This article has been peer reviewed

Cranial Strains and Malocclusion:

V. Side-Bend - Part I

By Gavin A. James, MDS, FDS and Dennis Strokon, DDS

The cranial strain known as a side-bend is the most complex of the strains examined so far. It is also the strain where the dental configuration most vividly reflects the cranial configuration. While acknowledging the complexities, an appreciation of the side-bend strain is of great value in understanding the etiology of a difficult group of malocclusions. In Angle classification terms, there is a Class II molar and cuspid relationship on the side-bend side and a Class I molar and cuspid relationship on the contra-lateral side. Within this general description lie several variations. The purpose of this article is to help the practitioner identify the diagnostic features of the cranial side-bend. Treatment of a side-bend strain will be discussed in the next article.

As with previous strains, it is necessary to understand the displacement of the sphenoid and occiput at the spheno-basilar symphysis (S.B.S.) and how this relates to the cranium overall. To avoid confusion, all the side-bend examples in this article are left side-bends. Right side-bend strains have a similar but contra-lateral pattern. Figure 1 is a vertex view of the cranial base in a left side-bend strain. There are two components to the side-bend pattern. The first is a rotation of the sphenoid in a clockwise direction around a vertical axis through the sella turcica. The occiput, meanwhile, rotates in an anti-clockwise direction around a vertical axis through foramen magnum. This creates a widening of the S.B.S. on the side-bend side. The outline of the cranium is asymmetric with a greater length and curvature on the side-bend side as compared to the contra-lateral side.

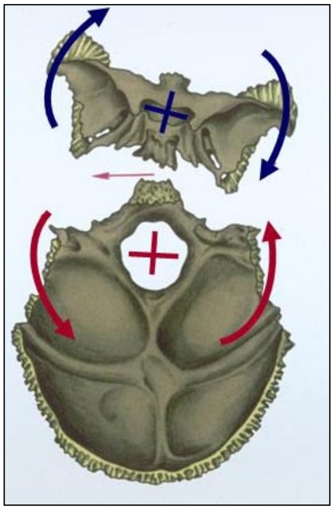


Fig. 1 - Left Sidebend, vertex view. Adapted from Orthopedic Gnathology, Hockel, J., Ed. 1983. With permission from Quintessence Publishing Co.

In Figure 2a the sphenoid plus the maxilla are shown in schematic fashion from a vertex viewpoint, together with the occiput, temporal bone and mandible. The entire maxilla rotates to the right following the greater wing of the sphenoid, while the temporal bone with the glenoid fossa follows the occiput and rotates to the left, carrying the mandible with it. The dental consequences are seen in Figure 2b. The maxillary centreline is off to the right of the facial midline and the mandibular centreline is off to the left. The molar and cuspid relationship is therefore Class II on the left and Class I on the right. It is worthwhile studying this schematic representation since it shows the connection between the cranial/facial displacement and the dental component.

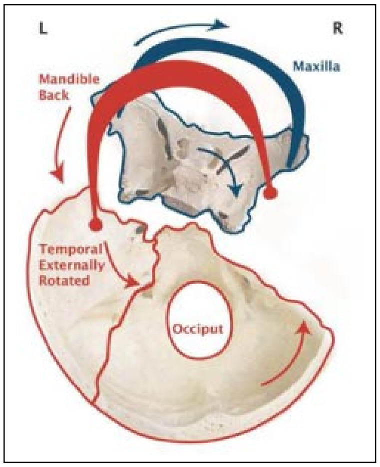


Fig. 2a - Left Sidebend, vertex view - Schematic

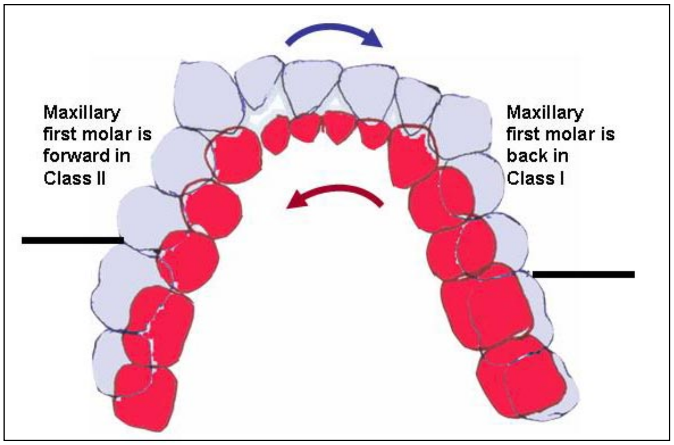


Fig. 2b - Superimposed vertex view of dental arches. Left Sidebend - Schematic.

