Molar Control
Part 4

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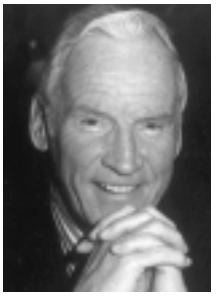
Following our discussion of toe-in bends and toe-out bends (Part 2, JCO, February 2002), we have seen how in-bends and out-bends can be applied clinically (Part 3, JCO, March 2002). These four bends constitute the category of off-center bends. The next category to be discussed is the step bend. As was stated earlier, all three categories will be treated as variations of the off-center bend, so there is really nothing to complicate the issue. Once again, it is only necessary to determine first if any rotations are present. If so, we place the necessary rotational bends. We then determine if there is any need for forces to correct buccal or lingual displacements of the molars, and we apply the in-bends or out-bends as indicated.

The Step Bend

In Figure 4-1, it is obvious that the first molar has a severe mesiolingual rotation with a lingual displacement. The buccal force associated with this toe-in bend is desirable, so the needed force system is already present. The second question in bend placement provides the opportunity for the use of in-bends or out-bends if desired. Although it is not required in this instance, the orthodontist may wish to use higher force magnitudes for a number of reasons. Maybe the patient is older. Maybe the patient has



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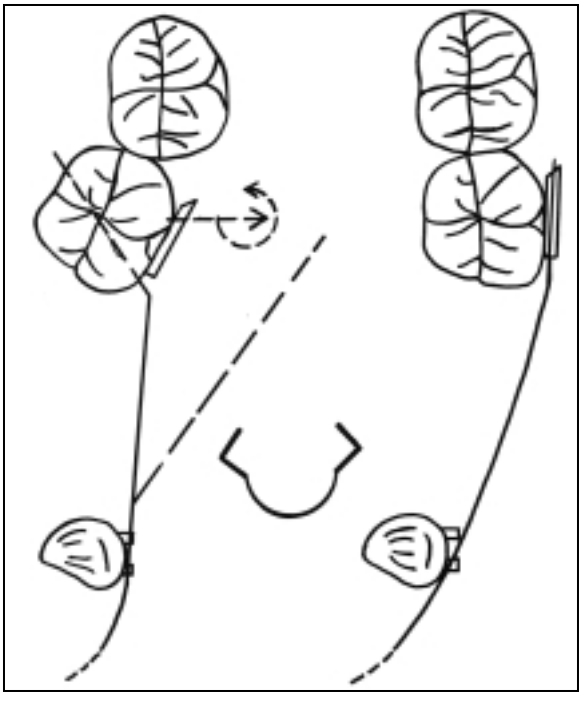

Fig. 4-1 Step bend.

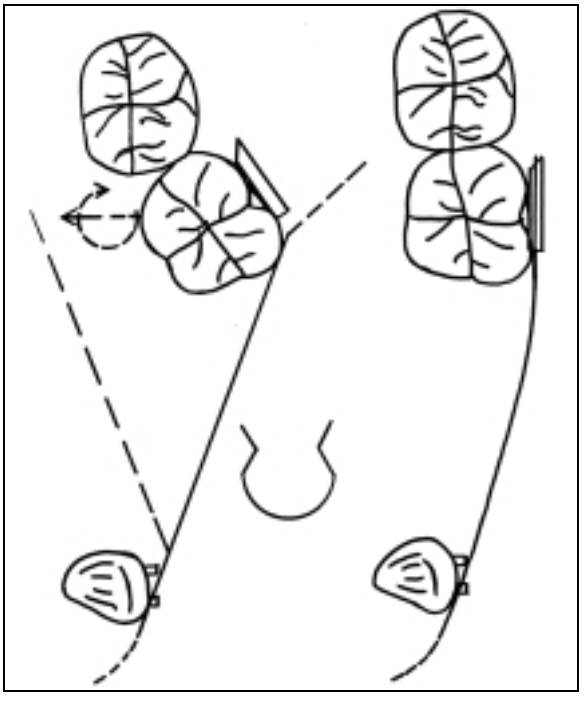

Fig. 4-2 Step bend with opposite forces and moments.

