A Comparison of Standard Edgewise, Preadjusted Edgewise, and Tip-Edge in Class II Extraction Treatment

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The edgewise technique and bracket type used in a particular practice are usually chosen according to the orthodontist's training and experience, rather than the type of malocclusion to be treated. The present study was designed to retrospectively evaluate the efficiency and effectiveness of standard edgewise, preadjusted edgewise, and Tip-Edge* appliances in the treatment of 105 similar malocclusions by eight experienced orthodontists.

The standard edgewise bracket, in either a single- or twin-wing version, is the system invented by Angle in the early 1900s.[1,2] The parallel upper and lower inner surfaces of the bracket slot are at right angles to both the base and sides of the bracket body (Fig. 1A).

The preadjusted-slot bracket, popularized by Andrews in 1972,[3] is intended to produce ideal crown torque and tip when engaged on a straight archwire. In 1983, Daisley introduced a rhomboidal bracket body,** with the occlusal and gingival tie wings parallel to the slot and the mesial and distal sides parallel to the long axis of the crown (Fig. 1B). This design improved the

*Registered trademark of TP Orthodontics, Inc., 100 Center Plaza, LaPorte, IN 46350.

**Richard J. Daisley, U.S. Patent No. 4,415,330, Nov. 15, 1983, Orthodontic Bracket Assembly.

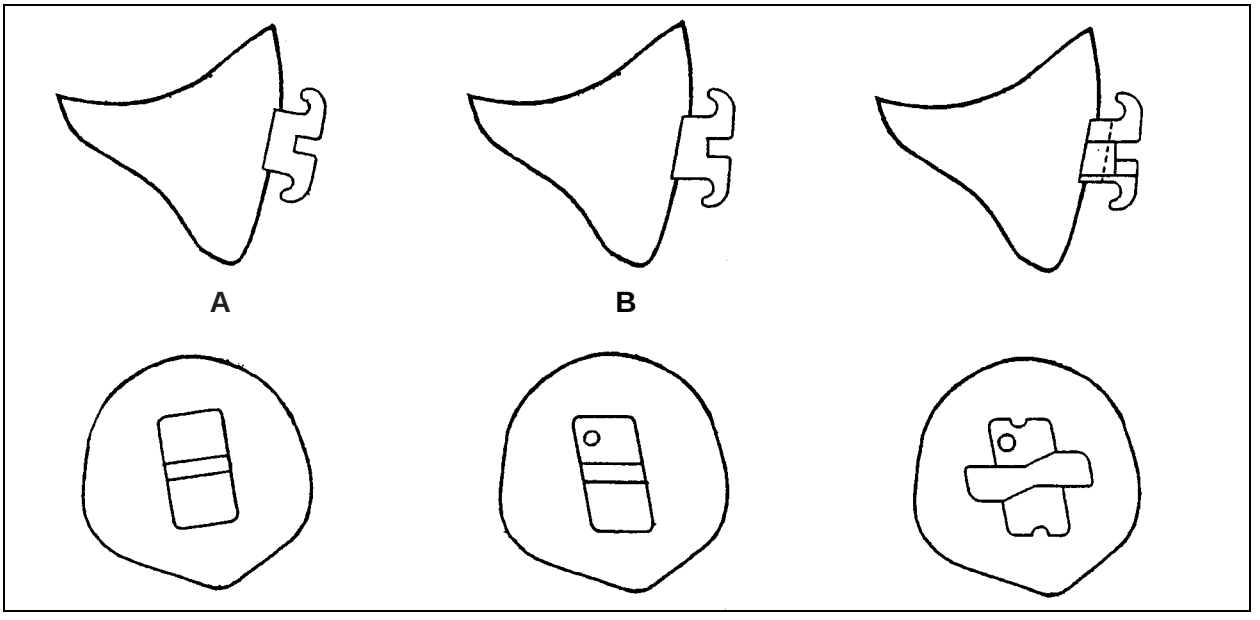
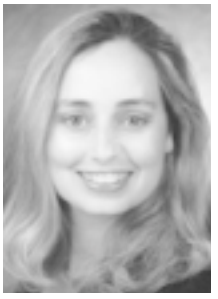
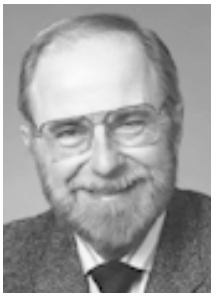


