C E C S M O R U B R I C

On the efficiency of two stage treatment for Class II division 1 malocclusions: a retrospective clinical study of 38 cases treated in one or two stages

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1 – INTRODUCTION

Recent evidence based prospective studies, reported by the Revue Cochrane of May 2009, suggest that the best course of action for treatment of Class II, division 1 malocclusions is to await the full eruption of the adolescent dentition and then to install a full banded and bonded appliance because at the end of treatment there is no significant difference between results obtained by a two-stage, orthopedic followed by full fixed appliance, treatment and a one- stage only of full banded and bonded therapy.

These studies also judge that adding a preliminary orthopedic stage to the therapeutic scheme lengthens total treatment time.

In a plea for increased efficiency these authors conclude that two-stage treatment should no longer be employed in contemporary orthodontics.

Nevertheless, more and more patients are seeking treatment at orthodontic offices at younger and younger ages, usually when they are between 9 and ten years old and 75% of them, according to Bassigny's estimate[1], have Class II malocclusions. Ideally, orthodontists ought to be able to take advantage of this time of growth, often accompanied by change in patients' dentitions, by instituting early treatment. The average age of patients beginning orthodontic treatment, according to these authors, is

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12 years when the permanent dentition is in place. Why wait so long?

The objective of this paper is not to make a case for one treatment strategy or another but, on the contrary, to find a golden mean between two different strategies that have both proven that they can achieve our treatment objectives. Our goal is to offer our young patients the best possible treatment to respond to their goals as effectively as we can but also as efficiently as possible to avoid losing their cooperation.

We have, accordingly, conducted a retrospective study analyzing cephalometric and clinical data. We have classified data related not only to the effectiveness of treatment in reaching its goals but also to clarifying its efficiency in reaching its goals with the least effort and the fewest complications.

2 – THIS STUDY

2 – 1 – Experimental protocol

This work consists of a retrospective study of 38 consecutively treated cases treated by Doctors André-Jean Horn and Isabelle Thiers-Jégou.

These patients all had Class II division 1 malocclusions characterized by:

– molars and canines in Class II Angle relationship (ranging from edge-to-edge to frank Class II;

– an incisal overjet of at least 6 mm;
– no lower anterior crowding;
– permanent second molars not yet erupted.

Patients whose records did not present these characteristics and patients whose records were incomplete or whose X-rays were taken elsewhere were all excluded from the study.

We selected two samples from this population:
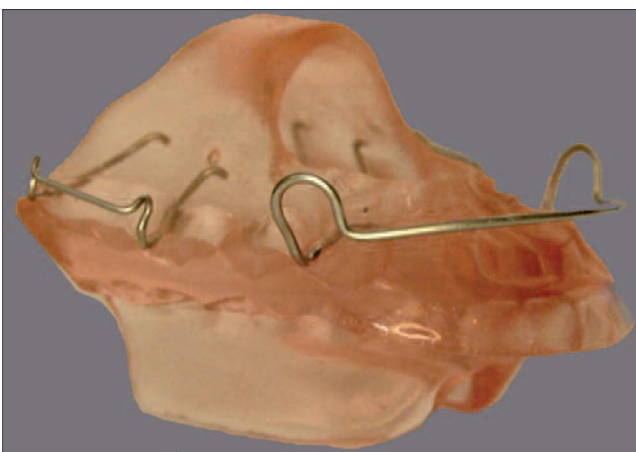
a

b

Figures 1a and 1b
Modified Andresen activator used by Doctors Horn and Jégou.

– the first comprised 19 patients treated in one stage;
– the second comprised 19 patients treated in two stages.
– The two-stage patients wore an Andresen type activator (fig. 1) at the end of the stable mixed dentition stage and later a full banded and bonded two arch appliance during the phase of establishment of the adolescent dentition.
– The single stage patients were treated with a full banded and bonded two arch appliance before eruption of the second molars. For all patients an Edgewise appliance with single slot, non-angulated .022 by .028 brackets was employed.

