Facial changes in extraction and nonextraction patients

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The effect of orthodontic treatment on the face is one of the orthodontist's major concerns. The extraction of premolars has been condemned because of its alleged detrimental effect on facial esthetics.[1] This alleged detrimental effect is used to justify the avoidance of extracting teeth in patients with tooth-size–arch-length discrepancies (TSALD). There is a belief among some general dentists, orthodontists, and lay persons that premolar extraction results in an excessively flat facial profile. Numerous studies provide documentation that this fear is unfounded in most instances.[2-12]

A more subtle and seemingly less arguable criticism is "I just don't like the extraction face," or "I like the face nonextraction treatment produces better." Esthetics are a matter of personal taste and/or fashion, and it is futile to debate what degree of straightness or fullness of the profile is most desirable. Everyone is entitled to his or her own opinion when taste is involved. However, if one cannot distinguish between faces produced by extraction and by nonextraction treatment, then the criticism is invalid.

Although facial esthetics have been discussed profusely in the literature, little has been written on whether or not the faces of extraction and nonextraction patients can be distinguished from each other based on posttreatment appearance alone.

Abstract

The purpose of this study was to determine if there are any differences in the posttreatment faces of patients treated nonextraction and those treated with premolar extraction in properly diagnosed and treated cases. The study was conducted in two parts. In Part 1, perceptions of 192 experienced general dentists and orthodontists were tested. Facial photos of 25 consecutively treated nonextraction patients and 25 consecutively treated four-premolar-extraction patients were shown to the study participants. They were asked if the patient was treated with the extraction of four premolars or without extractions. The mean score of the respondents was 54%, only slightly better than pure chance. In Part 2, profiles were evaluated based on cephalometric tracings. There was no significant difference between pretreatment and posttreatment profiles of the groups. The mean H-line values for both groups were within the desired esthetic range. It was concluded that experienced orthodontists and general dentists could not determine whether treatment was nonextraction or extraction by looking at the face alone. Also, there was no significant difference between the faces produced by the two types of treatments. Therefore, the avoidance of extracting premolars based on a fear of a significant detrimental effect on the face is unjustified when the case has been properly diagnosed and treated.

Key Words

Posttreatment faces • H-line • Facial change • Proper diagnosis

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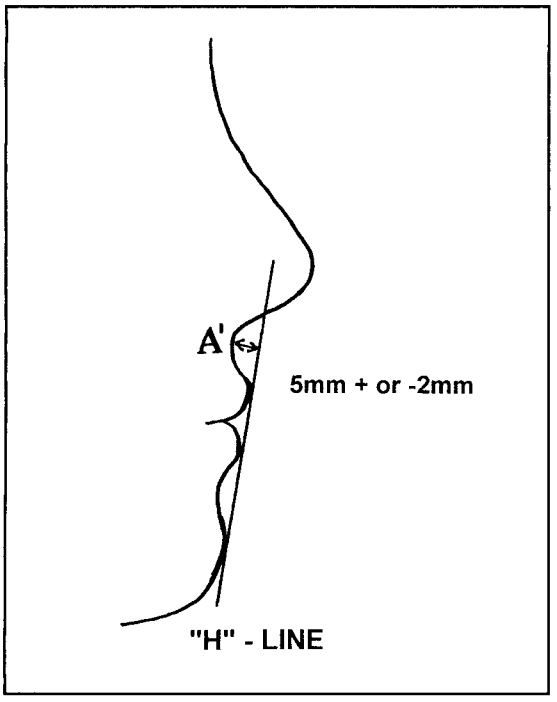