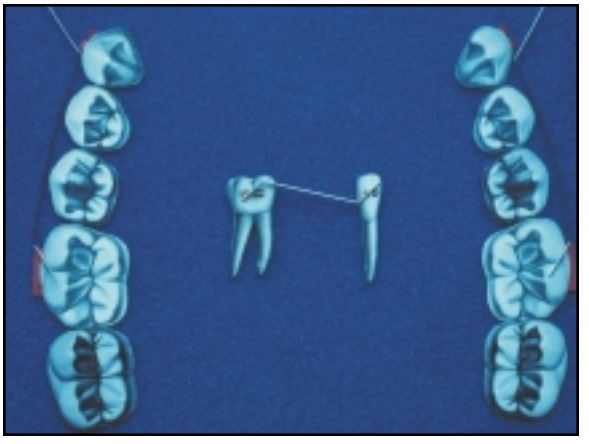

Fig. 4-3 Occlusal and sagittal views of step bend.

steep cusps, a flat mandibular plane, or just a strong bite. The orthodontist might be using .018" slots and would like higher forces without the need to increase slot size.

In any case, if an out-bend is added with a toe-in bend already present, we have created what amounts to a step bend. A step bend really amounts to two half-length cantilevers joined in the middle. The significance lies in the increased force magnitude associated with the step bend, which produces four times as much force as a full-length cantilever of the same interbracket distance. Rather than concerning ourselves with the exact increase in force magnitude, let it suffice to say that we would only place this bend for the purpose of increasing force magnitude, and that is just what we are doing. A simple rule will help us identify the step bend and the resulting increase in force magnitude. Whenever two bends are involved and each bend produces a force in the same direction, we know we are dealing with a step bend.

In Figure 4-2, the problem is simply the reverse of what we previously observed. The moments and forces are opposite in direction to those seen in Figure 4-1. Both bends produce forces in the same direction and therefore amount to a step bend with a higher force magnitude.

Figure 4-3 illustrates the use of the step

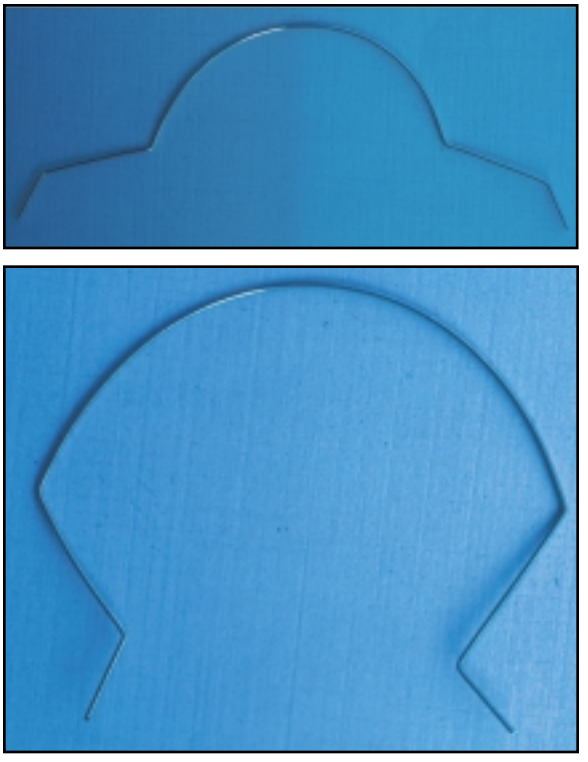

Fig. 4-4 "Force-driven" archwires with step bends.

bend in the occlusal plane. A sagittal view is also shown, as it helps clarify the use of the same force systems in different planes of space. Only the terminology changes. An eruptive force in one plane of space becomes a buccal force in another plane of space.

Note the shapes of the archwires, which are probably unlike any you have seen before. These archwires are known as "force-driven" appliances (Fig. 4-4). The usual type of archwire is referred to as "shape-driven" because the orthodontist expects the teeth to move in a manner "predicted" by the shape. This expectation, of course, is frequently met with disappointment.

As mentioned earlier, the step archwire and the wraparound archwire are used to create the same force systems. The only difference lies in the fact that the step archwire is capable of permitting increases in arch length, while the wraparound archwire allows reduction of arch length.

