

Is orthodontics an option in the management of bimaxillary protrusion?

SADJ October 2010, Vol 65 No 9 p404 - p408

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ABSTRACT

Successful orthodontic treatment is based on a clear perception by the clinician of a patient's facial preference and treatment needs. Bimaxillary protrusion is a normal facial trait seen in the Black population and the most acceptable bimaxillary facial profile in a sample of Black subjects was determined by Beukes *et al* in 2007¹. Variations from this ideal profile may require extractions as part of orthodontic treatment in order to attain the ideal. The objective of this study was to determine whether Black subjects with bimaxillary protrusion would want to change their facial profile to the ideal and at what financial cost.

A sample of 586 school learners and 321 university students were presented with four silhouetted profiles of varying degrees of bimaxillary protrusion. One of the silhouette profiles represented the ideal¹ and treatment procedures required to achieve this ideal were explained to the sample. They were then requested to answer a questionnaire that would assist in identifying their perception of their own profile and their desire to change their appearance.

The ideal silhouette was confirmed to be the most attractive (91.51%) and the sample felt that any severe deviations from this ideal profile should be treated. The financial cost of treatment was found to be a concern, as more subjects (62.84%) would undergo the required treatment if it were free. Many subjects (43.55%) would be prepared to pay for the necessary treatment to achieve the ideal profile. Females were found to be more definite in their decision making, reflecting a greater awareness about their aesthetic appearance than their male counterparts.

Findings from this study can serve as an essential tool to assist both orthodontists and maxillofacial surgeons in the treatment planning and management of Black patients with bimaxillary protrusion.

Keywords: Bimaxillary protrusion, Facial profile, Facial aesthetics

INTRODUCTION

People who seek orthodontic treatment do so mainly for cosmetic reasons^{2,3}. Peer groups and relatives who constitute the



Figure 1: The facial profile identified as ideal among Black patients¹

Figure 2: a, b, c and d representing silhouette profiles demonstrating varying degrees of bimaxillary protrusion

cultural domain are the primary determinants of standards of attractiveness. Research in this area is therefore primarily directed at finding out what is judged to be attractive or aesthetically pleasing to others.

One of the challenges facing the South African orthodontist is the treatment of bimaxillary protrusion which is defined as the excessive protrusion of the maxillary and mandibular alveolar arches and dentition beyond the jaw bases⁴. This is a normal facial trait of the Black race groups⁵⁻¹⁰. This facial type has a worldwide distribution and is not confined to the Black race groups but is also seen in other races such as the Chinese¹¹, Inuits and American Indians. Since 79,6% of South Africa's population belong to the Black race group¹², bimaxillary protrusion is a common and normal facial trait in this country.

Whether subjects with bimaxillary protrusion would want to change their facial appearance is open to speculation and investigation. While the findings of Beukes *et al* (2007)¹ identified the ideal facial profile preferred by a sample of Blacks (Figure 1), their study falls short of establishing whether Black subjects would want to be treated to this bimaxillary protrusive profile.

Since this facial profile (Figure 1) represents the ideal level of attractiveness¹, it needs to be ascertained what degree of deviation from this ideal would prompt black subjects to undergo the necessary treatment to change their profile.

Table 1: Evaluators questionnaire

| Questionnaire | |
|--|---------------|
| This study is undertaken to enable us to provide you with the best possible service. While your input is essential, you are by no means compelled to participate. | |
| Below are four figures marked a, b, c and d. | |
| Please study these figures carefully and answer the following questions concerning the figures truthfully in your own opinion. | |
| Your answers are confidential and you will remain anonymous. | |
| If you are unsure of anything please consult the supervisor who gave you this form. | |
| Age: _____ years | Gender: _____ |
| 1. In an earlier survey Figure d was found to be the most attractive. Do you agree? | |
| Yes or No (please circle your choice). | |
| 2. Which profile do you think you resemble the most? | |
| a b c or d (please circle your choice). | |
| 3. In order for a, b and c to look like d would require four extractions and two years of fixed orthodontic treatment (braces). Who do you feel should undergo the necessary treatment to look like d? | |
| i) a ii) b iii) c iv) a and b v) b and c vi) a and c | |
| vii) All of the above viii) None of the above | |
| (please circle your choice/s). | |
| 4. If you were not d would you be prepared to change your profile to look like d if the treatment was for free? | |
| Yes or No (please circle your choice). | |
| 5. If you were not d would you be prepared to change your profile to look like d if you had to pay for the treatment? | |
| Yes or No (please circle your choice). | |

AIM AND OBJECTIVES

The aim of this study was to determine the degree of deviation from the ideal Black profile that would prompt Black subjects to seek treatment to change their facial profile.