2 – 1 – 1 – Data collection

All radiographs were taken in the Horn-Jégou office with the same X-ray machine. Profile cephalograms were taken of all patients with teeth in occlusion. In addition, an intermediate cephalogram was taken of the two stage patients.

Full records were taken on all patients at the close of treatment and after six months and one year following removal of appliances.

The Procuste® program was employed to prepare all cephalometric analyses. To minimize bias, a single operator discerned all the cephalometric landmarks in a single day. Then statistical tests were made with the Excel and Aps programs.

The Excel statistical analysis allows comparisons to be made about:
– the values concerning the depart samples and the definition of an ''average'' patient;

– the values between the one-stage and the two-stage treatment groups.

The Student's t-test was used to compare these averages:
– Two significant confidence levels were used for the values:
   • $p < .01\%$: symbolized by (*);
   • $p < .001\%$ symbolized by (* *).
– A non-significant level for the values:
   • $p > .01\%$ symbolized by (NS) an abbreviation for ''non-significant''.

2 – 1 – 2 – Characteristics of the two samples

The first series of measurements shows that the samples at departure presented equivalent dento-alveolar characteristics. The patients were hypodivergent (FMA average = 22°) presenting a skeletal Ballard Class II gap with an average ANB of 5 and an
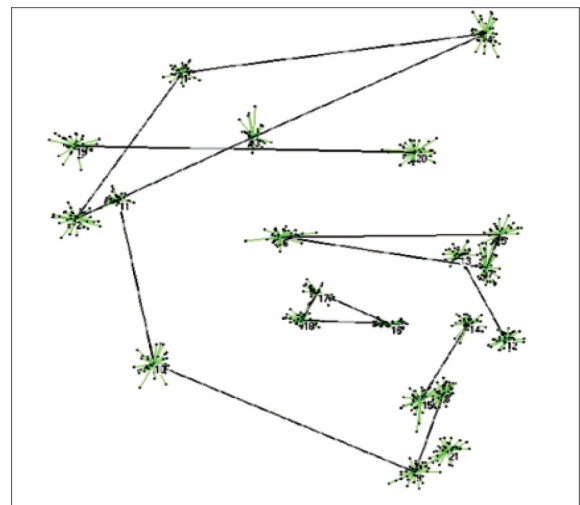

Figure 2
Dispersion of the points entered around the global consensus of the two samples.

average SNB of 75° < 80° ± 3, the maxilla being well located at an average SNA of 82°. Overjet for all patients was about 9 mm.

We then used the Aps program that works with the points registered by the Procuste® program to achieve the superimpositions.

The Procuste superimposition (Penin 2006[10], Simon 2005[11]), which is routinely used in anthropology, can eliminate problems arising in conventional cephalometry that are related to the utilization of angles and structural landmarks. It relies neither on angles nor on reference planes but simultaneously takes all the points of the tracing into account to make an adjustment by analyzing the distribution of a set of shapes. It is a quantitative method of studying living forms based on the statistical theory of conformation.

The study of the two samples at departure thanks to the Procuste superimposition (fig. 2) gives a modelization of our average patient:

In green are represented the points entered and their divergence from the average. We did not note any entering errors.