Fig. 1 Three edgewise brackets used in present study differ in bracket slots, as shown with maxillary right canine brackets. A. With standard edgewise bracket, torque and tip angulations require 2nd- and 3rd-order archwire bends. B. Preadjusted edgewise bracket provides predetermined crown tip and torque angulations from "straight" archwire. C. Tip-Edge bracket slot is preadjusted for final tip and torque and also modified to permit initial mesial or distal crown tipping.



Dr. Ramos

Dr. Killiany



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accuracy of bracket placement and subsequent evaluation of mesiodistal crown inclinations during treatment.

The Tip-Edge bracket, invented by Kesling in 1986,[4,5] has a preadjusted slot modified to permit free crown tipping, mesially or distally (but not in both directions), in the presence of a straight, continuous archwire (Fig. 1C). It also has a vertical slot to facilitate the use of auxiliaries for rotation, tip, and torque control.

Materials and Methods

The sample was selected randomly from a pool of before-and-after-treatment records of patients treated by eight orthodontists from six private practices: two standard edgewise practices with one orthodontist in each, two preadjusted practices with a total of three different orthodontists, and one Tip-Edge practice with records from three different orthodontists. Criteria for inclusion in the study were:

- Patient between the ages of 9 and 17 at the start of treatment.
- Pretreatment Class II, division 1 malocclusion (at least one-half cusp).
- Treatment plan including four premolar extractions.

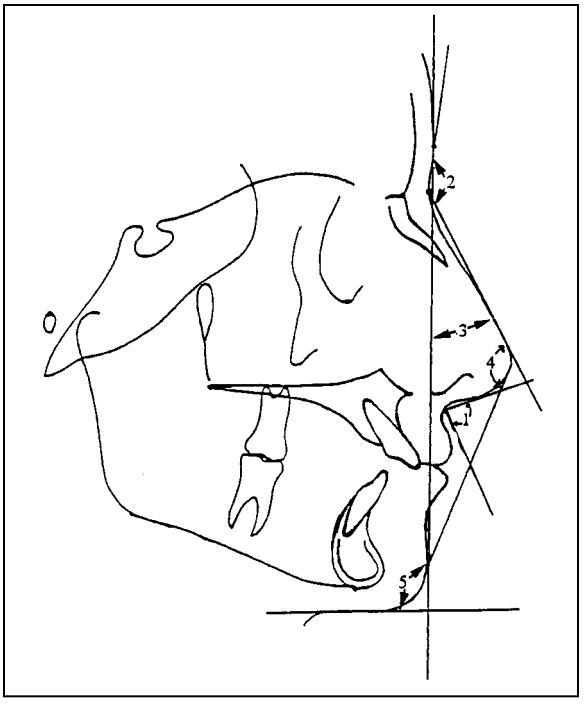

Fig. 2 Soft-tissue angular measurements. 1. Naslab. 2. Nasofrontal. 3. Nasofacial. 4. Nasomental. 5. Mentocervical.