The objectives were:

- To determine whether the ideal Black facial profile as established by Beukes *et al*¹ sets a paradigm for attractiveness in the community.
- To assess and quantify the varying extent of bimaxillary protrusion that is acceptable to this sample.
- To assess the demand for cosmetic change.
- To determine whether financial cost is a factor in achieving a preferred facial preference.

MATERIALS AND METHODS

A series of four facial profile silhouettes of Black subjects with bimaxillary protrusion (Figure 2) were displayed to a sample of evaluators. Figure 2, a, b, c and d represent varying degrees of bimaxillary protrusion with figure 2d being the ideal as determined by Beukes *et al*¹.

Silhouette profiles used for the aesthetic evaluation were derived from the soft tissue outline of the lateral photographs taken of Black patients visiting the Department of Orthodontics, School of Dentistry, University of Limpopo. These patients attended the examination and screening clinic, and none of them had any orthodontic treatment.

Table 2: Results on the frequency of answer selection in the entire evaluator sample with respect to gender difference

| | | Total Frequency | Percentage | Male % | Female % | P Value |
|------------|-----|-----------------|------------|--------|----------|---------|
| Question 1 | Yes | 830 | 91.51 | 88.29 | 94.16 | 0.002 |
| | No | 77 | 8.49 | 11.71 | 5.84 | |
| Question 2 | a | 179 | 19.71 | 30.73 | 10.64 | 0.000 |
| | b | 86 | 9.47 | 13.93 | 6.63 | |
| | c | 112 | 12.33 | 17.07 | 8.43 | |
| | d | 530 | 58.48 | 39.27 | 74.30 | |
| Question 3 | a | 94 | 10.31 | 10.57 | 10.10 | 0.733 |
| | b | 172 | 18.96 | 20.88 | 17.37 | |
| | c | 78 | 8.54 | 8.35 | 8.69 | |
| | a&b | 66 | 7.32 | 7.86 | 6.87 | |
| | b&c | 319 | 35.14 | 31.94 | 37.78 | |
| | a&c | 59 | 6.54 | 7.13 | 6.06 | |
| | All | 58 | 6.43 | 6.39 | 6.46 | |
| None | 61 | 6.76 | 6.88 | 6.67 | | |
| Question 4 | Yes | 570 | 62.84 | 58.54 | 66.40 | 0.015 |
| | No | 337 | 37.16 | 41.46 | 33.60 | |
| Question 5 | Yes | 395 | 43.55 | 39.12 | 47.19 | 0.015 |
| | No | 512 | 56.45 | 60.88 | 52.81 | |

Photographs of a number of Black South Africans were taken with a Nikon 4500 digital camera at a resolution of 4.0 effective mega-pixels. The camera was set up on a tripod and the profile photographs standardised by positioning the patient’s head in natural posture with the lips in relaxed position against a white background, with an object focal distance of two metres. The patients were requested to relax, face an opposing mirror and look straight into the reflections of their own eyes with their lips in repose. Patients were instructed to adopt their normal daily facial demeanour. Any headgear and/or spectacles were removed before the photographs were taken. No flash was used as all the photographs were taken in the morning before 12h00 when maximum natural light is available in the examination room. The profile photographs were then transformed into silhouettes using “CorelTRACE 11” software.

A sample of 907 Black South African evaluators were then presented with these four figures (Figure 2) and the nature of treatment required to correct bimaxillary protrusion to achieve the result in figure 2d was explained to each participant. The evaluators were then requested to answer a questionnaire (Table 1) that would assess their perception of their own profile and their willingness to change their appearance. An interpreter was available to overcome any language barriers and explain any incongruities.

The sample of evaluators consisted of 586 secondary school learners and 321 second-year medical and dental university students. Both the sample of evaluators and the patients whose silhouetted profiles were used for this study were from the South African Black race group.