2 – 2 – Comparison of the two treatment methods

To analyze the cephalometric data head, 90 films of all the patients were
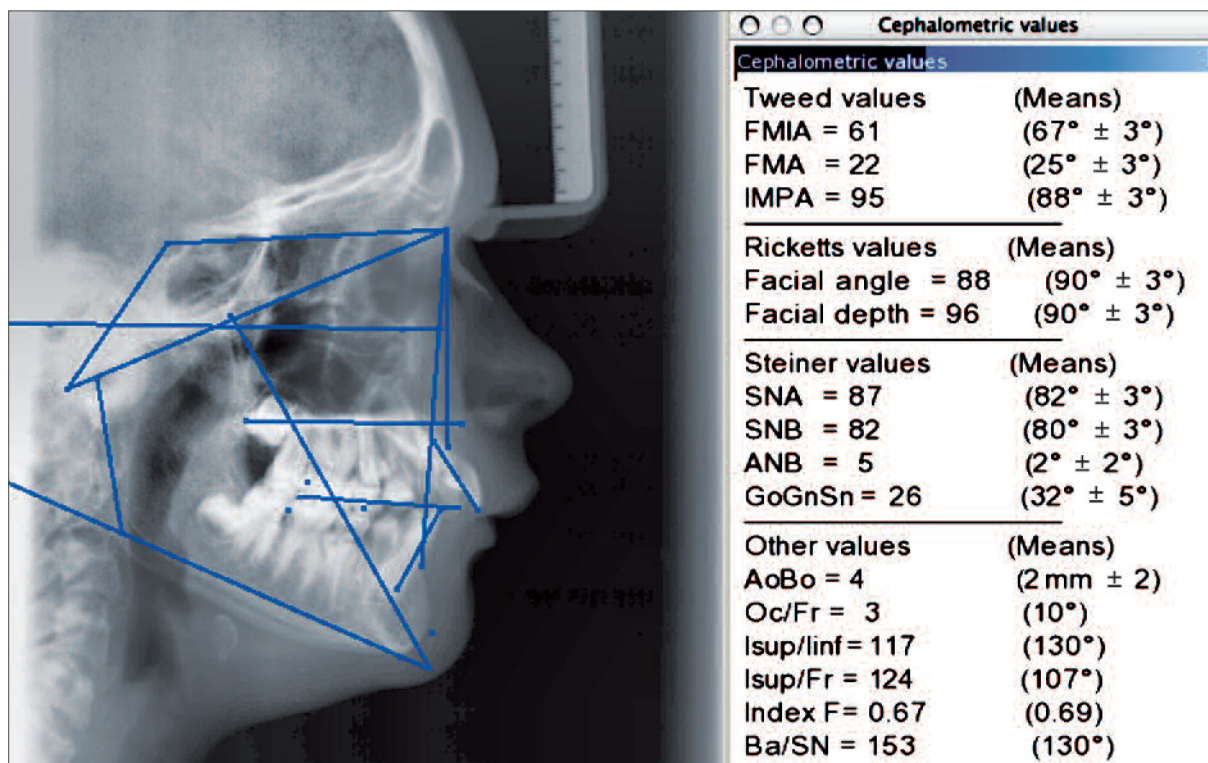

Figure 3
Procuste® cephalometric tracing data.

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Data: 38 Specimens, 21 Points, 2 Dimensions.
All specimen superimposed by GLS method.

Discrimination statistic for 1 component.
$R^2 = 0.135734$, F = 5.653826 with 1 and 36 DF, $p < 0.022849$.

Discrimination statistic for 2 components.
$R^2 = 0.483229$, F = 15.896581 with 2 and 35 DF, $p < 0.000012$.

