Biomechanical Considerations in Treatment with Miniscrew Anchorage

Part 2 The Horizontal and Transverse Planes

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In a previous article (JCO, February 2008), we described some biomechanical variations that may occur in the sagittal plane during the retraction of anterior teeth with miniscrew anchorage. The present article covers the horizontal and transverse planes.

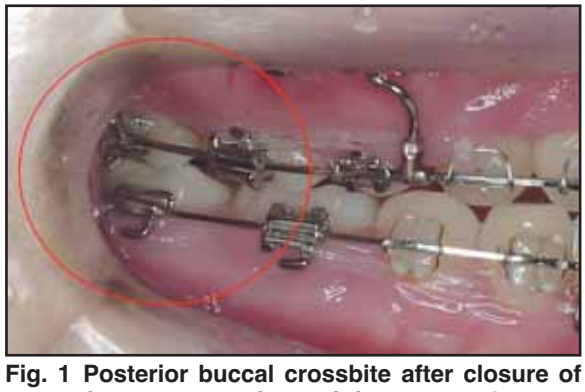

Fig. 1 Posterior buccal crossbite after closure of extraction space using miniscrew anchorage. Lower miniscrew was removed after space closure, and correction was maintained with power chain.

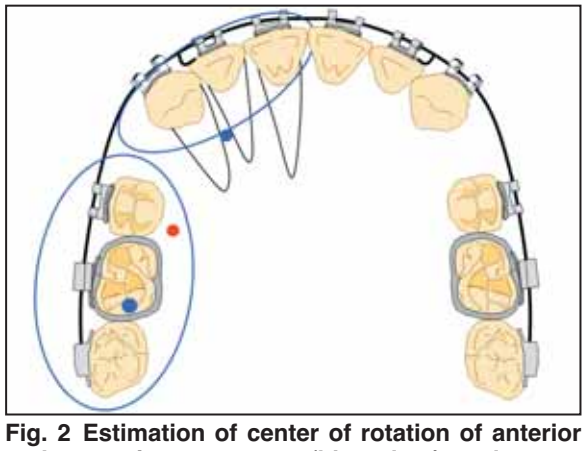

Fig. 2 Estimation of center of rotation of anterior and posterior segments (blue dots) and upper right quadrant (red dot).

The Horizontal Plane

As we discussed in Part 1, bite deepening is a frequent side effect of anterior retraction with miniscrew anchorage. Buccal crossbite is seen less often (Fig. 1).

When the upper arch is observed occlusally, the center of rotation of the anterior and posterior segments can be estimated in the horizontal plane (Fig. 2). If the anterior teeth are retracted en masse, each segment moves around its center of rotation (Fig. 3), but this rotational effect can be prevented by the natural curvature of the arch, similar to the effect of precurved archwires in preventing a deepening of the curve of Spee (see Part 1).

If miniscrews are used for anterior retraction, the right and left quadrants rotate around each center of rotation, and the molars tend to tip palatally (Fig. 4). Although this rotational effect is similar in both arches, there are some differences. Because the angulation of the incisors to the occlusal plane is less in the upper arch,[1] the distance between the retraction force and the center of rota-

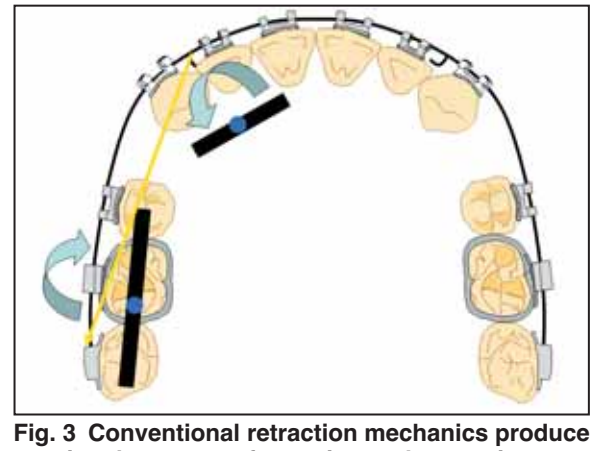

Fig. 3 Conventional retraction mechanics produce rotational vectors of anterior and posterior segments, usually inhibited by natural arch curvature.

