (1983), in their study to develop a dental/facial attractiveness scale, also found ICC reliability to be high.

The influence of antero-posterior (AP) discrepancies on facial attractiveness as measured by soft tissue ANB was examined in this investigation. Phillips *et al.* (1995) suggested that as the AP discrepancy increases, the perception of attractiveness by others decreases. Lucker and Graber (1980) considered the AP dimension to be the most important factor in judging facial attractiveness. This is not in agreement with the present findings, although a trend did emerge suggesting that the more ANB deviated from 5 degrees the less attractive the face. Kitay *et al.* (1999), Kerr and O'Donnell (1990), De Smit and Dermaut (1984) and Tulloch *et al.* (1993) have suggested that the most attractive profiles are Class I. This was confirmed by the results of this study.

The influence of ALFH is perceived to be more variable. De Smit and Dermaut (1984), Poulton (1967), Sassouni and Nanda (1964) all reported that subjects who viewed artificially constructed facial photographs did not consider lengthening of the soft tissue profile desirable. De Smit and Dermaut (1984) found that lengthening the facial profile could be more important than the AP dimension in judging facial attractiveness. However, Cox and van der Linden (1971) found no difference in preference. In this investigation there was a trend for an increase in the ALFH percentage to be associated with less attractive faces for female subjects, when judged by non-clinicians, but no clear trend when assessed by clinicians. In male subjects, the opposite trend was seen – less attractive faces had shorter ALFH percentages.

Table 4 Summed scores for male subjects.

Position	Clinician assessors		Non-clinician assessors		Female assessors		Male assessors	
	Photograph	Score	Photograph	Score	Photograph	Score	Photograph	Score
1	5	41	5	37	5	29	5	49
2	25	58	7	60	7	38	18	55
3	7	58	25	64	25	48	4	68
4	4	69	4	78	4	79	25	74
5	18	71	6	85	30	79	22	75
6	30	90	30	95	3	104	7	80
7	22	93	22	101	22	119	6	83
8	13	109	18	113	6	121	30	106
9	24	110	3	116	14	127	13	125
10	6	119	16	139	13	129	24	137
11	14	133	13	145	18	129	23	141
12	3	145	15	149	24	132	3	157
13	1	152	24	159	16	147	1	158
14	23	162	1	179	15	167	16	170
15	21	177	23	183	1	173	15	176
16	16	178	14	188	9	204	21	180
17	15	194	9	195	23	204	14	194
18	9	223	20	221	21	220	9	214
19	20	225	21	223	20	224	20	222
20	19	253	19	234	19	226	17	242
21	29	257	29	242	2	241	29	251
22	17	263	26	259	29	248	10	259
23	2	267	17	263	26	263	19	261
24	8	269	11	269	11	256	8	278
25	11	279	2	271	8	267	11	283
26	10	292	8	276	17	284	26	296
27	26	300	10	285	10	318	2	297
28	28	320	28	311	28	326	28	305
29	27	338	27	312	27	328	27	322
30	12	344	12	327	12	341	12	330

Table 5 Correlation for photograph rankings between groups of assessors for summed data.

Groups of assessors	Female subjects	Male subjects
Female clinicians/female non-clinicians	0.69	0.89
Male clinicians/male non-clinicians	0.73	0.93
Female assessors/male assessors	0.89	0.92
Clinicians/non-clinicians	0.82	0.95

In order to assemble a group of facial photographs representing an agreed order of facial attractiveness it is important to decide which group of photographs is the more valid, should there be a difference between clinicians and non-clinicians (Figures 3 and 4). Phillips *et al.* (1995) reported differences in the evaluation of profiles between lay persons and dental specialists. They also reported that individuals perceive their own profile differently from orthodontists, oral surgeons and lay persons. Shaw (1981), Prahl-Andersen *et al.* (1979), and Phillips *et al.* (1995) reported that clinicians and non-clinicians do not necessarily share views on what constitute attractive faces.

Giddon (1995) suggested that orthodontists have not reconciled the paradox that their diagnostic and treatment decisions are based largely on objective morphological considerations while their patient's decision making centres on aesthetic expectations, and other subjective factors relate to self-image and outcome. Lay people are often less discriminating than professionals and they are significantly more likely than orthodontists or oral surgeons to assign normal ratings to profile drawings (Bell *et al.*, 1985). Dunleavy *et al.* (1987) reported that 1:5 lay people found patients to be unimproved following surgery, regardless of the amount of skeletal change. Burcal *et al.* (1987) also reported that lay people are less stringent in appreciation of changes in profile and a 6 mm change had to occur before it was observed by two out of three lay people.