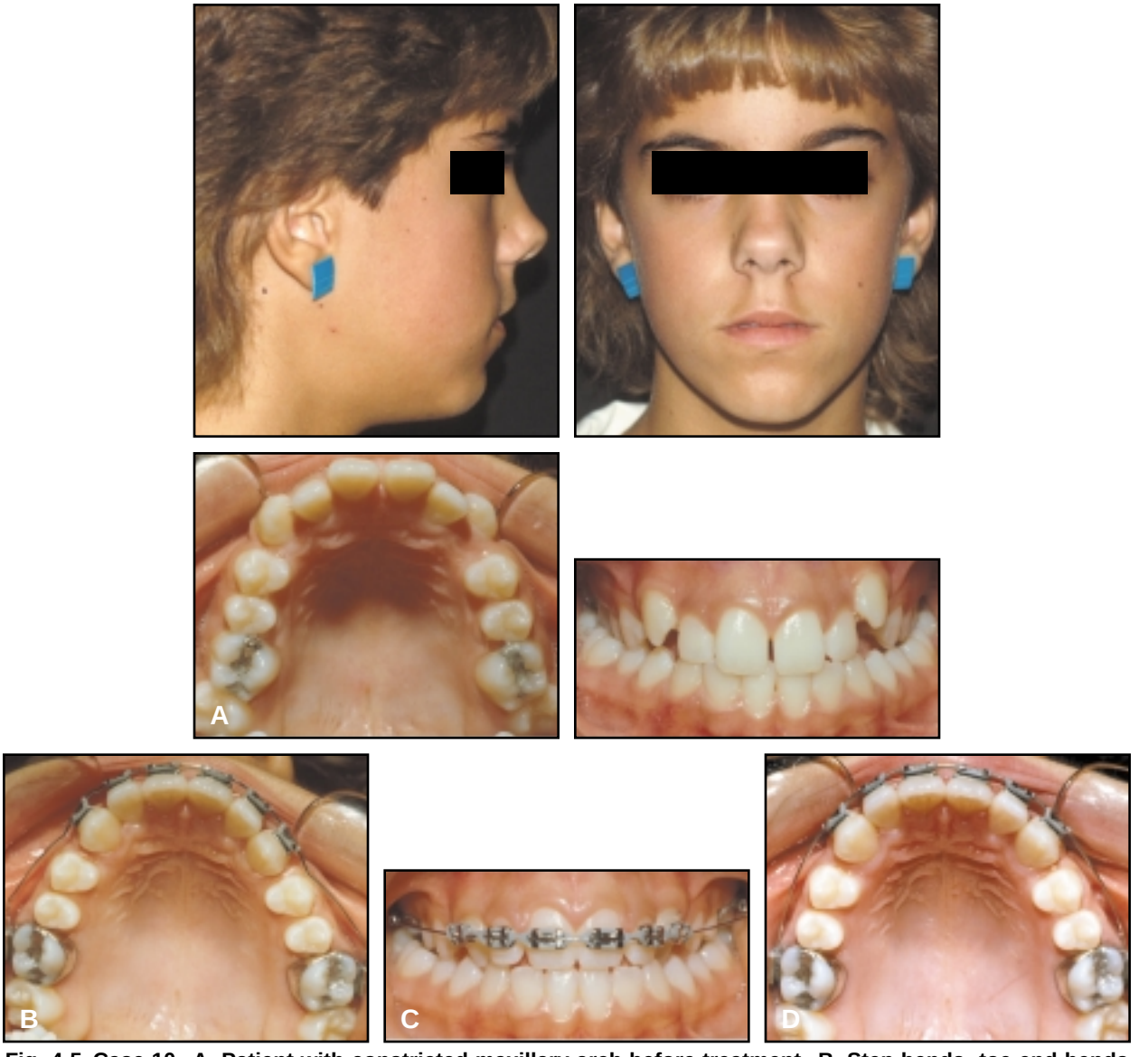

Fig. 4-5 Case 10. A. Patient with constricted maxillary arch before treatment. B. Step bends: toe-end bends combined with out-bends. C. Cuspids show some reciprocal effects from forces of step bends acting on molars. D. Anterior teeth and molar grooves aligned.