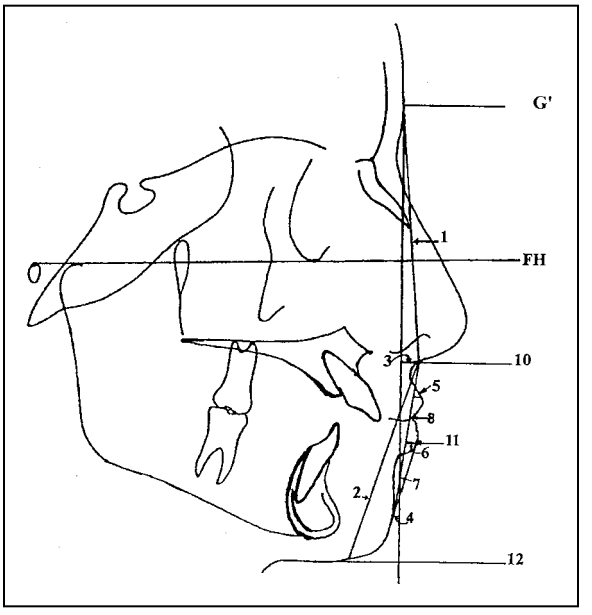

Fig. 3 Soft-tissue linear measurements. 1. G-Sn. 2. Sn-Me'. Facial height ratio is G-Sn/Sn-Me'. 3. Sn-GVert (Glabella vertical to Frankfort). 4. Pg'-GVert. 5. Upper lip protrusion (ULIPPROT). 6. Lower lip protrusion (LLIPPROT). 7. Sn-Pog. 8. Sn-STMs. 9. STMi-Me'. 10. Sn. 11. Labiale inferioris (Li). 12. Me'. 10-11. Sn-Li. 11-12. Li-Me' (vertical lower third). Vertical lower third ratio is Sn-Li/Li-Me'.

• No missing permanent teeth prior to treatment (except third molars).
• Overjet of 3.5mm or greater.
• Wits[6] appraisal of +1mm or greater.

Of the 105 patients, 33 were treated with standard edgewise brackets, 39 with preadjusted brackets, and 33 with Tip-Edge brackets.

The 210 pre- and post-treatment cephalometric tracings were digitized with a light-box digitizer.*** Soft-tissue measurements closely associated with facial esthetics were chosen for this analysis, although hard-tissue measurements were also employed (Figs. 2,3). The Ramos 60-point soft-tissue analysis is available from the authors on request.

The pre- and post-treatment study casts were evaluated using the Peer Assessment Rating Index,[7] which consists of linear measurements of five distinct areas of the occlusion:
• Maxillary and mandibular anterior segments.
• Left and right buccal occlusion.
• Overjet.
• Overbite.
• Midline.

The casts were measured using a special PAR Index ruler. A score of zero indicates good alignment; the higher the score, the more deviation from normal occlusion (scores are rarely higher than 50). The difference between the pre- and post-treatment PAR scores represents the degree of malocclusion correction (Figs. 4-6).

Means, standard deviations, and ranges were calculated for each of the treatment variables taken from the patients' record sheets, history forms, and pre- and post-treatment lateral cephalograms (Table 1).

***Model 2210 digitizing pad, Numonics Corporation, Montgomery, PA, with Dentofacial Planner software, version 7.0 (Dentofacial Software, Inc., Toronto, Canada).

Results

Overall, upper and lower lip protrusion was reduced significantly. Lower lip length increased significantly for the standard edgewise and Tip-Edge groups. The upper-lip-length-to-lower-lip-

TABLE 1
DIFFERENCES IN KEY VARIABLES AMONG STANDARD EDGEWISE, PREADJUSTED EDGEWISE, AND TIP-EDGE APPLIANCES

	Overall	Standard	Preadjusted	Tip-Edge	"F"	"p"
Pretreatment Variables						
Patient age (years)	12.5	12.8	12.9	12.1	2.627	.077
Orthodontist's experience (years)	10.5	10.6	9.0	11.8	2.849	.062
Overjet (mm)	6.3	6.5	5.7	6.8	2.495	.087
ANB (°)	6.0	5.4	5.8	6.8	4.665	.011*
Wits (mm)	+3.8	+3.2	+4.3	+4.0	+2.212	.115
PAR	32.2	32.5	34.1	30.1	1.957	.146
Treatment Variables						
Number of appointments	26.9	33.9	27.6	19.4	53.755	.000*
Number of missed appointments	2.4	2.6	2.2	2.5	2.627	.077
Number of archwire changes (sets)	4.9	5.0	6.1	3.6	0.174	.841
Treatment time (months)	28.1	31.1	26.0	27.1	7.834	.001*
PAR correction (absolute)	30.9	30.7	32.7	29.2	1.646	.198
PAR improvement (%)	95.6	94.1	96.1	96.6	3.755	.027*

*$p < .05$.