Although the silhouette obscured patient identity, consent was still sought from the subjects for the use of their silhouetted facial profiles for this study. Permission to conduct the study was also obtained from school principals and educators as well as from the Ethics Committee and managerial staff of the University of

Table 3: Results on the frequency of answer selection in the entire evaluator sample with respect to academic difference

| | | School % | University % | P Value |
|------------|------|----------|--------------|---------|
| Question 1 | Yes | 93 | 88.79 | 0.029 |
| | No | 7 | 11.21 | |
| Question 2 | a | 18.43 | 22.05 | 0.063 |
| | b | 10.92 | 6.83 | |
| | c | 13.48 | 10.25 | |
| | d | 57.17 | 60.87 | |
| Question 3 | a | 11.64 | 7.86 | 0.010 |
| | b | 18.66 | 19.50 | |
| | c | 8.73 | 8.18 | |
| | a&b | 8.56 | 5.03 | |
| | b&c | 30.82 | 43.08 | |
| | a&c | 7.02 | 5.66 | |
| | All | 7.36 | 4.72 | |
| | None | 7.19 | 5.97 | |
| Question 4 | Yes | 64.51 | 59.81 | 0.162 |
| | No | 35.49 | 40.19 | |
| Question 5 | Yes | 43.52 | 43.61 | 0.977 |
| | No | 56.48 | 56.39 | |

Limpopo (Medunsa campus). Evaluators were also explained that their participation would be totally voluntary and they could decline to complete the questionnaire if they wished. They were not coerced into or rewarded for their participation.

RESULTS

A total of 916 evaluators completed their questionnaire and nine were excluded as their forms were spoilt. The qualifying 907 evaluators consisted of 586 school learners with an average age of 16.68 years and 321 university students with an average age of 21.18 years. The evaluators were further separated into 409 females and 498 males.

Results from the questionnaires as answered by the 907 evaluators are presented in tables 2 to 6. P values associated with a Pearson χ^2 test are included to demonstrate any level of significance between groups.

An overall assessment of the results from the questionnaire (Table 2) illustrates the following:

- **Question 1** - 830 (91.51%) of the evaluators agree that figure 2d is the most attractive profile.
- **Question 2** - 530 (58.48%) of the evaluator group regard their facial profile to be the same as figure 2d (of these 74.30% were females and 39.27% were males).
- **Question 3** - 317 (35.14%) felt that people having the facial profile of figure 2b and 2c should seek treatment to resemble the profile seen in figure 2d.
- **Question 4** - 570 (62.84%) of the sample are prepared to undergo treatment to change their profile to figure 2d if the treatment were free, while 37.16% may be assumed to consider the treatment unnecessary.
- **Question 5** - 395 (43.55%) of the sample would be prepared to pay for the requisite treatment but the majority 512 (56.45%) would not undergo treatment to change their profile to resemble that of figure 2d if they had to pay for it.

Table 4: Results on the frequency of answer selection in schools and university with respect to gender difference

| | School | | | University | | | |
|------------|------------|--------|----------|------------|--------|----------|---------|
| | | Male % | Female % | P Value | Male % | Female % | P Value |
| Question 1 | Yes | 98.18 | 96.23 | 0.001 | 86.62 | 90.50 | 0.274 |
| | No | 10.82 | 3.77 | | 13.38 | 9.50 | |
| Question 2 | a | 30.97 | 7.86 | 0.000 | 30.28 | 15.56 | 0.000 |
| | b | 14.55 | 7.86 | | 9.86 | 4.44 | |
| | c | 16.79 | 10.69 | | 17.61 | 4.44 | |
| | d | 37.69 | 73.58 | | 42.25 | 75.56 | |
| Question 3 | a | 12.03 | 11.32 | 0.603 | 7.80 | 7.91 | 0.409 |
| | b | 22.18 | 15.72 | | 18.44 | 20.34 | |
| | c | 7.89 | 9.43 | | 9.22 | 7.34 | |
| | a&b | 8.65 | 8.49 | | 6.38 | 3.95 | |
| | b&c | 28.95 | 32.39 | | 37.59 | 47.46 | |
| | a&c | 7.14 | 6.92 | | 7.09 | 4.52 | |
| | All | 6.02 | 8.49 | | 7.09 | 2.82 | |
| | None | 7.14 | 7.23 | | 6.38 | 5.65 | |
| | Question 4 | Yes | 57.84 | | 70.13 | 0.002 | |
| No | | 42.16 | 29.87 | 40.14 | 40.22 | | |
| Question 5 | Yes | 38.81 | 47.48 | 0.035 | 39.72 | 46.67 | 0.213 |
| | No | 61.19 | 52.52 | | 60.28 | 53.33 | |

At a P value of $P \leq 0.05$ significant gender differences were found with regards to questions 1 ($P = 0.002$), 2 ($P = 0.000$), 4 ($P = 0.015$) and 5 ($P = 0.015$) (Table 2).