Assembling a group of ranked faces to represent a spectrum of facial attractiveness is possible, but in view of the differences in perception between clinicians and non-clinicians, the ranked group assembled by non-clinicians should be considered as the more valid, i.e. representing the lay population.

There were differences between clinicians and non-clinicians in this study, particularly in relation to female

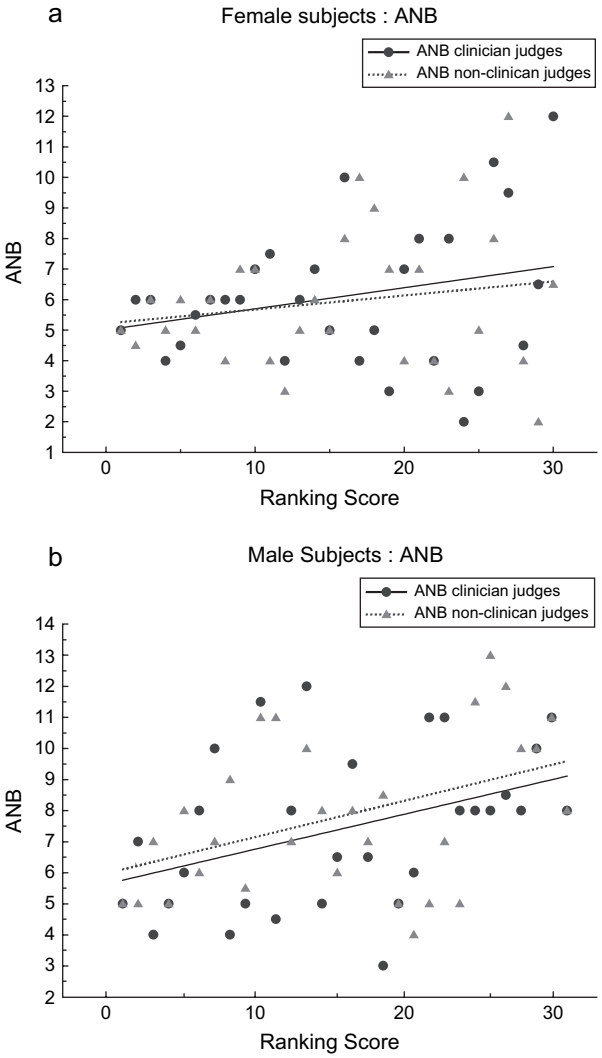

Figure 1 ANB distribution in (a) female and (b) male subjects for clinician and non-clinician judges.