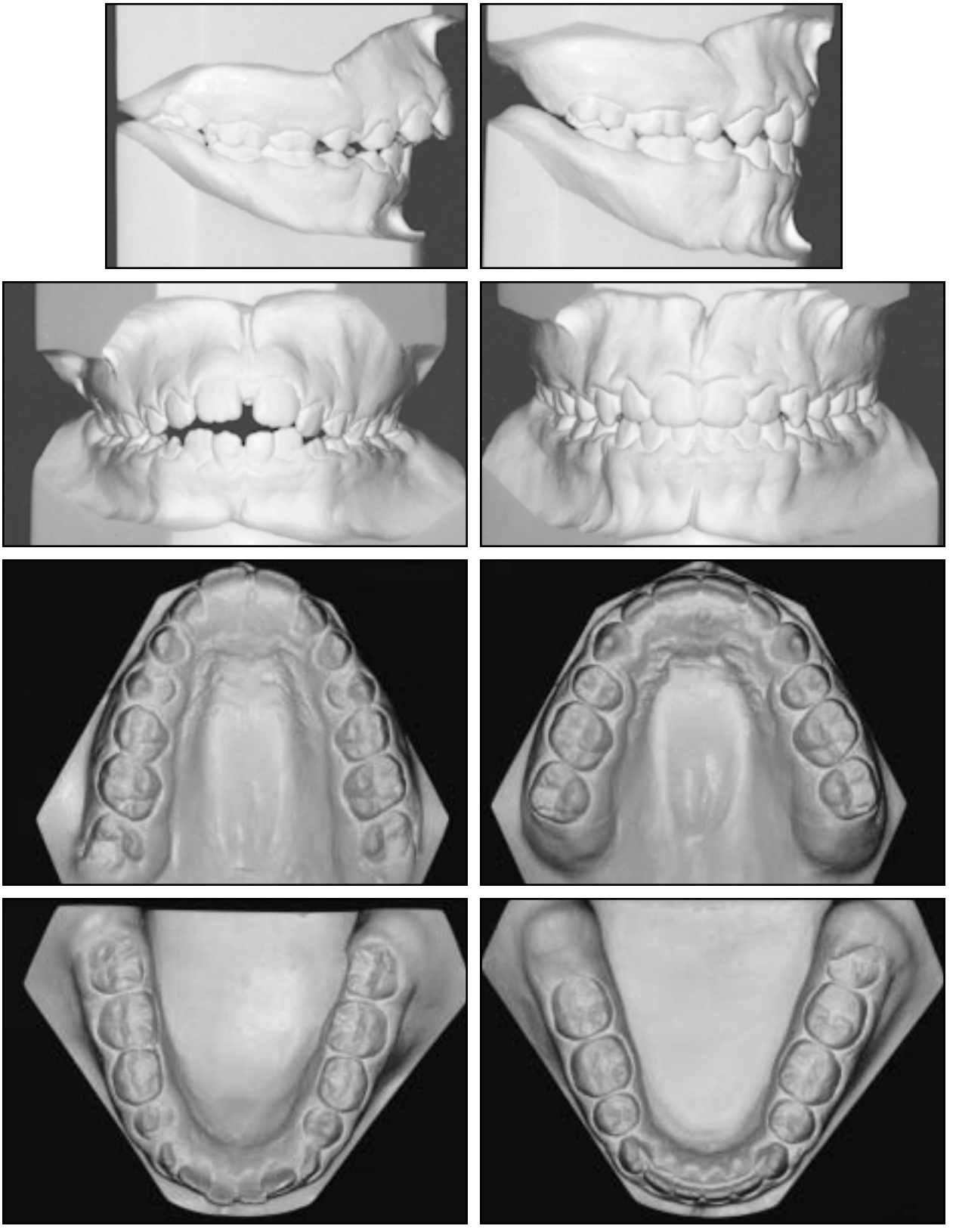

Fig. 4 Casts before (left) and after (right) treatment of typical case from standard edgewise group. Treatment time was 28 months, using 12 archwires and 39 appointments. PAR score improved 100%.