Discrimination statistic for 3 components.
$R^2 = 0.638853$, F = 19.458475 with 3 and 34 DF, $p < 0.000000$.
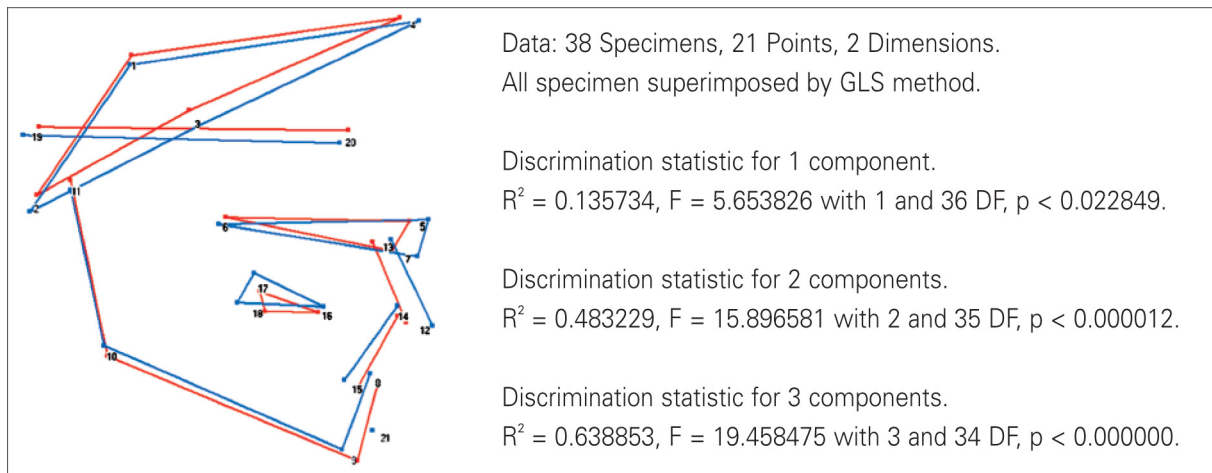
Figure 4
Procuste® superimposition of the average before (blue) and the after (red) treatment tracings for the one stage patients.

traced and analyzed with the aid of the Procuste® program (fig. 3), consisting of:
– 38 cephalograms taken at the beginning of treatment;
– 38 cephalograms taken six months to one year after the removal of appliances;
– 14 cephalograms taken between the end of first stage orthopedic therapy and the beginning of full banded and bonded treatment for the patients treated in two stages.

2 – 2 – 1 – Analysis of the cephalometric data

We used the Procuste program to compare and visualize the results of orthodontic therapy obtained for the two groups.

- **Comparison of the before and after tracings for the one stage patients** (fig. 4)
p is well below .001, which shows that treatment was very effective. The skeletal and dento-alveolar changes can be seen, with a clear retraction of point A and advancement of point B.

The maxillary incisors were intruded as they were retracted and as the mandibular incisors were moved forward.

- **Comparison of the before and after tracings for the two stage patients** (fig. 5)
For these patients *p* is also less than .001, demonstrating that therapy had been effective. It can also be seen that the coefficient R^2 is better than it was for group one.

It can also be seen that point A was retruded and point B advanced. The retraction of maxillary incisors was accompanied by a moderate tipping component. The mandibular incisors were repositioned.

- **Comparison of the after tracings between the two groups of one stage and two stage patients** (fig. 6)
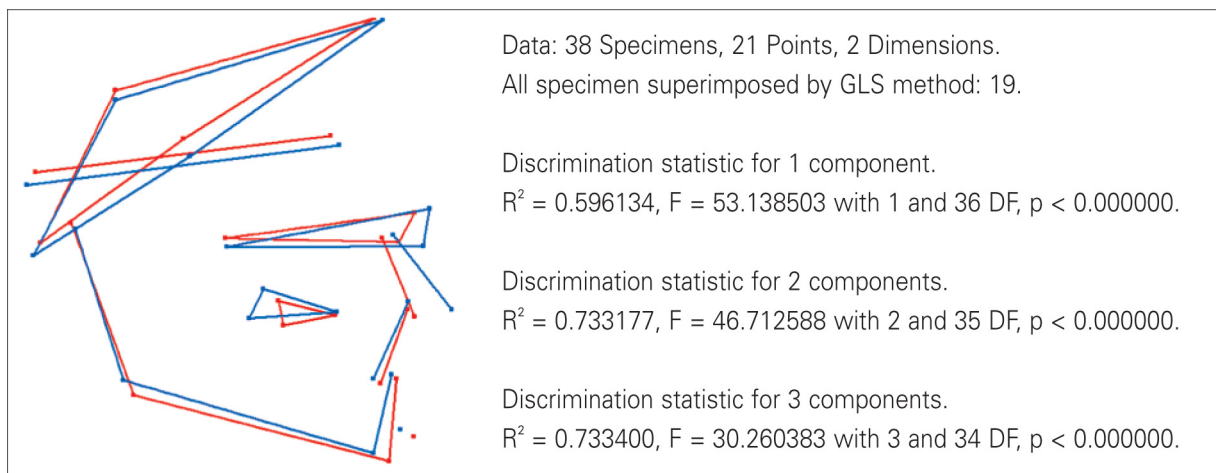
Data: 38 Specimens, 21 Points, 2 Dimensions.
All specimen superimposed by GLS method: 19.