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tion of the quadrant is slightly greater, which increases the amount of rotation. Also, because the root morphology of the upper molars provides less resistance to rotation, the upper molars tend to tip more than the lower molars. Furthermore, if brackets with an MBT* prescription are used, the reduced torque values for the lower molar brackets will tend to produce buccal uprighting.[2-4] Upper molars usually provide less anchorage than lower molars,[5] and because Class II malocclusion is more common than Class III malocclusion,[6] miniscrews are used more frequently in the upper arch. All of these factors can contribute to the development of posterior buccal crossbite in some patients.

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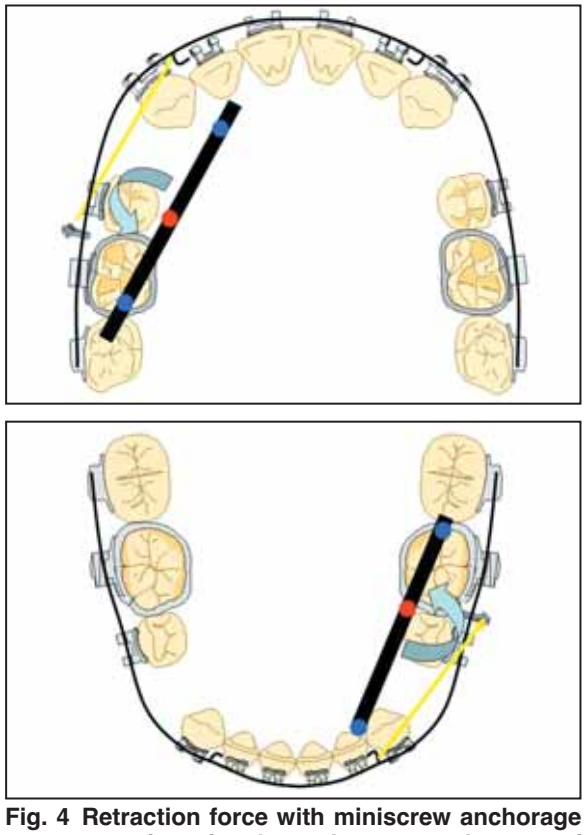

Fig. 4 Retraction force with miniscrew anchorage causes rotation of arch quadrant around center of rotation.

The Transverse Plane

Midline deviation is often corrected with intermaxillary elastics (Fig. 5). While these are easy to use, they do require patient cooperation, and they generate a vertical force vector. With miniscrew anchorage, on the other hand (Fig. 6), no special patient cooperation is needed, and the vector of the

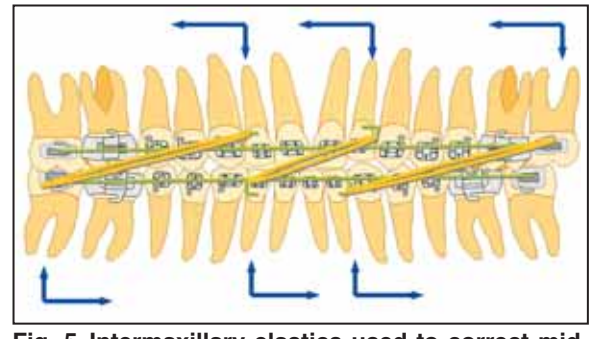

Fig. 5 Intermaxillary elastics used to correct midline deviation.

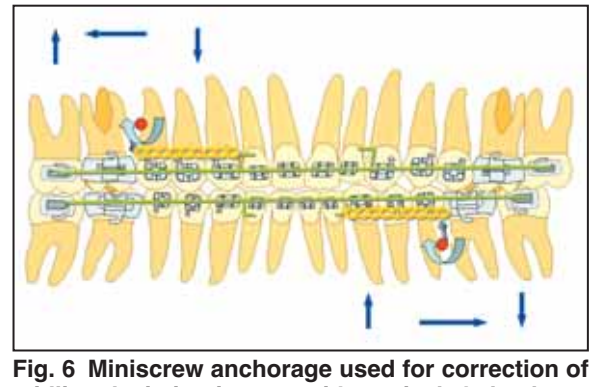

Fig. 6 Miniscrew anchorage used for correction of midline deviation in case with vertical skeletal pattern.