As mentioned, there are actually two components to the side-bend. The first is the displacement of both the occiput and the sphenoid around vertical axes as discussed. The second component is a rotation of both the sphenoid and occiput around an anteroposterior axis (Fig. 3). Both the sphenoid and the occiput rotate downward on the side-bend side and upward on the contra-lateral side.

Patient H.P (Fig. 4a, b) shows a face characteristic of a left side-bend. The ocular plane slopes down to the left while the occlusal plane slopes up to the left, i.e. there is convergence of the two planes on the side-bend side. Figure 5 shows the dentition. Figure 6 shows the models in maximum intercuspation. The occlusion is almost Class III molar and cuspid relationship on the right but is Class II molar and cuspid relationship on the left. The centreline discrepancy is also shown (Fig. 5).

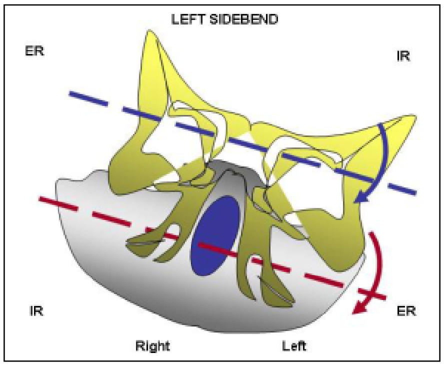


Fig. 3 - Movement of sphenoid relative to the occiput in Left Sidebend. Sphenoid rotates down and forward, occiput rotates down and back. Sphenoid and occiput are drawn from the anterior view.

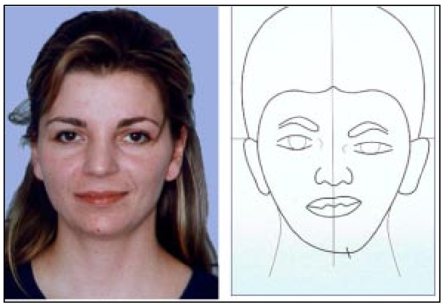


Fig. 4a - Facial view of Left Sidebend patient H.P.
Fig. 4b - Outline of Left Sidebend facial appearance.

Fig. 5 - Left Sidebend - patient H.P. Class I molar relationship on right and Class II molar relationship on patient's left with maxillary occlusal plane elevated on the left.

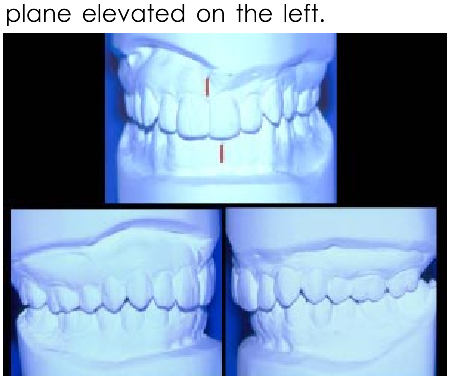


Fig 6 - Left Sidebend, models of patient H.P. Note asymmetric midlines.

Figure 7 shows a palatal view demonstrating that the left buccal segment is closer to the mid-line (internal rotation) than the right buccal segment which is more flared buccally (external rotation). The convergence of the ocular and occlusal planes to the side-bend side is in contrast to the parallelism of these planes in a torsion case[1] (Fig. 8a, b). This has proved to be a valuable tool in differential diagnosis.

Since the ocular plane tips down to the left in a left side-bend it should follow that the occlusal plane would also tip down on this side, but it does not do so. The key to understanding this lack of vertical development of the maxillary posterior teeth on the left is the movement of the mandible. As the occiput on the side-bend side tips down it carries the temporal bone with it. The temporal bone rotates around an axis from the external auditory meatus to the medial aspect of petrous portion of the bone (Fig. 9). As a result of this rotation the glenoid fossa is carried distally but also upwards. This in turn carries the mandibular left posterior teeth upward, thus preventing the maxillary left posterior teeth from erupting.