Discrimination statistic for 1 component.
$R^2 = 0.596134$, $F = 53.138503$ with 1 and 36 DF, $p < 0.000000$.

Discrimination statistic for 2 components.
$R^2 = 0.733177$, $F = 46.712588$ with 2 and 35 DF, $p < 0.000000$.

Discrimination statistic for 3 components.
$R^2 = 0.733400$, $F = 30.260383$ with 3 and 34 DF, $p < 0.000000$.

Figure 5
Procuste® superimposition of the average before (blue) and the after (red) treatment tracings for the two stage patients.
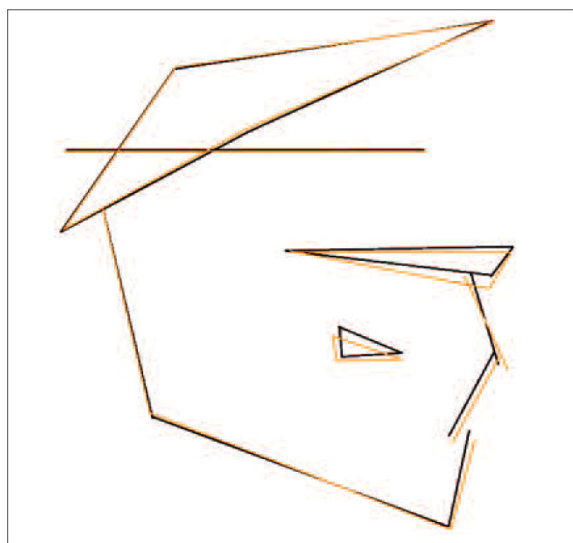

Figure 6
Comparison of after treatment tracings for the two groups, orange or red for the single stage group of patients and black for the two stage patients.

2 – 2 – 2 – Analysis of the clinical data

- **Age at the beginning of treatment** (table I)

We define beginning of treatment as the time a functional appliance was delivered or the time the first arch received bonded or cemented attachments.

There is, not unexpectedly, a significant difference between the two groups in average ages of patients beginning treatment. Orthopedic treatment began, on average at 10 years, nine months. Patients who had one-stage treatment began therapy about a year later.

- **Age at the end of treatment** (table II)

We define end of treatment as the time attachments were removed.

There was no significant difference between the two groups for ages of patients at the end of treatment.

- **Length of time patients wore activators**

Patients wore activators 6.84 months. They were asked to wear these appliances during sleeping

Age at the beginning of treatment		
Expectation of equality test: paired observations		
	age at the beginning of treatment group 1 time in years	age at the beginning of treatment group 2 time in years
Average	11.70931579	10.66421053
Variance	0.828863784	0.909530731
Observations	19	19
T test	3.697683925	
P (T<= t) bilateral	0.0016	*
Critical value of t (bilateral)	2.100922037	

Table I

Age at the end of treatment		
Expectation of equality test: paired observations		
	age at the end of treatment group 1 time in years	age at the end of treatment group 2 time in years
Average	14.04231579	13.76678947
Variance	0.738034006	0.897521953
Observations	19	19
T test	0.799538449	
P (T<= t) bilateral	0.434403172	NS
Critical value of t (bilateral)	2.100922037	

Table II

hours and as much as possible in the other times when they were at home.