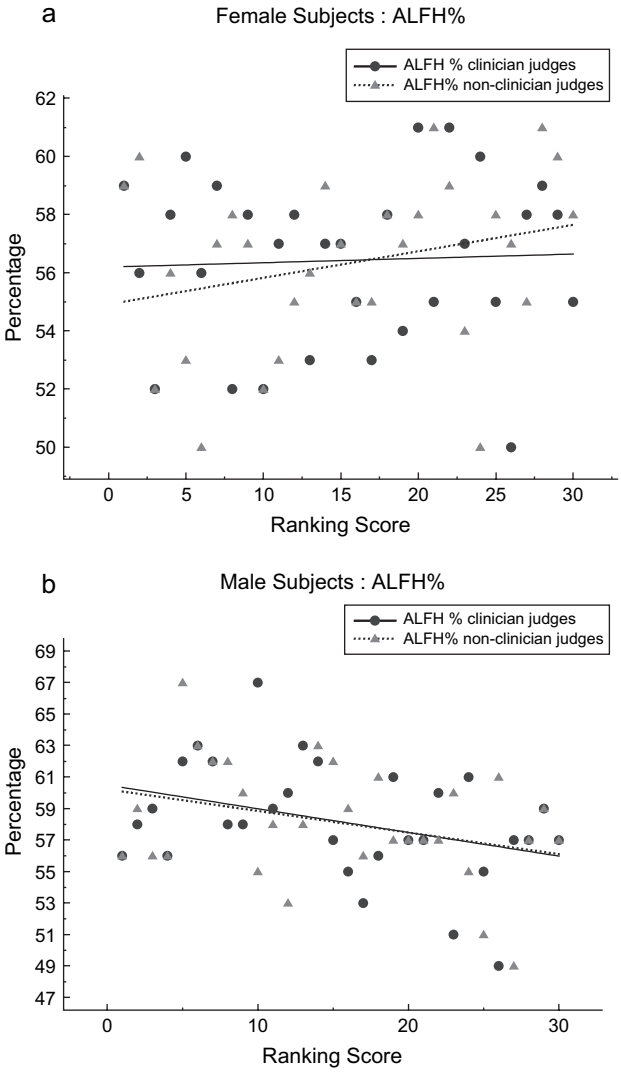

Figure 2 Anterior lower face height percentage (ALFH%) distribution in (a) female and (b) male subjects for clinician and non-clinician judges.

faces. Perception of faces regardless of the instructions given can result in the attribution of character and personality traits to the person whose face is being viewed (Howells and Shaw, 1985). It could be construed that in the female group, facial expression had more of an influence on ranking than for male subjects. It could be speculated that clinicians and non-clinicians were influenced when ranking the female faces by preferences in, e.g. hair appearance. Although the hair of female subjects was held back from the face, this did not hide the appearance of hair colour or texture. Male subjects had more uniform hair styling.

Despite the differences between clinicians and non-clinicians in this study, particularly in relation to female faces, there was complete agreement between all groups of assessors about the most attractive male and female faces. This can give clinicians confidence in the aesthetic aspect of treatment planning for orthognathic surgery in that the 'gold standard' was identical for both clinicians and lay people.

Conclusions

1. Either of the two series of ranked photographs as judged by clinicians and non-clinicians could be used as a standard against which facial attractiveness could be assessed for Caucasian subjects in early adulthood.
2. To judge the outcome of orthognathic treatment, the series of ranked photographs produced by the non-clinician group should be used as the 'standard' to reflect lay opinion.