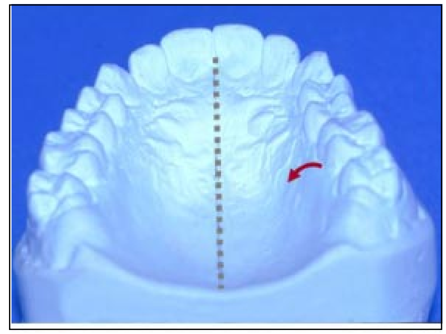


Fig. 7 - Internally rotated palate on the Sidebend side, patient's left - patient H.P.

Fig. 8a - Facial view of Left Sidebend patient.
Fig. 8b - Facial view of Left Torsion patient.

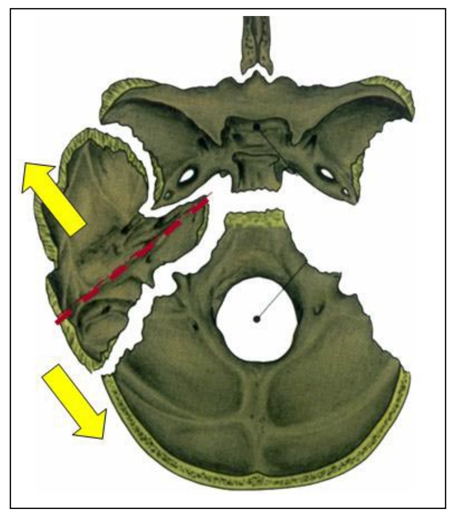


Fig. 9 - Vertex view of cranial base showing axis around which there is external rotation of left temporal bone in Left Sidebend. Adapted from Orthopedic Gnathology, Hockel, J., Ed.1983. With permission from Quintessence Publishing Co.

Figure 10 is a schematic illustration of the dental adaptation to the cranial configuration. The occlusal plane tips up to the left. The maxillary centreline shifts to the right of the facial mid-line and the mandibular centreline shifts to the left. There is external rotation of the maxillary right posterior quadrant and internal rotation of the maxillary left posterior quadrant.

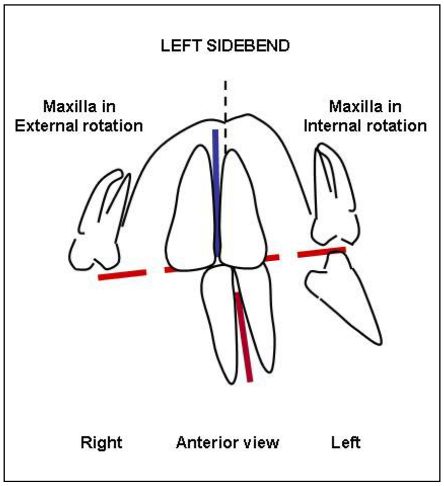


Fig. 10 - Dental configuration of posterior teeth in Left Sidebend drawn from the anterior view. Diagram shows "internal rotation" of the palate on the Sidebend side, patient's left.

Radiographic Evidence

The use of radiographs in identifying side-bend characteristics is helpful (Fig. 11). The fact that one greater wing of the sphenoid is rotated in front of the other can show up as an obvious anteroposterior discrepancy between the two greater wings. Double imaging of the pteryopalatine fossae and the boney orbits is common. Often the borders of the mandibular rami show double imaging. This can demonstrate a vertical displacement of the mandible, as well as the horizontal rotation.

In the posteroanterior radiograph (Fig. 12) the most obvious feature is the increased width of the cranium itself on the side-bend side as measured from the midline. The ocular plane is angled downward on the side-bend side. The occlusal plane is elevated on the side-bend side. The palatal outline is steeper on the side-bend side (internal rotation).

Fig. 11 - Lateral Skull Radiograph demonstrating Sidebend - patient H.P.