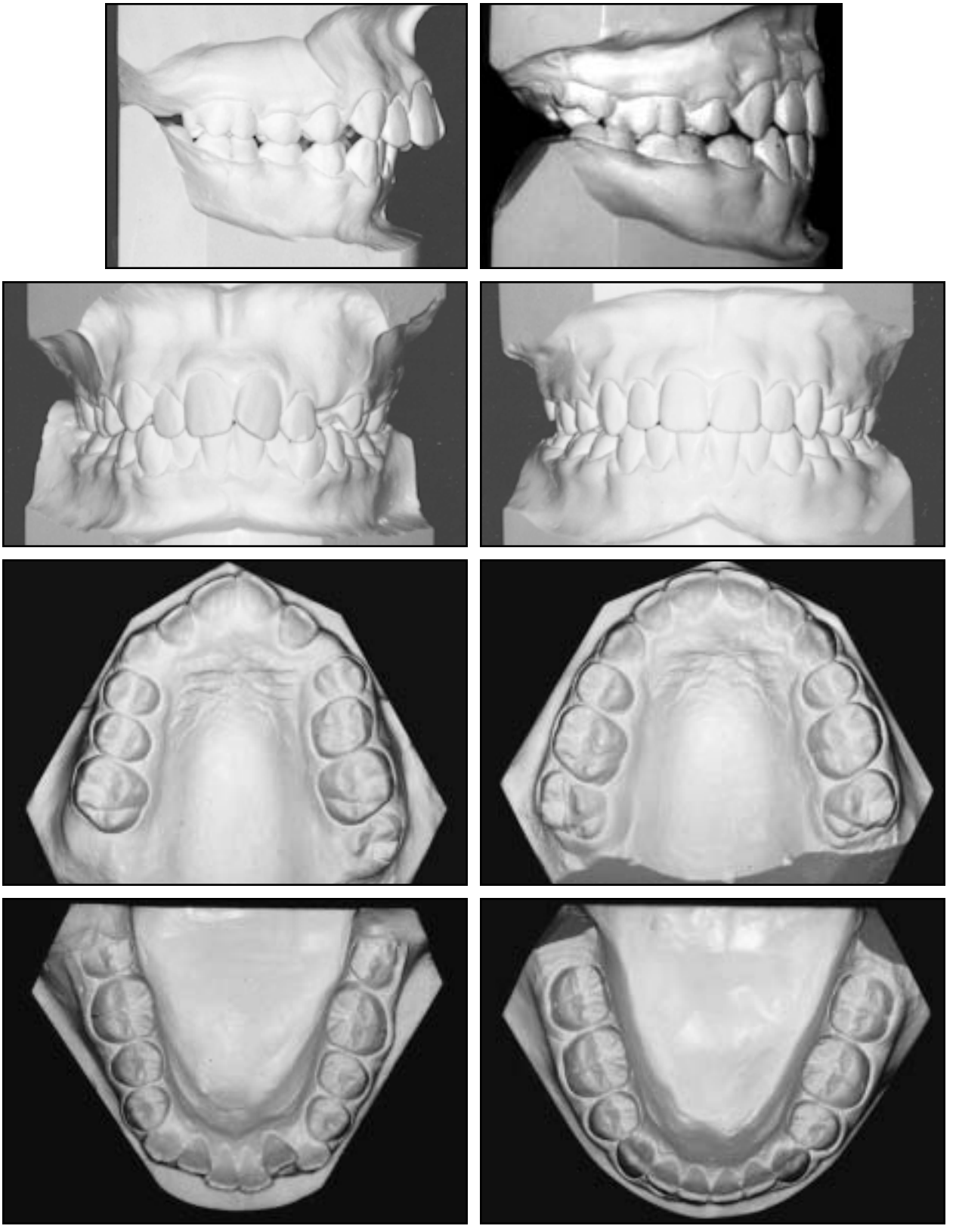

Fig. 5 Casts before (left) and after (right) treatment of typical case from preadjusted edgewise group. Treatment time was 23 months, using 14 archwires and 18 appointments. PAR score improved 100%.