When comparing results of the frequency of answer selection between school learners and university students (Table 3), significant differences were found with regard to question 1 ($P = 0.029$) and question 3 ($P = 0.010$). School learners appear to be more dogmatic in answering question 1 while the reverse is largely true for question 3.

Significant gender differences were also found among the school learners in their selection of answers to questions 1 ($P = 0.001$), 2 ($P = 0.000$), 4 ($P = 0.002$) and 5 ($P = 0.035$) and among university students in question 2 ($P = 0.000$) (Table 4). Females were in general more affirmative in their answers than were the males.

There was no statistical difference between the male school learners and the male university students (Table 5) while significant differences were found between female school learners and female university students (Table 6) pertaining to question 1 ($P = 0.009$), question 2 ($P = 0.003$), question 3 ($P = 0.004$) and question 4 ($P = 0.019$). Female university students were more positive in their support for answers to questions 2, 3 and 4, while female school learners were more assertive in answering question 1.

DISCUSSION

Since mild to moderate bimaxillary protrusion is a normal facial characteristic in Blacks it is obviously a condition that does not routinely require treatment. However, the inability of the patient to close the lips without strain, the severity of incisor protrusion and a respect for the patients' desire for change may sometimes warrant therapeutic intervention.

If necessary, bimaxillary protrusion can be managed with orthodontics, orthognathic surgery, or a combination of the two. The

Table 5: Results on the frequency of answer selection in males with respect to academic difference

| Males | | | | |
|------------|------|----------|--------------|---------|
| | | School % | University % | P Value |
| Question 1 | Yes | 89.18 | 86.62 | 0.443 |
| | No | 10.82 | 13.38 | |
| Question 2 | a | 30.97 | 30.28 | 0.547 |
| | b | 14.55 | 9.86 | |
| | c | 16.79 | 17.61 | |
| | d | 37.69 | 42.25 | |
| Question 3 | a | 12.03 | 7.80 | 0.615 |
| | b | 22.18 | 18.44 | |
| | c | 7.89 | 9.22 | |
| | a&b | 8.65 | 6.38 | |
| | b&c | 28.95 | 37.59 | |
| | a&c | 7.14 | 7.09 | |
| | All | 6.02 | 7.09 | |
| | None | 7.14 | 6.38 | |
| Question 4 | Yes | 57.84 | 59.86 | 0.692 |
| | No | 42.16 | 40.14 | |
| Question 5 | Yes | 38.81 | 39.72 | 0.858 |
| | No | 61.19 | 60.28 | |

Table 6: Results on the frequency of answer selection in females with respect to academic difference

| Females | | | | |
|------------|------|----------|--------------|---------|
| | | School % | University % | P Value |
| Question 1 | Yes | 96.23 | 90.50 | 0.009 |
| | No | 3.77 | 9.50 | |
| Question 2 | a | 7.86 | 15.56 | 0.003 |
| | b | 7.86 | 4.44 | |
| | c | 10.69 | 4.44 | |
| | d | 73.58 | 75.56 | |
| Question 3 | a | 11.32 | 7.91 | 0.004 |
| | b | 15.72 | 20.34 | |
| | c | 9.43 | 7.34 | |
| | a&b | 8.49 | 3.95 | |
| | b&c | 32.39 | 47.46 | |
| | a&c | 6.92 | 4.52 | |
| | All | 8.49 | 2.82 | |
| | None | 7.23 | 5.65 | |
| Question 4 | Yes | 59.78 | 66.40 | 0.019 |
| | No | 40.22 | 33.60 | |
| Question 5 | Yes | 47.48 | 46.67 | 0.861 |
| | No | 52.52 | 53.53 | |

orthodontic approach involves the extraction of (usually healthy) upper and lower first premolars with retraction of the upper and lower incisors using full fixed orthodontic appliances^{13, 14}. Active treatment usually extends over two years followed by a year of passive retention wear.