Figure 1

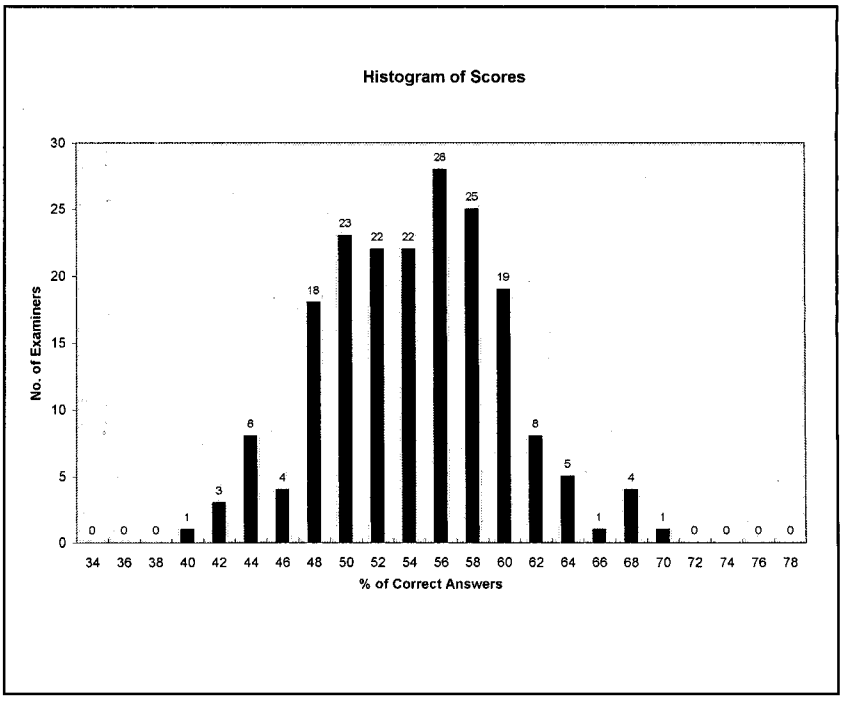

Figure 2

Figure 1
Holdaway H-line

Figure 2
Graph of questionnaire results

This study was designed to supply documentation on this important question. The hypothesis is: It is impossible to distinguish between patients treated with the extraction of four premolars and those treated without the extraction of any teeth by looking only at the posttreatment face.

Materials and methods

In order to test the hypothesis, a two-part study was devised. Consecutively treated patients were taken from a single clinician who applied consistent treatment objectives for both extraction and nonextraction patients. These treatment objectives were to establish an excellent occlusion and resolve tooth-size–arch-length discrepancies while maintaining the basic original arch form and keeping the mandibular incisors in their original position or uprighting them. Treatment objectives, such as desired position of the anterior teeth, minimal expansion in the mandibular arch, etc., were determined first, then, where little or no space was required, the patients were treated nonextraction. If more space was required, some combination of first or second premolars were extracted. Fifty patients were selected by arbitrarily entering the files of the senior author and proceeding consecutively until the sample was complete. The sample comprised 22 males and 28 females. All participants were adolescents except for two adults, 22 years and 34 years old.

The selection criteria were as follows:

1. Only consecutively treated patients (25 extraction and 25 nonextraction) were used
2. The senior author started and finished all cases.
3. Both arches were treated, with treatment lasting 14 months or more.
4. No surgery patients were included.
5. Sufficient records were available.

In the first part of the study, questionnaires were sent to 301 experienced orthodontists and general dentists. The participants were selected from the rosters of Diplomates of the American Board of Orthodontics, the Edward H. Angle Society of Orthodontists, the Charles H. Tweed International Foundation for Orthodontic Research, the Charles H. Tweed Orthodontic Group of Texas, the L.D. Pankey Institute, and general dentists from the Dallas area. At least 50 participants were selected from each orthodontic directory. Pairs of posttreatment profile and full-face photos of 50 patients were randomized. The participants were asked to look at each picture and decide if the patient had been treated with the extraction of four premolars or without the extraction of any teeth (other than third molars). A self-addressed, stamped answer card was provided.