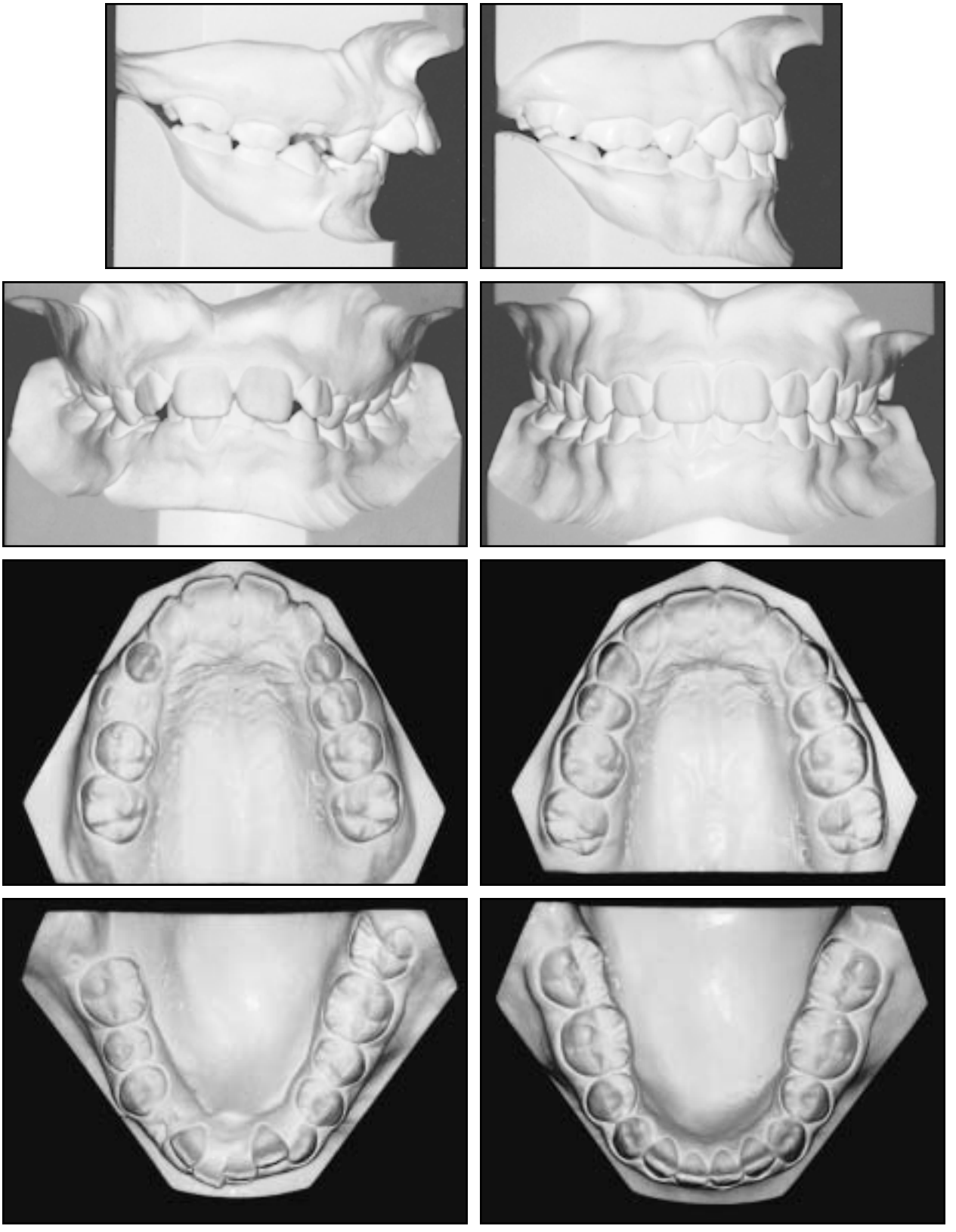

Fig. 6 Casts before (left) and after (right) treatment of typical case from Tip-Edge group. Treatment time was 27 months, using seven archwires and 16 appointments. PAR score improved 96.6%.