- **Length of time patients wore full bonded and banded appliances** (table III)

The difference between the two groups in the time they wore full banded and bonded appliances was not significant but the value of p was near to .01.

One-stage patients wore the fixed appliances for two years and three months, on average and two-stage patients wore them, on average, for one year and ten months.

- **The length of time needed for Class II correction (wearing of elastics)** (table IV)

We defined this period as the first time patients began to wear elastics, of whatever force, until the moment they no longer had to wear them. We did not calculate the time of any interruptions.

The difference between the two groups is quite significant (p < .001). Patients in the one stage group wore the elastics, on average, for one year, but patients in the two-stage group wore them for only six months.

Duration of full-banded treatment		
Expectation of equality test: paired observations		
	duration full banded treatment group 1 time in months	duration full banded treatment group 2 time in months
Average	26.94736842	22.36842105
Variance	38.16374269	15.02339181
Observations	19	19
T test	2.661049611	
P (T<= t) bilateral	0.01591	NS
Critical value of t (bilateral)	2.100922037	

Table III

Duration of elastic wearing		
Expectation of equality test: paired observations		
	duration of elastic wearing group 1 time in months	duration of elastic wearing group 2 time in months
Average	12.63157895	6.842105263
Variance	25.57894737	18.58479532
Observations	19	19
T test	4.495729228	
P (T<= t) bilateral	0.000280	***
Critical value of t (bilateral)	2.100922037	

Table IV

- **Total treatment time** (table V)

We calculated total treatment time by adding the duration of orthopedic therapy to the length of fixed appliance treatment.

There was no significant difference in total treatment time between the one- stage group and the two-stage group.

2 – 3 – Resumé of the results

We found that treatment objectives for both groups had been achieved and that the results were comparable. But a comparison of the tracings of the two groups (fig. 5) as well as the values for R^2 showed slight differences. Gonion descended slightly further in the two-stage group and it appeared that the skeletal contribution to Class II correction was also greater in the two-stage group.

Our analysis of the clinical data showed that there was no significant difference between the two groups in total treatment, length of time in fixed appliance therapy, and age at the end

Total treatment time		
Expectation of equality test: paired observations		
	total treatment time group 1 time in months	total treatment time group 2 time in months
Average	26.94736842	30.15789474
Variance	38.16374269	17.69590643
Observations	19	19
T test	$-$ 1.658776823	
P (T<= t) bilateral	0.114	NS
Critical value of t (bilateral)	2.100922037	

Table V

of treatment. Two-stage treatment, then, does not last longer than one phase therapy and does not require superior cooperation from patients.

But treatment for two-stage patients did began earlier than it did for patients whose treatment was completed in a single stage.

Time of wearing elastics was half as long for the two-stage group com-pared to the one stage group, which is a positive finding that signifies either that treatment was easier for them or that they wore elastics more faithfully than the one-stage group. This would seem to show that an early phase of orthopedic therapy did not decrease cooperation of patents.

3 – DISCUSSION

3 – 1 – Does a retrospective study prove anything today?

In a recent article published in the Cochrane Review[3] reviewing two-stage orthodontic therapy, which provoked us to undertake this study, K.D. O'Brien excluded all retrospective studies. But should we really ignore many years of clinical research because of the arrival of the concept of ''Evidence Based Dentistry?'' L. E. Johnston[5] doesn't seem to think so. In a 2002 article published in the *Journal of Orthodontics,* he tried to find a happy medium between case reports and evidence based conclusions. In doing so he offered advice on how we can make the best use retrospective studies.

– **First principle:** choose patients who will be included in a prospective study at the beginning of treatment. All patients who have been chosen because of the result obtained should be excluded.