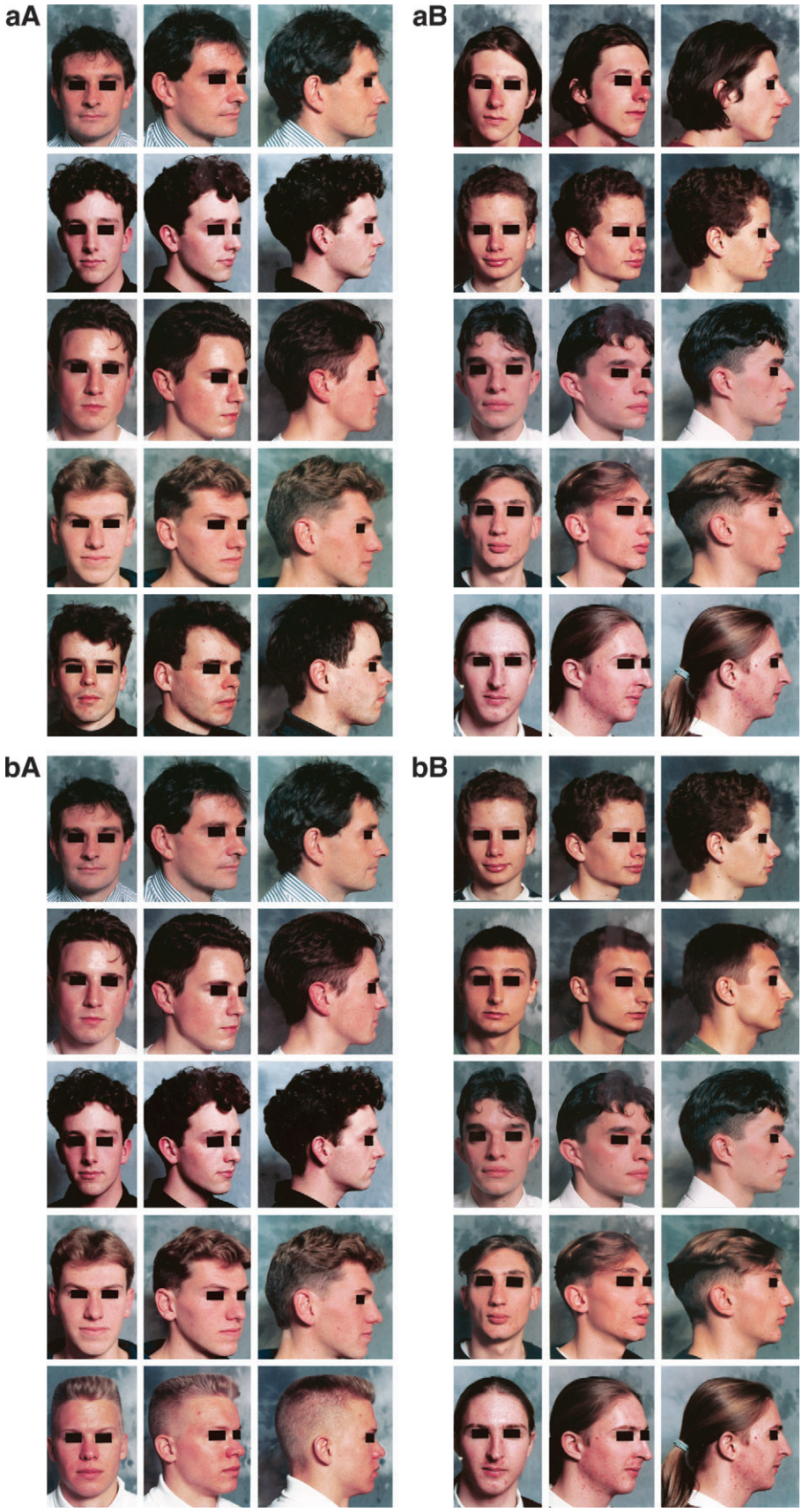

Figure 3 Male subjects: (a) clinician assessors and (b) non-clinician assessors. (A) Ranking positions 1–5 (most attractive faces), (B) ranking positions 25–30 (least attractive faces).

Figure 4 Female subjects: (a) clinician assessors and (b) non-clinician assessors. (A) Ranking positions 1–5 (most attractive faces), (B) ranking positions 25–30 (least attractive faces).

3. The value of ANB has little influence on facial attractiveness, but less attractive faces tend to have ANB values that diverge widely from the values found in the most attractive faces.
4. ALFH percentage has little influence on facial attractiveness, but a trend emerged for female faces – the greater the percentage, the less attractive the face. For male faces the opposite trend was found.
5. Clinicians and non-clinicians are in total agreement about the most attractive faces.

Address for correspondence

Helen Knight
Orthodontic Department
Royal United NHS Trust Bath
Combe Park
Bath BA1 3NG
UK
E-mail: kniboo@waitrose.com

Acknowledgements

We would like to thank Dr Gordon Taylor, Medical Statistician, for his assistance in the statistical analysis and Mr Simon Tutty, Medical Photographer, for his practical help and advice. We are grateful also to Dr Tony Ireland and Professor Chris Stephens for their advice. This study was supported by a grant from the Wessex Regional Health Authority.

References

Aitkin R C B 1969 Measurement of feelings using visual analogue scales. Proceedings of the Royal Society of Medicine 62: 993–996

Alley T R, Hildebrandt K A 1988 Determinants and consequences of facial aesthetics. In: Alley T R (ed.) Social and applied aspects of perceiving faces. Lawrence Erlbaum Associates, Hillsdale, New Jersey, pp. 101–140

Baldwin D C 1980 Appearance and aesthetics in oral health. Community Dentistry and Oral Epidemiology 8: 244–256

Barnett D P 1975 Variations in the soft tissue profile and their relevance to the clinical assessment of skeletal pattern. British Journal of Orthodontics 2: 235–238

Bell R, Kiyak H A, Joondeph D R, McNeill R W, Wallen T R 1985 Perceptions of facial profile and their influence on the decision to undergo orthognathic surgery. American Journal of Orthodontics 88: 323–332

Burcal R G, Laskin D M, Sperry T P 1987 Recognition of profile change after simulated orthognathic surgery. Journal of Oral and Maxillofacial Surgery 45: 666–670

Cochrane S M, Cunningham S J, Hunt N P 1999 A comparison of the perception of facial profile by the general public and 3 groups of clinicians. International Journal of Adult Orthodontics and Orthognathic Surgery 14: 291–295