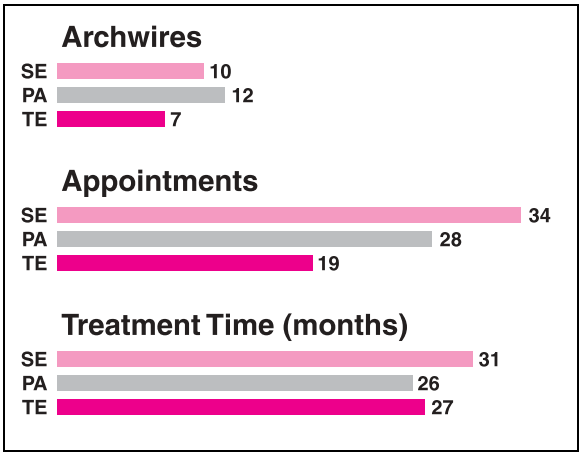

Fig. 7 Relative efficiency of treatment in Class II, division 1 four-premolar-extraction cases between standard edgewise (SE), preadjusted (PA), and Tip-Edge (TE) as measured in archwires, appointments, and treatment times.

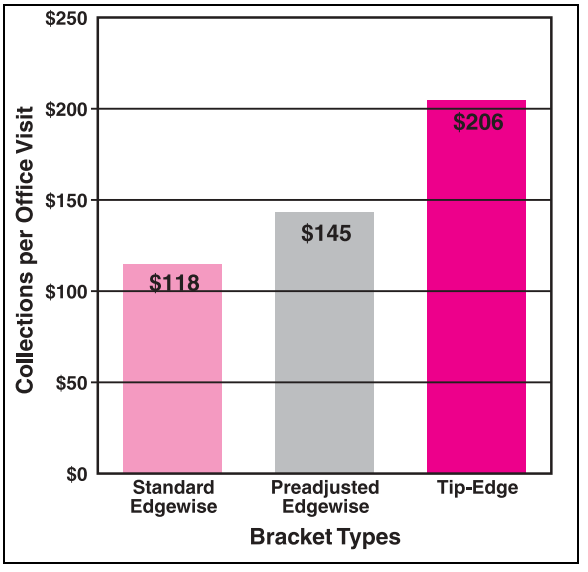

Fig. 8 Collections per visit if each patient were treated for $4,000 fee.

length ratio decreased significantly for standard edgewise and Tip-Edge patients.

Upper facial heights increased significantly in the standard edgewise and Tip-Edge groups, with a significant difference between the two. Ratios of upper and lower facial heights increased slightly for both standard edgewise and Tip-Edge patients. Lower facial heights decreased in the standard edgewise and Tip-Edge groups, with a significant difference between the two. Overall increases in nasal projection, pogonion to NB, and upper and lower facial height indicated patient growth during treatment.

A stepwise multiple regression analysis indicated that overjet was the only variable among 18 that affected treatment times, using the following equation: Treatment time in months (Y) = 20.07 + (1.807) overjet.

Treatment time was significantly different among the three groups, with standard edgewise patients treated in a mean 31.1 months, Tip-Edge patients in 27.1 months, and preadjusted edgewise patients in 26.0 months (Fig. 7).

The number of patient visits (including bonding, emergencies, and debonding) varied significantly, with Tip-Edge patients having the fewest appointments (19.4), followed by preadjusted (27.6) and standard edgewise (33.9) patients.

