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Cranial Strains and Malocclusion:
IV. Torsion

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

Abstract: *The cranial strain known as torsion does not fit within the Angle Classification. This strain is described and how to identify it. Torsion may occur as the only strain or is more commonly superimposed on another strain. Recognizing the presence of a torsion has a significant bearing on treatment sequencing. An approach to treatment is demonstrated.*

The four cranial strains examined in previous articles, hyperflexion[1], hyperextension[2], superior vertical strain[2] and inferior vertical strain[3] each predispose towards a particular type of malocclusion which can be described within the Angle classification. This also applies to the strain to be discussed in our next article, namely side-bend. Torsion, the subject of this article, can not be classified under the Angle system but it is a significant etiological factor in malocclusion. The Angle classification is based on two-dimensional thinking. Introducing torsion into the diagnostic process necessarily implies thinking in three dimensions.

Subject C.G. (fig.1a) demonstrates the facial features of a right torsion. The strain is described by what happens to the sphenoid. The primary distortion is a rotation of the sphenoid at the spheno-basilar symphysis so that the right greater wing is elevated and the left greater wing is depressed. As a result the ocular plane slopes up to the right. The lateral occlusal plane (plane of Wilson) also shows a slope or cant up to the right (fig.1a). When the postero-anterior radiograph is examined (fig.1c) the tilt of the ocular and occlusal plane can be seen. The floor of the nares also slopes up to the right. It is as if the entire right side of the face was displaced upwards and the left side downwards Subject G.M. (fig.2a, b, c, d) shows a left torsion with similar but contra-lateral characteristics.

When the cranial base is examined from a vertex view, the displacement occurs along the anteroposterior axis (fig. 3). Figures 4 and 5 represent the movement of the sphenoid in a right torsion seen from an anterior view. The sphenoid rotates up to the right and the occiput rotates down. There are a number of other facial characteristics, such as variations in orbital dimensions, which are described in the osteopathic literature[4] and which also accompany a torsion. The important point, from a dental aspect, is that one side of the face is different from the other unlike the previous strains discussed. The diagram of Sutherland's quadrants demonstrates this (fig.3). Both the anterior and posterior cranial quadrants on the right side are externally rotated, while both the quadrants on the left side are internally rotated.

One dental configuration of the posterior teeth in right torsion is illustrated in figure 6a. The right maxilla is flared buccally as well as being elevated. The palatal outline shows that the right half is more flat and wider than the left, i.e. there is an external rotation of the right maxilla and an internal rotation of the left maxilla. Another configuration of the teeth in a right torsion is also illustrated in figure 6b. The right

Fig. 1a - Right Torsion patient C.G. Frontal view showing maxillary cant.

Fig. 1b - Right Torsion patient C.G. Class I molar relationship with maxillary occlusal plane elevated on the right.

Fig. 1c - Anteroposterior Skull Radiograph of Right Torsion patient C.G.

Fig. 2a - Left Torsion – Frontal view showing maxillary cant – patient G.M.

Fig. 2b - Left Torsion patient G.M. Class I molar relationship with maxillary occlusal plane elevated on the left.

Fig. 2c - Anteroposterior Skull Radiograph of Left Torsion patient G.M.

Fig 2d - Lateral Skull Radiograph of Torsion patient G.M. Note double imaging of mandibular inferior border and posterior dentition.

maxilla is elevated along with the eye and the dentition, but the teeth in this case do not flare outwards as in figure 6a. That is the dentition does not show external rotation although the maxilla itself follows the lateral displacement of the greater wing of the sphenoid. This variation explains the partial posterior crossbite of the right buccal segments in Patient C.G. (fig.1b).

The etiology of a torsion varies. It may occur prior to the birth process, for example where the head is jammed against the pelvis. It most commonly may develop during the birth process itself. Even in a straightforward birth the head twists to accommodate to the reduced anteroposterior dimension of the birth canal behind the pubic symphysis.[5] There are a number of other possibilities for displacement

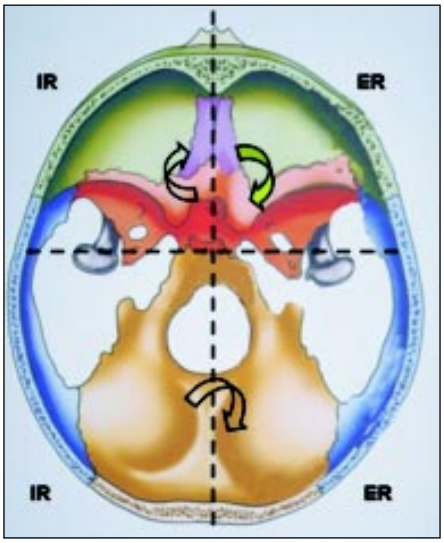

Fig. 3 - Outline of Right Torsion – vertex view
IR = Internal Rotation
ER = External Rotation