Case 10

The first case to be shown here is a young lady who had surgery recommended by several orthodontists. The facial features certainly don't reveal the underlying skeletal problem (Fig. 4-5A). The profile and frontal views were quite acceptable to the patient, who wanted orthodontic treatment without surgery. Her only concern was dental cosmetics—and justifiably so. The constriction of the upper arch is evident. After I explained that orthodontics alone would involve compromise, but would provide an outcome that would be better for the patient than no treatment

Fig. 4-6 Case 10. A. After appliance removal, entire right buccal segments are in Class III relationship and left cuspids in Class I. Note minimal overbite and lingual crown inclination of buccal segments. B. Six months later, right cuspids and left bicuspids are in Class I relationship, with slightly increased overbite.

at all, treatment was initiated.

The mesiolingual rotations of the first molars afford the opportunity for correction and for the creation of buccal forces in the process. It is important not to place a full appliance including the second molars. Buccal movement of the first molars would result in lingual movement of the second molars, thereby impinging on space intended for the dorsum of the tongue. The tongue is a powerful muscle, and this space is important for support of the increased arch width.

The step bends in this case were toe-in bends combined with out-bends (Fig. 4-5B). These provided the moments necessary for rotational corrections and the buccal forces to increase the molar width. The first molars were rotated properly and moved buccally so that their central grooves were aligned with those of the second molars. It can be seen that reciprocal effects may take place on the cuspids in a 2×6 strap-up with step bends, but that the cuspids can be nicely aligned, usually in one appointment, following completion of molar positioning. Actually, the reciprocal effects are not as great as would appear in Figure 4-5C. Because I routinely use standard brackets without offsets, the labiolingual thickness of the cuspids causes some lingual displacement of these teeth. Only about one-third of the displacement is actually

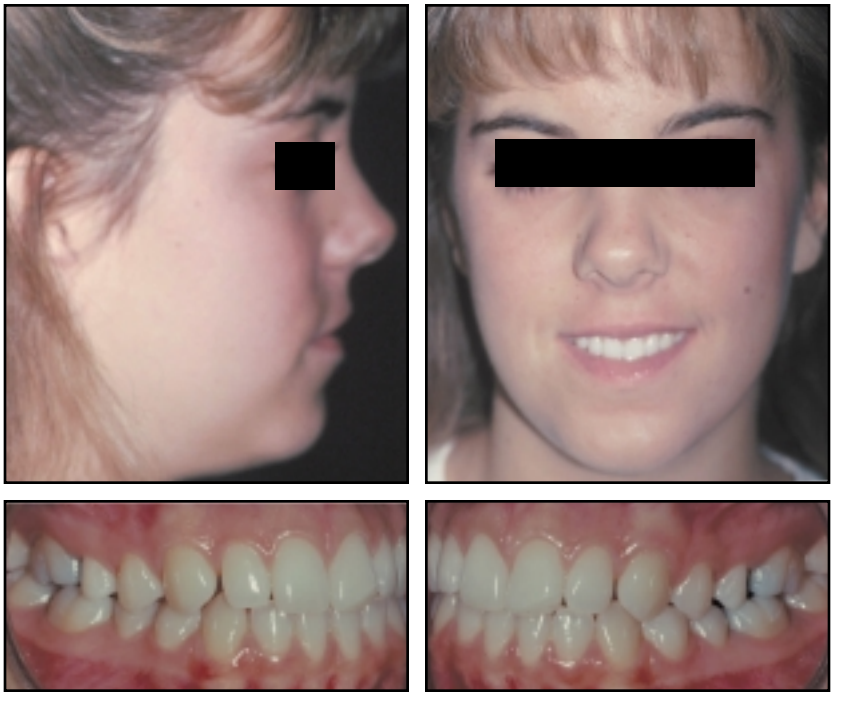

Fig. 4-7 Case 10. Several years later, right buccal segments are almost in Class I relationship and left buccal segments in Class I.

due to the reciprocal force acting on the cuspids.

When the appliance was removed, the entire right buccal segments were in a Class III relationship, while the left cuspids were Class I (Fig. 4-6A). Six months later, the right cuspids and left bicuspids had attained a Class I relationship (Fig. 4-6B). Several years later, without any type of retention, the buccal segments on the right side were almost in a Class I relationship, while the buccal segments on the left side were Class I (Fig. 4-7).