– **Second principle:** To avoid any hint of bias in the selection process, compare only treatment results of

comparable cases. All patients chosen should have characteristics that would have made them eligible for being included in any prospective study. To help researchers meet this goal Johnston advises them to select patients on the similarity of traits like SNA, SNB, overjet, etc.

In our study we have shown that all patients selected for the two samples did have comparable characteristics.

– **Third principle:** do not choose eligible patients on the basis of their having full records available to avoid detection of bias.

In our office we take the same complete records on all patients, all have before and after radiographs taken with the same machines.

We have, accordingly, taken every possible precaution to avoid the bias inherent in any retrospective study in order to validate it even though it is not possible to prove we have completely respected this requirement.

3 – 2 – Are two-stage treatments still appropriate in contemporary orthodontics?[2-4,6,9,12,13]

According to the Cochrane Review article, two-stage treatment is no longer appropriate in modern orthodontics because evidence based orthodontics has shown that there is no difference between the results obtained in the two procedures, except that two-stage therapy takes longer. In addition, there is no reduction in the number of activations in full appliance therapy for the patients who had an early phase of orthopedic therapy. Viewing the situation from the standpoint of efficiency, the article concludes that two-stage therapy confers no extra benefits.

J.F. Camilla Tulloch[13] came to the same conclusion but stated it in more moderate terms. She did not advocate complete abandonment of the two-stage procedure but recommended that it be reserved for the specific situations of severe psychological anguish, high risk of fracturing upper anterior teeth, or a family's express desire for early intervention.

And, in effect, marked protrusion is the most frequent cause of patients consulting orthodontists (17%), after severe crowding (56%), according to Southard[12].

Many American studies have shown that people perceived as being good looking are not only better liked by their peers than those who are not as handsome but are also considered to be more intelligent. And having a severe overjet is certainly an impediment that worsens a person's appearance. These findings might be a factor strengthening the case for starting orthodontic treatment early.

In 2009 O'Brien[7,8] published the results of his 10-year prospective study of the effectiveness of the Twin-Block appliance. One of the aspects of this study focused on the intermediate effects of treatment immediately after an initial orthopedic phase. It suggested that the reduction of overjet and slight adjustment of the facial skeletal framework improved the self-esteem of patients. It also noted that 13, or 15% of the 89 patients who received initial orthopedic treatment judged the results to be so satisfactory that they decided not to undergo a second, fixed appliance treatment.

O'Brien's conclusion was the same as that of others who deprecated two stage therapy, stating that in his view a preliminary orthopedic therapy was not productive because it lengthened total treatment time. (Our results, however, indicate that two-stage and one-stage therapies have the same overall duration.)

4 – CONCLUSION

Our cephalometric analyzes have shown that there are no appreciable differences between the results obtained in orthodontic treatment of Class II malocclusions by one-stage therapy and those achieved by two-stage therapy. There are, however, some differences in the extent the two types of therapy bestow benefits on patients.

We have seen that fixed appliance therapy is simplified by a preliminary orthopedic stage. Patients have to wear elastics for a shorter period, they begin full-banded therapy with molars either in Class I relationship or in end-to-end occlusion, provided fixed therapy begins immediately after the orthopedic stage is concluded. For this reason the English phrase ''Two-stage'' is more appropriate than the French ''Deux temps,'' which suggests a time gap between therapies.

Adding a preliminary orthopedic phase, according to our study, does not increase over-all treatment time. Adding this finding to the timely esthetic benefits that early orthopedic intervention bestow on young patients we are persuaded that two-stage therapy for Class II division 1 patients remains a viable treatment approach in modern orthodontics.

Other recent studies on this issue have not dealt with these clinical differences because prospective studies are usually conducted jointly by practitioners of varying degrees of experience working with different techniques in a widely dispersed group of treatment centers.

In the final analysis, individual practitioners, taking into account their own preferences and experience, working in harmony with fully informed patients and their families, must decide whether two-stage or one-stage therapy is most appropriate, on a case by case basis.

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