In the second part of the study, the soft tissue initial (T1) and finished (T2) profiles were evaluated from cephalometric tracings. The distance from subnasale (A') to the Holdaway H-line or harmony line[13] was selected for the evaluation because it is a simple, accurate way to evaluate the fullness of the lips, and it is not influenced

Table 1
Face quiz results. Breakdown of scores by group surveyed

Group surveyed	Number surveyed	Number responses	Average score
ABO	51	26	54.07%
Angle Society	65	41	54.19%
Tweed Foundation	51	40	53.45%
Texas Tweed group	51	40	55.85%
Pankey dentists	45	15	53.86%
Dallas dentists	38	30	54.05%
All groups	301	192	54.32%

by the size of the nose. The H-line is drawn tangent to the soft tissue chin and the upper lip (Figure 1). The desired range for pleasing esthetics is from 3 mm to 7 mm, with a mean of 5 mm. Both the initial and posttreatment profiles were evaluated, and the changes that occurred during treatment were noted.

Results

At the time of data tabulation, response cards from 192 doctors had been received. The scores ranged from 40% to 70% correct, with a mean of 54.3% and a standard deviation of 4.76. The 54.3% mean score by these experienced general dentists and specialists is only slightly better than the 50% that would be expected as a result of flipping a coin.

A graph (Figure 2) of the test score results shows a normal distribution. Table 1 gives the results of the six different groups of dentists and orthodontists. Note the similarity of results.

In order to have a better statistical understanding of the results, we subjected the data to tests for sensitivity, specificity, accuracy of positive prediction, and accuracy of negative prediction, as described by Vig.[14]

Sensitivity indicates how often a positive identification is correct. In this case, it means the number of extraction cases identified correctly divided by the total number of extraction cases. Sensitivity was rated at 54.66%. *Specificity* indicates how often a negative identification is correct. In this case, it means the number of nonextraction cases correctly identified divided by the number of nonextraction cases in the sample. Specificity was rated at 46.02%. *Accuracy of positive prediction* is defined as the percent of extraction identifications that were correct (50.32%), and *accuracy of negative prediction* is the percent of nonextraction identifications that were correct (50.38%). The results show that looking at finished facial appearance is not a reliable method for determining whether premolar extractions were a part of the treatments (Table 2).

Table 2
Diagnostic tests performed to determine validity of using posttreatment photos to identify extraction treatment

Index	Score
Sensitivity	54.66
Specificity	46.02
Accuracy of pos. prediction	50.32
Accuracy of neg. prediction	50.38

Table 3
Holdaway H-line values for extraction and nonextraction patient groups

	Pretreatment		Posttreatment		Treatment change	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Nonextraction	5.76	2.18	4.46	1.83	-1.3	2.18
Extraction	5.24	1.68	4.16	1.32	-1.08	1.06
Difference	0.52		0.30		-0.22	

The results of the soft tissue profile evaluation from the cephalometric tracings gave very similar findings for both extraction and nonextraction patients (Table 3). The H-line values for the groups were similar at the beginning and at the end of treatment; the nonextraction patients were 0.64 mm fuller at the beginning of treatment and 0.3 mm fuller at the end of treatment than extraction patients. Both groups were within the desired profile range at the start and end of treatment. At T2, the extraction patients' H-line mean was 4.16 mm, with a standard deviation of 1.32 mm, while the nonextraction patients had a mean of 4.46 mm, with a standard deviation of 1.83 mm. The vast majority of the profiles became straighter during treatment. Eighteen of the 25 extraction patients (72%) and 21 of the 25 nonextraction patients (84%) experienced a straightening of the profile. The mean reduction in H-line value was 1.08 mm (S.D. 1.06 mm) and 1.3 mm (S.D. 2.18), respectively.

Surprisingly, nonextraction patients started with slightly fuller profiles than extraction patients, 5.76 mm (S.D. 2.18) versus 5.24 mm (S.D. 1.68). Equally surprising, the profiles of nonextraction patients flattened slightly more during treatment, 0.22 mm, than the profiles of extraction patients.

Figure 3A-H
Examples from the questionnaire illustrate problems faced by respondents. They were in strong agreement (>60%) on 76% of the faces. Certain faces were consistently judged nonextraction. However, the respondents were correct in only 50% of their decisions, suggesting they used similar criteria, such as fullness of the lips, balance, attractiveness, etc. Whatever criteria they used, it was no better than chance.