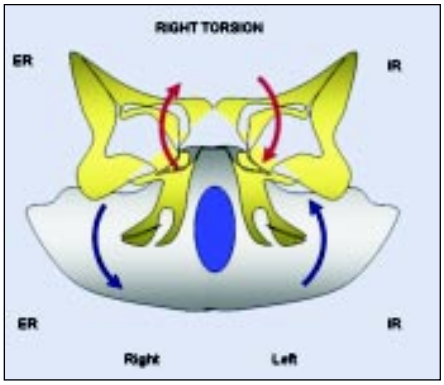

Fig 4 - Movement of sphenoid relative to the occiput in Right Torsion. Sphenoid and occiput are drawn from the anterior view.

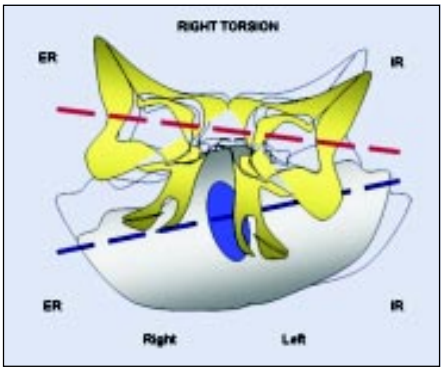

Fig. 5 - Movement of sphenoid relative to the occiput in Right Torsion. Sphenoid and occiput are drawn from the anterior view.

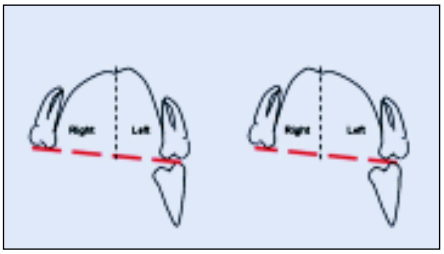

Fig. 6a - Dental configuration of posterior teeth in Right Torsion drawn from the anterior view.
Diagram shows "external rotation" of the palate on the Torsion side, patient's right.
Fig. 6b - Alternative dental configuration of posterior teeth in Right Torsion drawn from the anterior view. Diagram shows "internal rotation" of the palate on the Torsion side, patient's right.

Fig. 7 - Maxillary model trimmed to occlusal plane (left) and same model mounted on Acculiner (right). Note cant of posterior occlusion, demonstrating Right Torsion.

due to later trauma.[4,6] These include direct trauma such as in a motor vehicle accident or as a consequence of an extraction in the maxilla, which can create such leverage on the maxilla it displaces the bone downwards or upwards.[4] A premature occlusal contact, over time, has the potential to cause the maxilla to gradually displace.[7] Torsion is normally a response to another strain somewhere within the head, neck or body.

Torsion is actually quite a common finding, but is often not recognized for several reasons. The first is the simple fact that we can not diagnose what we do not see. If the torsion is only mild, a standard orthodontic clinical examination may miss the presence of the strain. A tongue depressor or Fox plane placed between the posterior teeth, at the time of the clinical examination, is very helpful in focusing attention on this (fig.1a). Similarly, in record taking, torsion is often overlooked. Bench articulated models not only fail to show a torsion, they actually eliminate the cant in the process of carving the maxillary model, which is trimmed to the occlusal plane. Figure 7 shows a maxillary model trimmed to the occlusal plane and the same model mounted with a face bow on an Acculiner Articulator.

A postero-anterior radiograph is essential in identifying a torsion strain. It is important in making the diagnosis to use all the available information. It should be noted in using a face bow that the ears may not be level and this can affect the mounting process. It has to be recognized that when recording facial structures in this way everything is relative. There are no absolutes. It is therefore useful to note any variation in the ear level at the time of examination and keep this on record.

Another reason that a torsion strain may be overlooked is that torsion often accompanies another strain. For teaching purposes in this series of articles, we have described each strain as a separate entity. In practice, torsion is not usually encountered as a single factor. Patients C.G. and G.M. both have a Class I molar and cuspid relationship and the torsion appears to be the primary strain, but Patient K.F. (fig. 8a, b, c, d) has a mild superior vertical strain in which a right torsion component is also present. This combination of torsion and another strain is much the more common finding. The presence of the other strain can easily mask the torsion, especially if the clinical examination and record taking are not designed to identify it.

Another diagnostic feature which is of use is the lateral skull radiograph (fig. 2d). In many, but not all torsion cases, there is a double image of the lower border of the ramus and the posterior teeth also show double imaging. This can be a useful clue, which draws attention to the need to examine other criteria.