Cox N H, van der Linden F P G M 1971 Facial harmony. American Journal of Orthodontics 60: 175–183

De Smit A, Dermaut L 1984 Soft-tissue profile preference. American Journal of Orthodontics 86: 67–73

Dunleavy H A, White R P, Proffit W R, Turvey T A 1987 Professional and lay judgment of facial esthetic changes following orthognathic surgery. International Journal of Adult Orthodontics and Orthognathic Surgery 2: 151–158

Giddon D B 1995 Orthodontic applications of psychological and perceptual studies of facial esthetics. Seminars in Orthodontics 1: 82–93

Glass L, Starr C D, Stewart R E, Hodge S E 1981 Indentikit Model II – a potential tool for judging cosmetic appearance. Cleft Palate Journal 18: 147–151

Howells D J, Shaw W C 1985 The validity and reliability of ratings of dental and facial attractiveness for epidemiologic use. American Journal of Orthodontics 88: 402–408

Iliffe A H 1960 A study of preferences in feminine beauty. British Journal of Psychology 51: 267–273

Kerr W J S, O'Donnell J M 1990 Panel perception of facial attractiveness. British Journal of Orthodontics 17: 299–304

Kitay D, BeGole E A, Evans C A, Giddon D B 1999 Computer-animated comparison of self-perception with actual profiles of orthodontic and nonorthodontic subjects. International Journal of Adult Orthodontics and Orthognathic Surgery 14: 125–134

Kiyak H A, Hohl T, Sherrick P, West R A, McNeill R W, Bucher F 1981 Sex differences in motives for and outcomes of orthognathic surgery. Journal of Oral Surgery 39: 757–764

Laufer D, Glick D, Gutman D, Sharon A 1976 Patient motivation and response to surgical correction of prognathism. Oral Surgery, Oral Medicine, Oral Pathology 41: 309–313

Lucker G W, Graber L W 1980 Physiognomic features and facial appearance judgements in children. Journal of Psychology 104: 261–268

Lundström A, Woodside D G, Popovich F 1987 Panel assessments of facial profile related to mandibular growth direction. European Journal of Orthodontics 9: 271–278

Patzer G L 1985 The physical attractiveness phenomena. Plenum Press, New York

Peerlings R H J, Kuijpers-Jagtman A M, Hoeksma J B 1995 A photographic scale to measure facial aesthetics. European Journal of Orthodontics 17: 101–109

Phillips C, Tulloch C, Dann C 1992 Rating of facial attractiveness. Community Dentistry and Oral Epidemiology 20: 214–220

Phillips C, Griffin T, Bennett E 1995 Perception of facial attractiveness by patients, peers, and professionals. International Journal of Adult Orthodontics and Orthognathic Surgery 10: 127–135

Poulton D R 1967 The influence of extra oral traction. American Journal of Orthodontics 53: 8–18

Prahl-Andersen B, Boersma H, van der Linden F P G M, Moore A W 1979 Perceptions of dentofacial morphology by laypersons, general dentists, and orthodontists. Journal of the American Dental Association 98: 209–212

Roberts-Harry D, Stephens C D 1992 Panel perception of facial attractiveness. British Journal of Orthodontics 18: 152–153

Sassouni V, Nanda S 1964 Analysis of dentofacial vertical proportions. American Journal of Orthodontics 50: 801–823

Shaw W C 1981 The influence of children's dentofacial appearance on their social attractiveness as judged by peers and lay adults. American Journal of Orthodontics 79: 399–415

Tedesco L A, Albino J E, Cunat J J, Slakter M J, Waltz K J 1983 A dental-facial attractiveness scale. Part II. Consistency of perception. American Journal of Orthodontics 83: 44–46

Tulloch C, Phillips C, Dann C IV 1993 Cephalometric measures as indicators of facial attractiveness. International Journal of Adult Orthodontics and Orthognathic Surgery 8: 171–179

Udry J R 1965 Structural correlates of feminine beauty preferences in Britain and the United States: a comparison. Sociology and Social Research 49: 330–342

Wictorin L, Hillerstrom K, Sorenson S 1969 Biological and psychosocial factors in patients with malformation of the jaws. 1. A study of 95 patients prior to treatment. Scandinavian Journal of Plastic Reconstructive Surgery 3: 138–143

Copyright of European Journal of Orthodontics is the property of Oxford University Press / UK and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.