A-B: Typical faces in which the respondents were in high agreement (>60%), but were incorrect. "A" was judged to be nonextraction by 62%; she had upper first and lower second premolars extracted. "B" was judged to be nonextraction by 66%; she also had upper first and lower second premolars extracted.

C-D: Representing the four patients about which the respondents were the most indecisive (45% to 55% agreement). "C" was judged extraction by 53%; she had all four second premolars extracted. "D" was judged nonextraction by 47%, and they were correct.

E-F: Representing the faces most frequently misjudged. "E" was judged nonextraction by 79%; she had four first premolars extracted. "F" was judged extraction by 81%; she was nonextraction.

G-H: Representing the patients most frequently judged correctly. "G" was judged extraction by 87%; she had four first premolars extracted. "H" was judged nonextraction by 85%, and they were correct.


Figure 3A


Figure 3B


Figure 3C

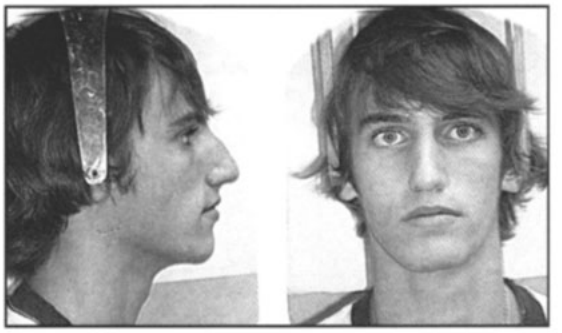
Figure 3D


Figure 3E

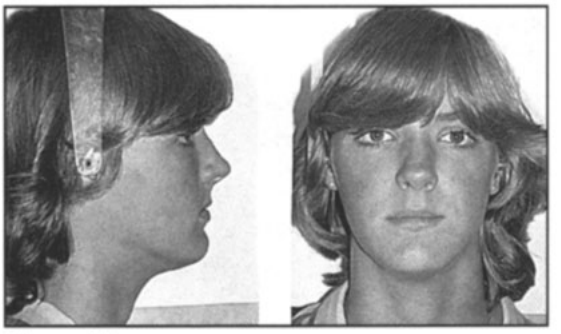
Figure 3F


Figure 3G


Figure 3H

Discussion

Results of this study show that, in this sample, the trained eye of experienced professionals could do only slightly (4%) better than pure chance in determining if the extraction of four premolars was a part of the patient's treatment.

The soft tissue study based on cephalometric tracings gives a plausible explanation. The finished profiles varied by only 0.30 mm and were within the desired normal range. The results of this study agree with the findings of Rushing[15] and Johnson,[16] in that there was no appreciable difference in the faces of extraction and nonextraction patients posttreatment.

Why were the faces in this study so indistinguishable? The answer is, all patients (extraction and nonextraction) were treated to a mandibular incisor position that was predetermined in the belief that it would give good facial balance and a healthy, functional, stable dentition. Also, the