The overbite was minimal following appliance removal, but was increasing six months later. Generally, the overbite in these cases tends to increase about 1mm in the first year. This may not sound like much, but it is evidence that the bite does not have the tendency to open. It can be seen in the frontal view that the transverse problem has been corrected without flaring the buccal segments. In fact, the crowns in the buccal segments have a distinct lingual inclination following treatment.

Before the appliance was removed, the patient was required to go several visits with no archwires. When archwires are removed periodically prior to debonding and the teeth are positioned—to the extent possible—by the natural forces of the occlusion and muscles, good things often seem to follow. If teeth maintain themselves following removal of archwires, it is pretty difficult to argue that the treatment is incorrect. No effort was made to improve the anteroposterior relationship in this case, but improvement did take place. Keep in mind that the anteroposterior problem was a planned compromise, as the patient elected not to accept surgery. Also, I do not intend to contraindicate the use of transverse appliances by others for such correction. Every clinician should do what is considered best for the patient.

Although it was the purpose of treatment only to align the maxillary teeth and treat trans-

verse problems, archwire removal provided the opportunity to test the repositioning of teeth in a favorably altered environment. Since the palatal vault has additional space for the tongue, the orthodontist may have some pleasant surprises when removing archwires and treating to the cuspid and molar widths indicated by environmental influences. All this, of course, is combined with common sense. We must provide harmony between the functional curves of Monson and Wilson, which in turn provide functional harmony between the internal pterygoid muscles and the long axes of the teeth in the buccal segments during the forces of occlusion.

This case involved the use of toe-in bends combined with out-bends to form step bends in a 2×6 strap-up. On close examination, it can be seen that the short sections at the brackets or tubes adjacent to the bends point in opposite directions. This indicates the use of step bends. In such cases, the forces involved can increase as much as four times.

Case 11

Next, we will see the practical use of the same bends in a 2×4 strap-up. However, the brackets adjacent to the bends will not meet the requirements of a step relationship, as the short sections are not parallel. Therefore, the magnitudes of force will not be as high as previously discussed, but only about two times as high as those of a single bend. We are simply combining two 45° bends, without creating the parallel relationship at the cuspid brackets as in the previous case. The emphasis is on applying a uniform and consistent approach on a daily basis. The only reason a second bend is introduced in the first place is to maximize the force, and that is exactly what we are doing, although to a lesser extent.

From now on, it will only be necessary to remember that whenever we introduce a second bend that creates a force on the molar in the same direction as the first bend, we are maximizing the forces involved. It is not essential that the wire-bracket relationship be an actual step relationship. Keep your life simple by not allowing yourself to become too academic.

This patient had what appeared to be a unilateral crossbite, but was really a bilateral crossbite with a displacement of the mandible to the right (Fig. 4-8). Toe-in bends, combined with out-bends, rotated the molars and moved them buccally (Fig. 4-9A).