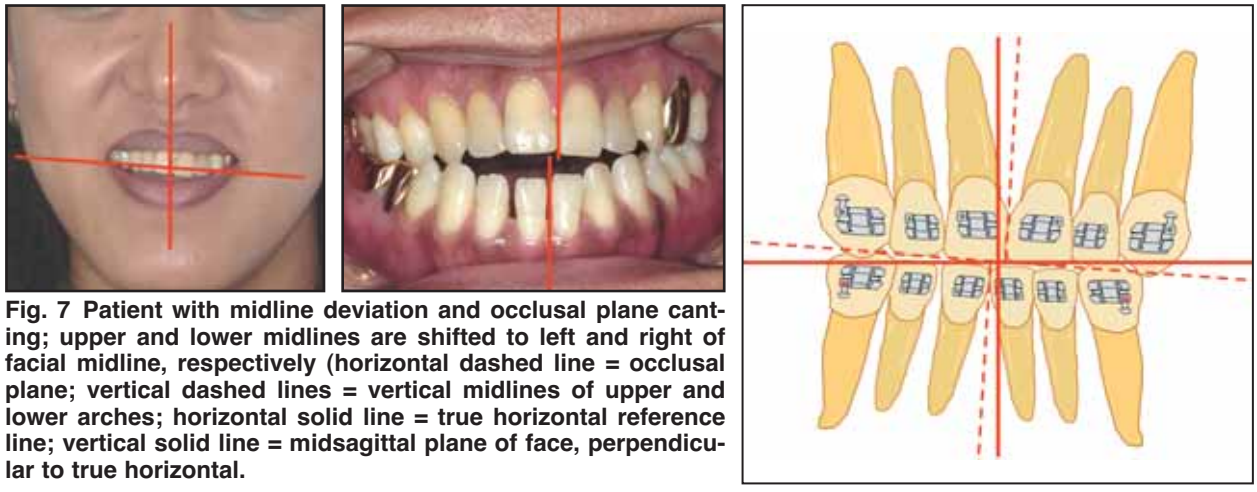

Fig. 7 Patient with midline deviation and occlusal plane canting; upper and lower midlines are shifted to left and right of facial midline, respectively (horizontal dashed line = occlusal plane; vertical dashed lines = vertical midlines of upper and lower arches; horizontal solid line = true horizontal reference line; vertical solid line = midsagittal plane of face, perpendicular to true horizontal.

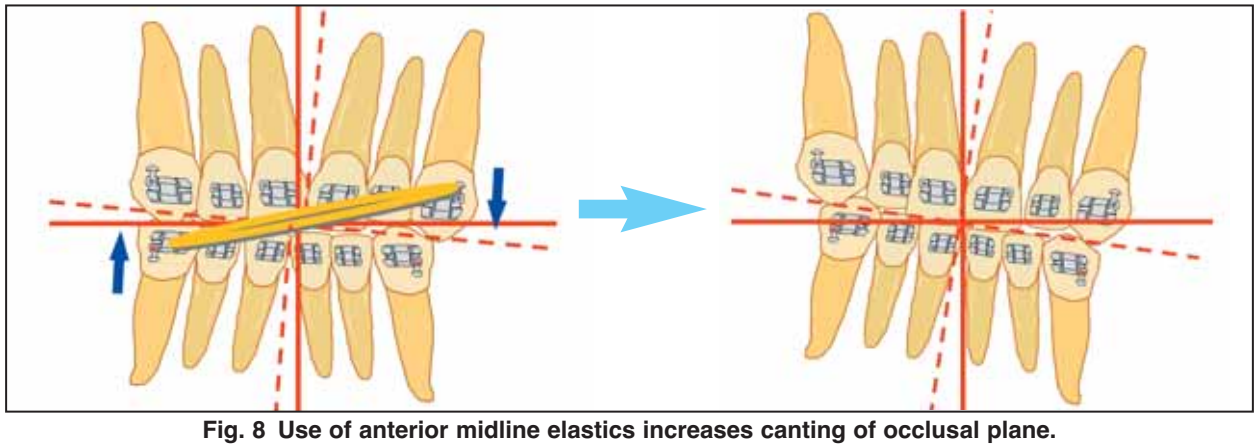

Fig. 8 Use of anterior midline elastics increases canting of occlusal plane.