Figure 4A

Figure 4B

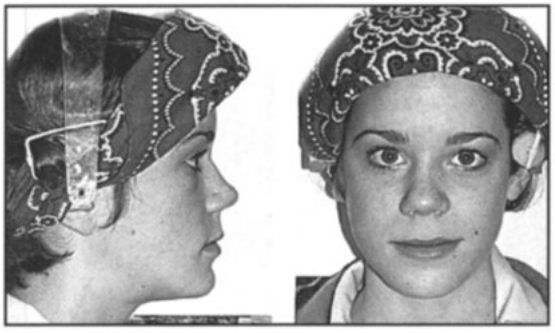

Figure 4C

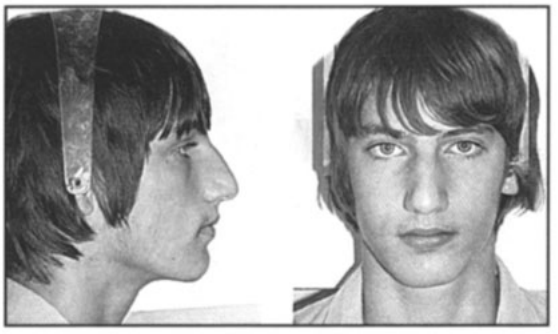

Figure 4D

Figure 4E

Figure 4F

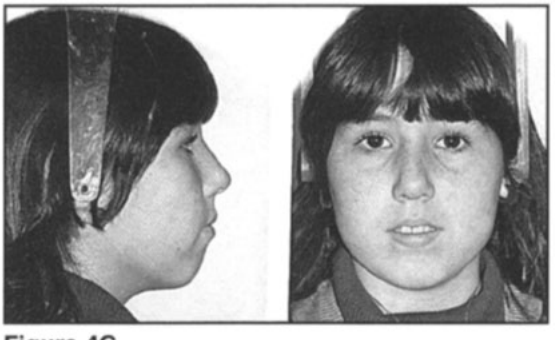

Figure 4G

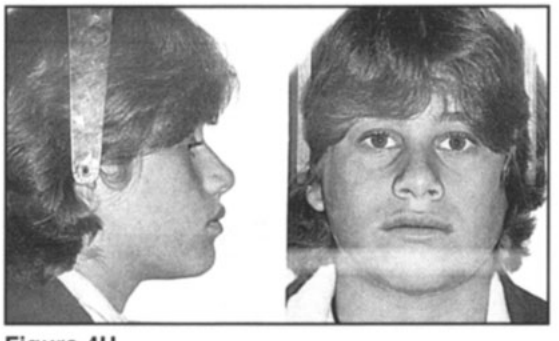

Figure 4H

Figure 4A-H
Pretreatment photos of patients in Figure 3A-H. The posttreatment photos (Figure 3A-H) show the profiles straightened slightly (approximately 1 mm) during treatment as measured by the H-line. In the majority of patients who had a good or satisfactory initial profile (84%) the profile either improved or did not change significantly. G and H represent patients who, because of their skeletal patterns, are usually treated in a specific way (dolichocephalic - extraction; brachycephalic - nonextraction).

A: Pretreatment photos of patient in Figure 3A. H-line values: T1=6.5 mm; T2=5.0 mm

B: Pretreatment photos of patient in Figure 3B. H-line values: T1=6.0 mm; T2=4.0 mm.

C: Pretreatment photos of patient in Figure 3C. H-line values: T1=6.0 mm; T2=4.5 mm.

D: Pretreatment photos of patient in Figure 3D. H-line values: T1=5.0 mm; T2=2.0 mm.

E: Pretreatment photos of patient in Figure 3E. H-line values: T1=6.5 mm; T2=6.5 mm.

F: Pretreatment photos of patient in Figure 3F. H-line values: T1=4.0 mm; T2=2.0 mm.

G: Pretreatment photos of patient in Figure 3G. H-line values: T1=6.0 mm; T2=3.5 mm.

H: Pretreatment photos of patient in Figure 3H . H-line values: T1=6.5 mm; T2=6.0 mm.

treatment mechanics employed usually came near the pretreatment goal and rarely resulted in counterclockwise rotation of the mandible.

How could this be? First, we need to agree on certain basic assumptions.

1. The mandible will grow just as much with two premolars missing as it will with a full complement of teeth.[17]

2. Various treatment approaches will not result in a clinically significant difference in mandibular growth during treatment as measured by SNB and/or the facial angle (N-Pg to Frankfurt); i.e., there is no approach to treatment that routinely produces more than a 2° increase in SNB during treatment.[17-26]

3. Appropriate mechanics will rarely induce a counterclockwise rotation of the mandible.

4. The presence or absence of premolars will not affect the amount of nose and chin growth.

5. The desired position of the mandibular incisors is determined at the onset of treatment. It is the position which, in the judgment of the practitioner, is most likely to give good facial esthetics and a healthy, functional, stable denture. Thus, the extraction decision is based on how to resolve the tooth-size–arch-length discrepancy and position the mandibular incisors in the predetermined position without appreciable expansion in the lower arch.

6. The maxillary incisors will be positioned in a proper relationship with the mandibular incisors.

Under these circumstances, how could the faces be significantly different whether 24 or 28 teeth are present?