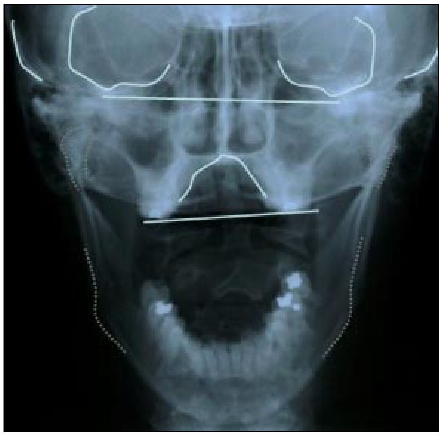


Fig. 12 - Anteroposterior Skull Radiograph demonstrating Sidebend - patient H.P.

The side-bend strain may be the only strain evident as in figure 4a. However, a side-bend strain can also be found superimposed on other strain patterns. The most common of these is a combination of an inferior vertical strain[2] and a side-bend. Patient K. M. (Fig. 13a, b) is a striking example of this combination. The mandibular retrusion apparent on the lateral view reflects the inferior vertical strain. The anterior view (Fig. 13c) shows the effect of the side-bend. There is rotation of the maxilla to the right, carrying the nose with it and also the philtrum, which extends down to the left. The chin is off centre to the left. The ocular and occlusal planes converge on the left. The left ear is more flared than on the right. The lateral skull radiograph (Fig. 14) shows double imaging of the borders of the mandible and the greater wings of the sphenoid.

The dental pattern (Fig. 15) is of a full unit Class II molar and cuspid relationship on the left side and a Class I molar and cuspid relationship on the right side. The maxilla is

Fig. 13a,b - Facial and profile view of patient with both Left Sidebend and Inferior Vertical strain. Note converging lines of ocular and occlusal planes - patient K.M.

Fig. 13c - Facial view of Left Sidebend patient K.M. Note deviation of facial structures related to the anatomical midline.

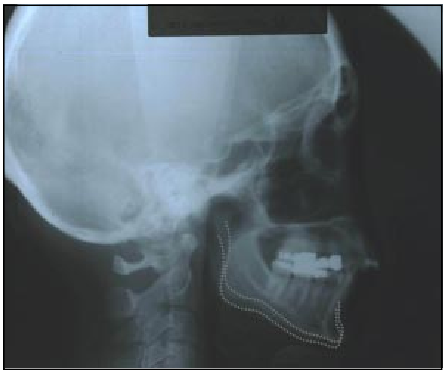


Fig. 14 - Lateral Skull Radiograph demonstrating Sidebend. Double imaging of mandibular borders is outlined - patient K.M.

contracted and constricted laterally with an increased overjet, plus crowding in the mandibular arch. This combination of inferior vertical strain and side-bend represents one of the most complex types of malocclusion which can occur, but is more clearly understood with an appreciation of the underlying cranial strains.

A side-bend strain can also be found in combination with a hyperflexion[3], a hyperextension[4], or as in Patient L.S. (Fig. 16a, b, c) with a superior vertical strain.[4] In this patient, the occlusal plane tips upward to the left. This is exaggerated by a unilateral tongue thrust on this side and a resulting open bite. Figure 17a shows the palatal view of the maxillary arch demonstrating the internal rotation of the left side of the palate. The asymmetry of the palate is obvious, but is even more apparent when the maxillary impression is also examined (Fig. 17b).

Fig. 15 - Left Sidebend patient K.M. Class I molar relationship on right and Class II molar relationship on patient's left with maxillary occlusal plane elevated on the left.

Fig. 16a,b - Facial and lateral view of Left Sidebend patient combined with mild Skeletal Class III (Superior vertical strain) - patient L.S.

Fig. 16c - Left Sidebend, patient L.S. Class I molar relationship on right and Class II molar relationship on patient's left. Maxillary occlusal plane elevated on the left accentuated by posterior unilateral open bite.

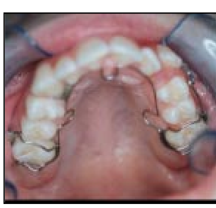


Fig. 17a - Intra-oral view, showing deep narrow palatal vault shape (internal rotation) on the Sidebend side – patient's left.

Fig. 17b - Impression of palate demonstrating internal rotation of the palate on the Sidebend side - patient L.S.