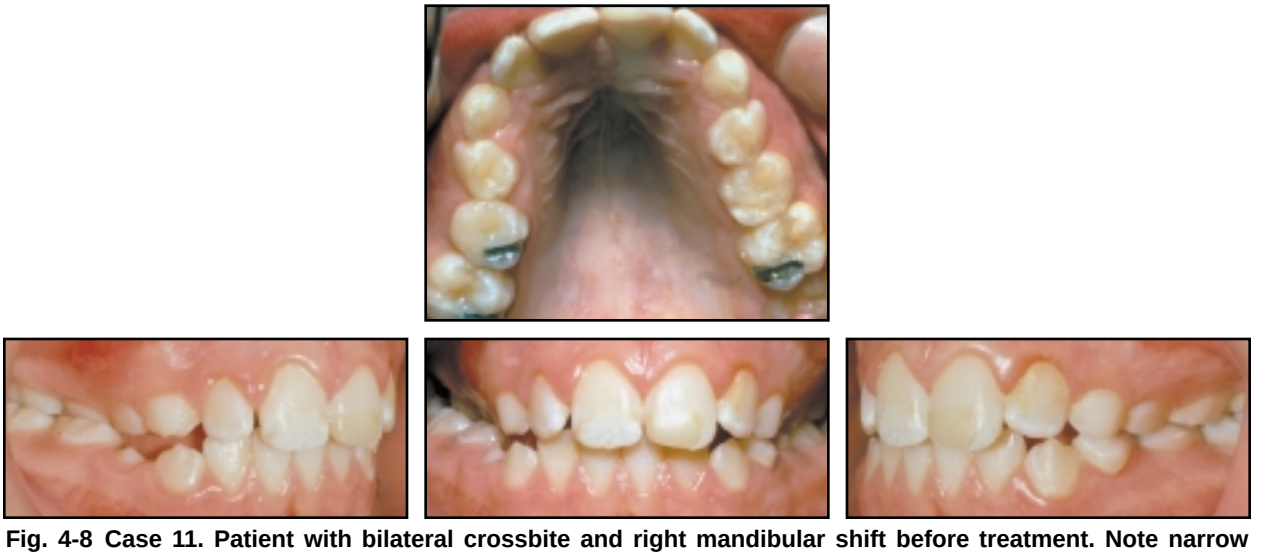

Fig. 4-8 Case 11. Patient with bilateral crossbite and right mandibular shift before treatment. Note narrow palatal vault and molar rotations.

The bicuspids must not be bracketed during the use of molar-control bends. If this is done, any bend placed mesial to the molar tube will not serve as a genuine off-center bend. Remember that only the brackets adjacent to the bends are considered when looking for the primary force system. In this case, the right bicuspids were initially left in lingual positions and were later corrected by tying them to the archwire with ligature wire (Fig. 4-9B). There is no need to bracket such teeth later unless rotations are present.

It is extremely important to recognize that none of these cases can be evaluated in centric occlusion. At the initial examination, the patient

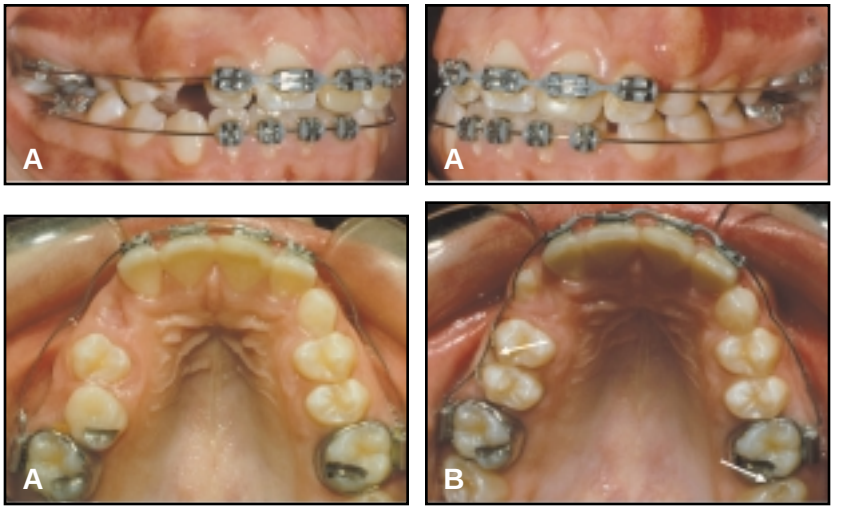

Fig. 4-9 Case 11. A. Toe-in bends combined with out-bends to correct molars, with right bicuspids remaining in crossbite. Bilateral expansion confirms molar positions as correct. B. Right bicuspids tied to archwire with ligature wire. Note alignment of central molar grooves.