There is agreement within the specialty that a patient can be misdiagnosed and/or mistreated, either extraction or nonextraction, resulting in a "less than ideal" face. Also, certain skeletal patterns are so aberrant that satisfactory results cannot be obtained without orthognathic surgery. When these types of problems are treated without surgery, frequently by extractions, the compromised result should be blamed on the skeletal problem and not on the extractions.

This study illustrated that when overjet is corrected, the profile typically flattens, regardless of whether teeth are extracted. One exception would be if the correction is due to advancing the mandibular incisors.

The findings of this and other studies[16,17] show that, in properly treated patients, one can rarely tell if the treatment included the extraction of premolars. Why, then, does the perception persist that nonextraction treatment produces better faces? One reason may be the result of an earlier era of occasional overtreatment, misdiagnosis, or compromise made to accommodate severe skeletal patterns before the advent of orthognathic surgery. Second, certain types of skeletal patterns are likely predisposed to certain treatments. For example, the patient with a brachycephalic skeletal pattern is more likely to be treated nonextraction, while the patient with a dolichocephalic pattern is more likely to be treated with extractions. There is also little doubt that the patient with a long, narrow dolichocephalic facial pattern and crowding will not have as pleasing a face posttreatment as a patient with a brachycephalic pattern with its nice broad arches, no matter how the patients are treated. Extractions are often an effort to make the most of a bad situation. Therefore, good skeletal patterns and good faces tend to be treated without extractions, while poor skeletal patterns and poor faces tend to be treated with extractions. The same is true for lesser degrees of these two extremes, and patients with better starting skeletal patterns and less crowding are more likely to be treated nonextraction;[3,18] since they started with better faces, it seems logical that they would also end with better faces.

The key to the similarity in profiles of the patients included in this sample is the specification of being "properly diagnosed and properly treated." A treatment approach that results in good facial esthetics and a healthy, functional, stable dentition should qualify these patients as being well treated. Eighty-four percent (84%) were in the desired H-line range for good facial esthetics.

What about the "healthy, functional, stable" requirement? Only a few of the patients in this study were tested for long-term stability. However, they were treated by the same clinician, using a nonexpansion approach and the same treatment objectives that produced patients for three long-term studies of stability. The three theses found similar results, with approximately 80% of the patients presenting satisfactory stability over 10 years postretention.[27-29]

Therefore, since 84% of the patients had good facial esthetics after treatment and were treated in a manner that has been shown to be stable in 80% of patients, it can be concluded that they were properly diagnosed and properly treated.

The clinical significance of the findings of this study is that the presence or absence of four premolars is not the determining factor of facial appearance. The findings also document that satisfactory facial results can be achieved consistently either by extracting premolars or not extracting them, as long as the diagnosis and treatment are correct. Most of the extraction patients started with satisfactory profiles and, after being treated with extractions in order to enhance health and stability, the profiles were still satisfactory.

Conclusions

1. In the vast majority of instances, it was not possible to determine if a patient was treated with or without the extraction of four premolars by observing only posttreatment profile and frontal view photos.
2. There was no statistical difference in the ability to evaluate faces between general practitioners and orthodontists.
3. There were no significant differences in the cephalometric evaluation of the soft tissue profile between extraction and nonextraction patients at the end of treatment.
4. The majority of the profiles, both extraction and nonextraction, became straighter during treatment.
5. The mean finished profile assessment for both extraction and nonextraction patients fell within the pleasing normal range, as measured by the Holdaway[13] H-line.
6. Treatment was very face-friendly. Eighty-four percent of the finished profiles were within the desired normal range. In only eight patients did the value for the H-line go from a normal range to outside that range. It is interesting to note that of these eight patients, six were treated nonextraction. The vast majority of the profiles stayed within the desired range, and some patients moved from outside the desired range to inside it during treatment.
7. The "ruining" of the face or, even a significant detrimental effect on the face, is a rare occurrence in properly diagnosed and treated patients.
8. Premolar extraction is still a valuable adjunct in the treatment of appropriate problems.

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