Differential Diagnosis

As was the case in torsion, a careful evaluation must be made to rule out the possibility of trauma or a pathological developmental anomaly being present.[5] For example, a unilateral condylar hypertrophy or a hemi-facial microsomia will show an obvious facial asymmetry. Treatment of these patients is beyond the scope of this article and normally requires a multi-disciplinary approach.[6]

Having ruled out trauma or developmental pathology, there are two broad categories for differential diagnosis. The first group are genuine cranial side-bend cases, which may or may not be found with another strain also present. The skeletal, facial and dental consequences have been described. The second group shows an asymmetry of the dentition with a Class II molar and cuspid relationship on one side and Class I on the other side but may not be side-bends. The key to differentiation is thorough examination and record taking. The first objective is to view the maxillary centreline relative to the anatomical facial midline. Mounting of the maxillary model on an articulator with a face bow may or may not show asymmetry of the maxilla relative to the face. Secondly, mounting of the mandibular model in centric relation and not maximum intercuspation is also important. There are various techniques for obtaining centric relation. For orthodontic purposes, separation of the teeth for a short interval then obtaining a swallow bite with a softened wax rim is usually sufficient. When this is done reduction or elimination of a functional shift (lateral, anteroposterior or both) may be observed. The asymmetry of the occlusion noted in maximum intercuspation may not be apparent when the wax bite is in place. This simple technique helps to differentiate between a skeletal cranial distortion and an adaptive shift of the mandible caused by dental interference.

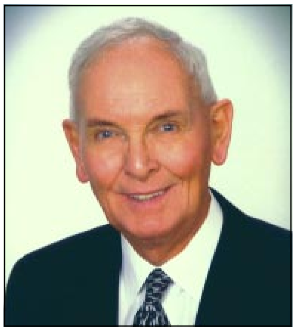
Occasionally, despite this level of record taking, a diagnosis may still not be clear. In these cases, the use of a full coverage flat plane mandibular splint worn full-time for a month may reveal a sudden change in mandibular position. The use of a splint as a diagnostic tool can be very helpful in releasing any muscular adaptation which the patient has developed.

It has been our hypothesis from the start of this series that the cranial strain concept, based as it is on anatomical realities, offers a far more profound and insightful diagnosis of malocclusion than any other approach. We hope that this has become obvious as we have worked through the various strains. An understanding of a side-bend strain, with its cranial, facial and dental consequences, seems to us to be strong evidence for our argument. The cranial concept really does bring clarity to a group of orthodontic problems not well dealt with in the literature but which can present regularly in our offices.

There is an appropriate protocol for the treatment of a cranial side-bend. This will be discussed in the next article.

References:

1. James, G.A., Strokon, D. "Cranial Strains and Malocclusion: IV Torsion." Int. J. Orthodont. 17:1:19-24: 2006.
2. James, G.A., Strokon, D. "Cranial Strains and Malocclusion: III Inferior Vertical Strain," Int. J. Orthodont. 16:4:21-29:2005.
3. James, G.A., Strokon, D. "Cranial Strains and Malocclusion. A Rationale for a New Diagnostic and Treatment Approach." Int. J. Orthodont. 16:2:25-29:2005.
4. James, G.A., Strokon, D. "Cranial Strains and Malocclusion. II Hyperextension and Superior Vertical Strain." Int. J. Orthodont. 16:3:15-19:2005.
5. Defabianis, P. "Biology and Mechanics of Facial Asymmetry in Children and Adults." Func. Orthodont. 20:1:32-39:2003.
6. Proffitt, W., White, R.P., Sarver, D.M. Contemporary Treatment of Dentofacial Deformity. Pub. Mosby Inc.: 2003.



Dr. James is an Orthodontic Specialist in Barrie, Ontario. A major part of his practice is concerned with the management of temporomandibular joint and craniomandibular disorders. His interst in cranial movement has developed as a part of a more comprehensive examination of the problem of head and neck pain.

Dr. Strokon is a general dentist in Ottawa, Ontario. He received his dental degree from the University of Western Ontario in 1972. For the past twenty-five years he has taken an interst in treating symptomatic patients using both restorative and orthodontic techniques in his practice. Dr. Strokon and Dr. James lecture on the philosophy, treatment concepts and design of the ALF appliance.