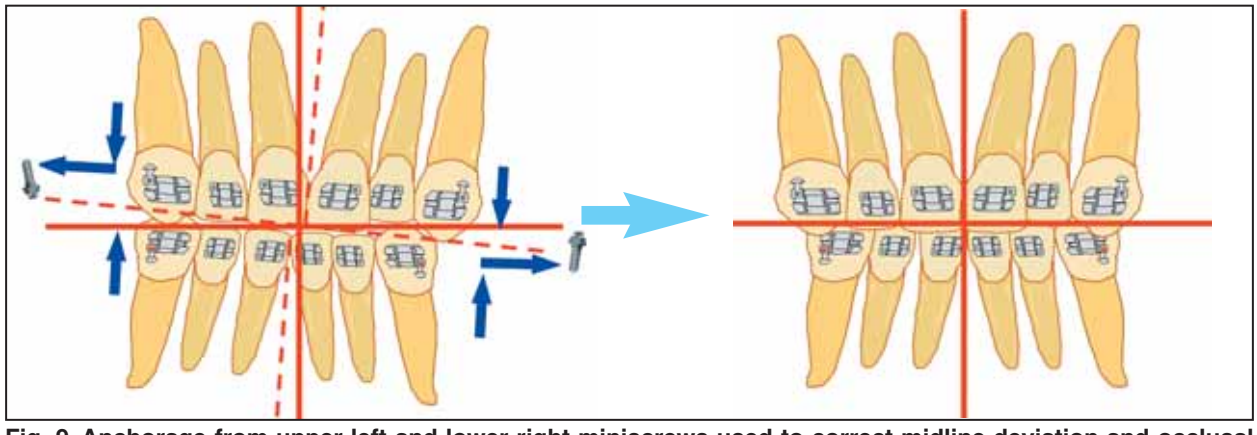

Fig. 9 Anchorage from upper left and lower right miniscrews used to correct midline deviation and occlusal plane canting.

retraction force is usually different from that generated by intermaxillary elastics. If the side effects described in Part 1 are controlled, the midline can be corrected without adverse vertical changes.

In the patient shown in Figure 7, the upper midline is shifted to the left of the facial midline, and the lower midline to the right. Application of intermaxillary elastics between the upper left and lower right canines would worsen the canting of the occlusal plane (Fig. 8). As an alternative, miniscrews can be placed for anchorage in the upper left and lower right posterior regions to correct the midline deviation and occlusal plane canting (Fig. 9).

The patient in Figure 10 has a deviation of both the upper and lower midlines to the right of the facial midline, as well as occlusal plane cant-

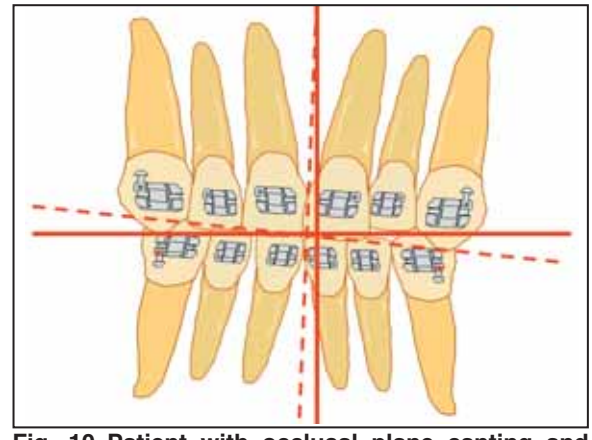

Fig. 10 Patient with occlusal plane canting and deviation of upper and lower midlines to right of facial midline.