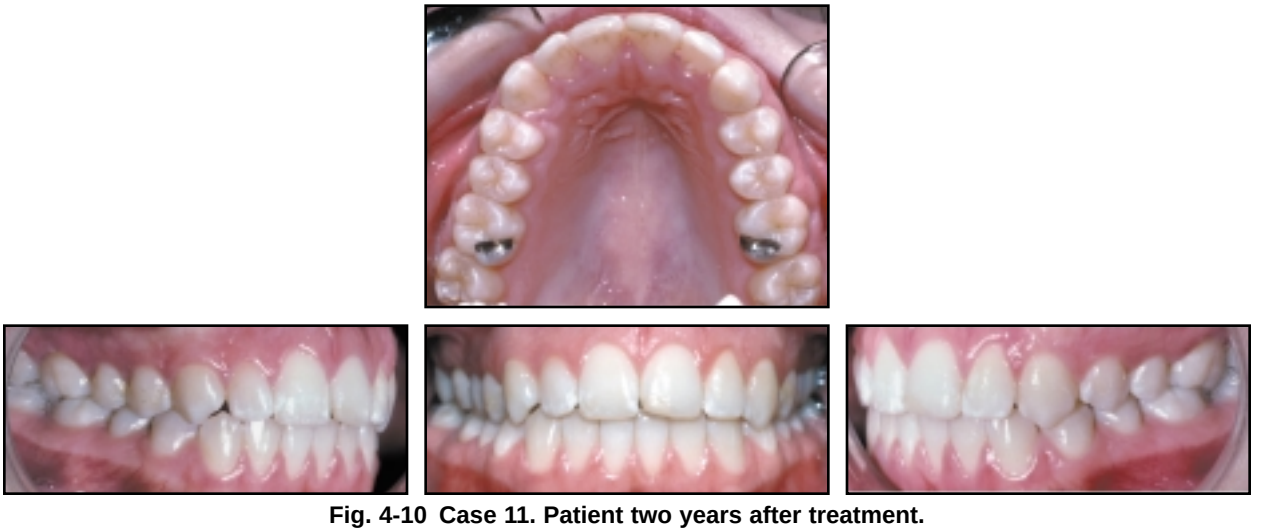

Fig. 4-10 Case 11. Patient two years after treatment.

is checked for closure on the centric arc, and the malocclusion is evaluated when the first contact is made on closure. Full closure will result in anteroposterior and/or lateral displacements of the mandible. Mounting cases will achieve the same advantage. In any case, do not evaluate the malocclusion from a static set of unmounted models. The advice given here is not that you must mount or not mount your cases, but rather that you should evaluate each patient on the centric arc following the attempt to eliminate proprioception during the initial examination.

Case 12

The next patient is a young girl who came to the office with a dental and skeletal Class III malocclusion and an anterior open bite tendency, as well as a tendency toward anterior crossbite, particularly on the left side (Fig. 4-11). Because there was a lateral shift of the mandible, the crossbite was bilateral rather than unilateral.

Toe-in bends and out-bends were used to correct the molar crossbite (Fig. 4-12). The left first bicuspid was later tied to the archwire to move it labially (Fig. 4-13). After the midlines were aligned and the buccal relationships were corrected to Class I, the archwire was removed to evaluate stability (Fig. 4-14). Because the occlusion continued to improve, there was no need for retainers (Fig. 4-15).

Conclusion

This concludes the discussion of the step bend. The purpose for its use is to take advantage

Fig. 4-11 Case 12. Patient with left mandibular shift in centric occlusion before treatment, with anterior open bite and upper left central and lateral incisors tending toward crossbite.

Fig. 4-12 Case 12. A. Step bends: toe-in bends and out-bends. B. Midline corrected, anterior crossbite nearly corrected, open bite improving, molar crossbite corrected, and left first bicuspid still in crossbite.

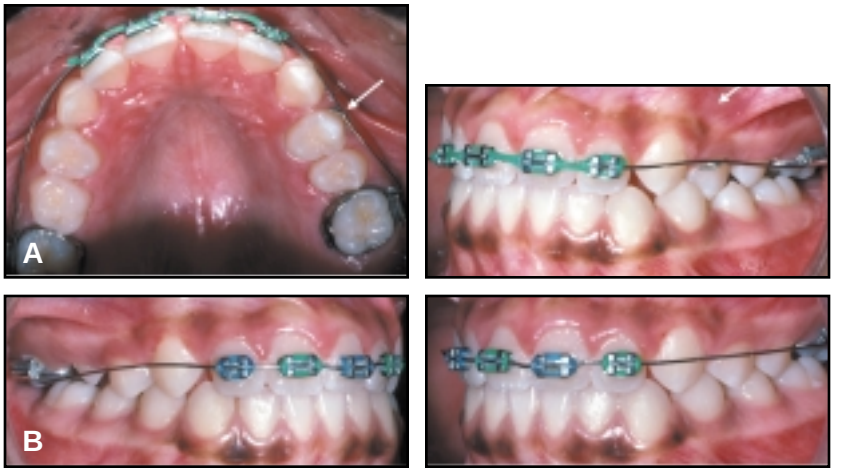

Fig. 4-13 Case 12. A. Left first bicuspid tied to archwire with ligature wire. B. Case progress.