While surgical techniques such as subapical osteotomies¹⁵ can produce results in a shorter treatment period, some orthodontic adjustment may be necessary to refine the occlusion¹⁶. The surgical correction of bimaxillary protrusion is usually restricted to extremely severe and rare cases and none of the profiles represented in the questionnaire fit this requirement.

Indeed the silhouettes portrayed in a to c of the questionnaire (Table 1) can readily be treated to the profile of silhouette d or at least an approximation thereof, by the extraction of four first premolars and fixed orthodontic treatment. Surgical correction as a treatment method was therefore omitted from the questionnaire.

From an orthodontic perspective correction of bimaxillary protrusion achieves favourable soft tissue changes without causing undesirable effects on the underlying hard tissues¹⁷⁻¹⁹. As the anterior teeth are retracted, the facial soft tissues tend to flatten with an opening of the nasolabial angle. The lower lip follows the lower incisor retraction more closely than the upper lip follows the upper incisors^{13, 20}. There is also some indication that mildly incompetent lips become competent by the retraction of the incisors and in such cases the lips remain stable^{21, 22}.

The treatment procedures to manage bimaxillary protrusion and alter the facial profile are standard and the results attainable. Whether and when such intervention should occur will depend on the need and requirements of the patients and not necessarily on the orthodontists and maxillofacial surgeons' clinical skill or perceptions of facial beauty.

Results from this study confirm that the facial profile in figure 2d¹ sets a paradigm among the Black sample and that 58.48% of the evaluators felt that they resemble this profile. The gender difference is significant in that 74.30% of females and only 39.27% of males thought that their profile matched the silhouette in figure 2d. The facial preference and treatment need of those who do not resemble the facial profile in figure 2d must be interpreted with caution as more subjects (62.84%) of evaluators would have treatment if it were free, whilst fewer subjects (43.55%) would be prepared to pay for treatment. It is pertinent that 35.14% of the evaluators agree that figures 2b and 2c as a group, are unattractive and people having these profiles should seek treatment, more urgently than those subjects with a profile resembling figure 2a (10.31%), 2b (18.96%) and 2c (8.54%) individually. While the latter does show evidence of lip incompetence possibly associated with anterior open bite, the associated low recommendation for treatment supports the findings of Dawjee *et al* who found that anterior open bite is not a major cause for aesthetic concern among Black subjects²³.

Although the sample size consisted of more males (n=498) than females (n=409), the latter appeared to be more affirmative in their answers to the questionnaire reflecting a greater aesthetic awareness than do males. This was evidenced by the P values in questions 1, 2, 4, and 5 in table 2 and the P values found for gender differences in table 4. University females were also shown to have a greater affinity for the selected answers than female school learners (Table 6).

The difference between the number of school learners (n=586) and the university students (n= 321) had no bearing on the study outcome as seen in table 3, where the two questions having a significant difference are in fact evenly spread.

CONCLUSION

The dilemma of whether to treat or not to treat bimaxillary protrusion is evident. Findings from this study indicate that:

- The silhouette profile in figure 2d can be accepted as ideal among the Black sample.
- Those patients with moderately severe deviations such as those seen in figure 2b and 2c could benefit from having treatment explained to derive the maximum benefit from therapy.
- Black subjects with deviation from the ideal bimaxillary protrusion could be interested in the ideal result but financial cost of treatment can be a restricting factor.
- Females appear to be more conscious of their aesthetic appearance and would therefore be more amenable to treatment.
- The findings from this study can assist both orthodontists and maxillofacial surgeons in the treatment planning and management of Black patients with bimaxillary protrusion who would like to change their facial profile.

While this study attempts to shed some light on the management of bimaxillary protrusion in Black subjects, a comparative and relevant follow up would be to determine the degree of bimaxillary protrusion that would be acceptable among the Caucasian race, particularly in light of the current trend toward dentoalveolar expansion and non-extraction orthodontic treatment.

The authors would like to express their sincere gratitude to Drs. C.K. Mzimkulu and S.E. Monehi for their assistance with the fieldwork.

Declaration: No conflict of interest.

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EOUS23092010