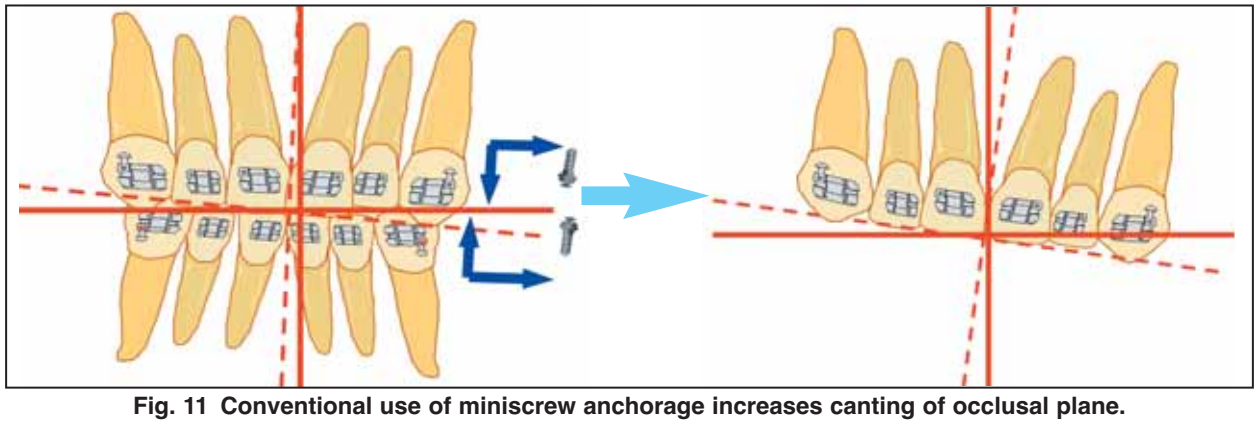

Fig. 11 Conventional use of miniscrew anchorage increases canting of occlusal plane.

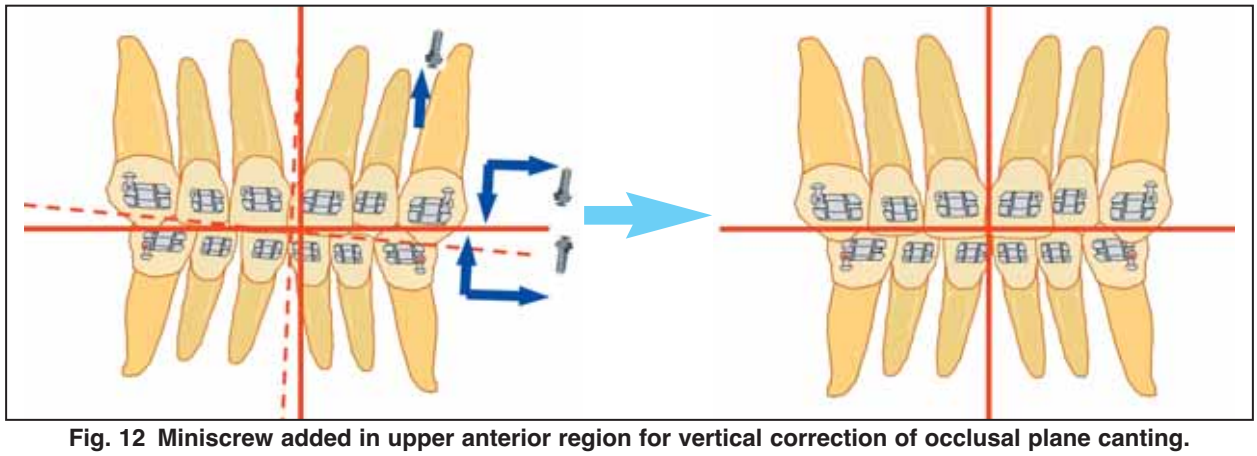

Fig. 12 Miniscrew added in upper anterior region for vertical correction of occlusal plane canting.

ing. Use of conventional miniscrew anchorage to correct the upper and lower midlines would result in increased canting of the upper occlusal plane (Fig. 11). Additional vertical correction is needed to resolve the problem (Fig. 12).

Discussion

Many orthodontists now prefer to use bondable tubes instead of bands in the posterior region for convenience and better hygiene.[7,8] When miniscrews are used for retraction, however, it becomes difficult, if not impossible, to direct the retraction force through the center of rotation without using a transpalatal arch or lingual extension wire. Therefore, the mechanical systems shown in this article require bands on the posterior teeth and palatal miniscrew placement.[9]

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