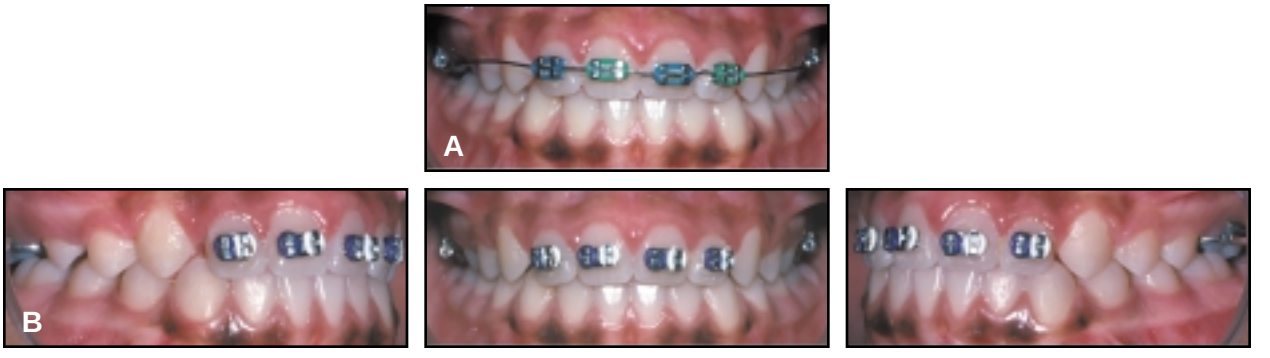

Fig. 4-14 Case 12. A. Midline and overbite corrected. B. Archwire removed, with only elastomeric ligatures present. Note Class I relationship and good overbite.

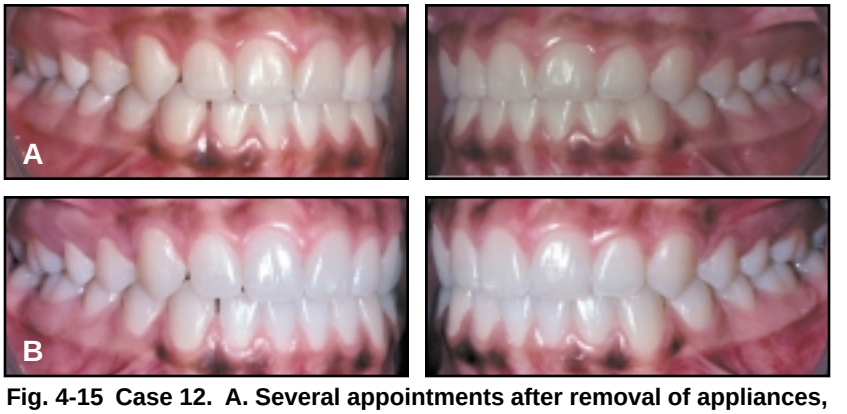

Fig. 4-15 Case 12. A. Several appointments after removal of appliances, occlusion shows marked improvement and stability. B. Two years following appliance removal.

of higher force magnitudes, which can be useful in the occlusal plane of space but often detrimental in the sagittal plane of space. When toe-in bends are combined with out-bends, or toe-out bends with in-bends, a true wire-bracket step relationship is present only when the two bends are parallel at the brackets adjacent to the bends. In such a case, the force magnitudes may be as much as four times higher than those of a cantilever with the same interbracket distance.

It is not important that we concern ourselves with the exact increase in force magnitude. We can apply the same bends in a 2×4 strap-up as in a 2×6, and even though we don't have a true step relationship, the force still increases as much as two times. Since the whole purpose is to maximize force magnitude, we accomplish our goal while still using the same procedure on a regular basis.

Because the forces are higher, there is a greater chance that reciprocal effects may occur on the cuspids when they are bracketed. But the anterior segment is relatively rigid compared to the posterior area, and therefore the response is minimized. If desired, the reciprocal response can be avoided by overlaying a continuous arch on an anterior segment.

SUGGESTED READING

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