The number of archwire changes was also significantly different, with the preadjusted group showing the most changes (a total of 12 wires), the standard edgewise group next (10 wires), and the Tip-Edge group the least (seven wires).

Discussion

The experience of the orthodontists did not vary significantly from the mean of 10.4 years. All three appliance systems achieved similarly good results, as measured by the PAR Index. Cephalometric analysis did not indicate that any appliance controlled anchorage, vertical dimensions, or occlusal planes better than another. In other words, all eight practitioners achieved excellent results in the treatment of Class II, division 1 four-premolar-extraction cases.

Both intermaxillary (Class II) and intramaxillary elastics were used by all three groups, although the Class II elastic forces in the Tip-

Edge sample were only 2-3oz—about half the force delivered in the other two groups. Headgear was used in 67% of standard edgewise cases, in 5% of the preadjusted edgewise cases, and in none of the Tip-Edge cases.

The differences in wire changes and numbers of appointments were highly significant, with Tip-Edge brackets showing the least in both categories. Typically, a Tip-Edge patient was seen every six to eight weeks, whereas a standard or preadjusted edgewise patient was seen every three to four weeks. Treatment times with standard edgewise appliances were significantly greater than with either Tip-Edge or preadjusted edgewise appliances. Although the preadjusted and Tip-Edge brackets both use average prescriptions, they have a greater potential to achieve the desired final tip and torque angles than standard edgewise brackets, which require modifications to the archwires themselves. In a busy practice, this means fewer appointments and shorter treatment times.

The even fewer appointments and archwire changes required by the Tip-Edge group as compared to the preadjusted edgewise group suggest further investigation. The advantage might be due to the difference in tooth movement—bodily with preadjusted edgewise vs. differential with Tip-Edge. In 1941, Strang, a student of Angle's, pointed out the limitations in tooth movement inherent in edgewise bracket slots: ". . . in fact, each and every tooth is now an anchorage auxiliary."[9] In 1956, Begg clearly demonstrated the advantages of light, continuous forces with differential tooth movement by treating a Class II, four-premolar-extraction case in four months with just one set of archwires.[10] The Tip-Edge bracket permits the same type of differential tooth movement—initial crown tipping followed by controlled root uprighting when required. (The case shown by Begg did not need root uprighting or torque.) A recent controlled, yet limited, study substantiated the increased effectiveness of continuous forces compared to impulsive forces.[11] Although this study involved bodily tooth movement, the principles and biology should apply to differential tooth movement as well.

Another advantage of Tip-Edge brackets is the relatively nonexistent friction between archwires and brackets. During space closure with other edgewise appliances, the teeth and brackets are moved bodily along the archwire, creating the greatest amount of sliding friction in orthodontics. In Tip-Edge treatment, the archwires move distally at the same rate as the brackets, and friction is limited to that between the archwires and the molar tubes. Even if Tip-Edge operators elected to move teeth distally along the archwires, they still would experience less friction, because the Tip-Edge slot effectively opens during retraction. A controlled study to measure the relative sliding friction between brackets with standard edgewise slots and those with Tip-Edge slots could shed some light on this subject.

Conclusion

The Tip-Edge bracket, with its preadjusted and modified slot, produced equally good treatment results in this study, with fewer archwires and appointments, compared to standard and preadjusted edgewise brackets. As pointed out by practice consultant Charlene White, the efficiency of an appliance, as measured by the number of office visits required to treat a case, can have a significant economic impact[12] (Fig. 8). From another perspective, in the same number of office visits, the practitioners using Tip-Edge brackets could treat 75% more patients than those using standard edgewise brackets, or 42% more than those using preadjusted edgewise brackets. Future studies could be conducted to determine the actual chairtime required by each group, and what percentage (if any) of the work was performed by auxiliary personnel.

Further studies of these three edgewise techniques could also include more comprehensive dental measurements, such as the torque and tip angles of all teeth, as well as the alignment and levels of marginal ridges (as required by the ABO), to more accurately evaluate any differences among the three appliances in the control of individual teeth.

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