Differential Diagnosis:

Differential diagnosis is important. It recognizes that possibilities other than a torsion may be present. In Subject R.L. (fig. 9a, b, c, d, e) there clearly is an occlusal slope or cant up to the right. Examination of the face and p-a radiograph shows that the ocular plane and the floor of the nose are actually horizontal. The condylar heads are level, but there is an obvious asymmetry of the mandibular outline. The lateral skull film (fig.9d) shows the double imaging of the lower border of the mandible and overlapping of the teeth as mentioned previously, but the Panorex film (fig. 9e) shows that the right vertical ramus is 10mm. shorter than the left vertical ramus. There was a history of a probable untreated fracture of the right mandible at ten years of age. This asymmetry could

Fig. 8a - Right Torsion – Frontal view showing maxillary cant – patient K.F.

Fig. 8b - Intra-oral photographs. Right Torsion patient K.F.

Fig. 8c - Lateral Skull Radiograph of Torsion patient K.F.

Fig. 8d - Anteroposterior Skull Radiograph of Right Torsion patient K.F.

Fig. 9a - Patient R.L. Mandibular fracture at 10 years of age. Occlusal slope created by trauma, not cranial Torsion.

Fig. 9b - Intra-oral photographs, patient R.L.

therefore be classified as being of pathological origin. It is not a torsion strain. There have been a number of reviews of facial asymmetry identifying various types of pathology or developmental anomalies which can contribute to asymmetry.[8,9] Defabianis[10] has recently published an excellent summary drawing from a wide spectrum of medical and dental literature. It is not within the scope of this article to go into details as to these more extreme variations. It is important to realize that *while a torsion strain will show a cant of the maxilla, not all maxillary cants indicate the presence of a torsion.*

If we accept that a torsion can exist either as a separate entity or imposed on another strain, does this really matter? It is true that some individuals may have an obvious cant of the maxilla, but are asymptomatic. Having recognized this possibility we also have to consider what damage may result from a torsion strain. Frymann[5] has identified a high incidence of torsion strains in infants with respiratory and circulatory problems. With displacement of the exterior structures of the face and skull, there is distortion of the internal membranes of the cranium, which can create uneven pressure throughout the cranium and also around the nerves exiting through the cranial base.

Frymann[5] has also pointed out that an uneven level of the temporal bones will follow from the torsion. This has obvious implications in any assessment of temporomandibular joint dysfunction. Uneven loading of the temporomandibular joints may induce functional compensation of mandibular movement. The uneven horizontal level of the fossae is likely to cause compression, particularly of the condyle on the torsion side.[7] In the opposite joint there is excessive movement and also uneven loading.

Another result of a torsion is an uneven distribution of the forces of occlusion on the cranial base. This distortion exaggerates the asymmetry of the cranial base, which may result in neuropathic entrapment of cranial nerves. This has been well documented by Magoun.[4, 7] He also points out that with the semi-circular canals being uneven there can be problems with the sense of balance. Furthermore, our clinical experience to date shows that where there is excessive bruxing or clenching, this may be as a result of the torsion. It can represent a subconscious attempt of the body to level the occlusal cant and the cranial strain with it. It is striking that when individuals with severe attrition are examined how often there is a cant of the maxilla present.

Treatment:

Treatment for torsion, especially where it is combined with another strain, has to be included from the very beginning of treatment. Failure to recognize and treat the torsion component can become a major limitation in treatment efforts. It is quite possible to level a maxillary cant where there is a torsion. Leveling of the ocular plane can even be achieved. The patient shown in figures 10a-l has a left torsion. The reason for treatment was a severe temporomandibular joint dysfunction. Treatment was initiated with Advanced Lightwire Functional (A.L.F.) appliances. In the maxilla (fig.10d), this appliance has a very light lateral expansile force to mobilize the

Fig. 9c - Anteroposterior Skull Radiograph of trauma patient. Note ocular plane is level.

Fig. 9d - Lateral Skull Radiograph of patient R.L. Note double imaging of mandibular inferior border.

Fig. 9e - Panorex film of patient R.L.

Fig. 10a - Full face and profile of Left Torsion patient.

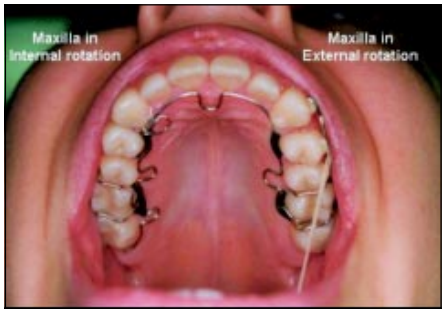

Fig. 10d - First elastic placement on the externally rotated side. A.L.F. dedicated to correct the internally rotated side of Maxilla.

Fig. 10g - Indexed acrylic pad and second vertical elastic.

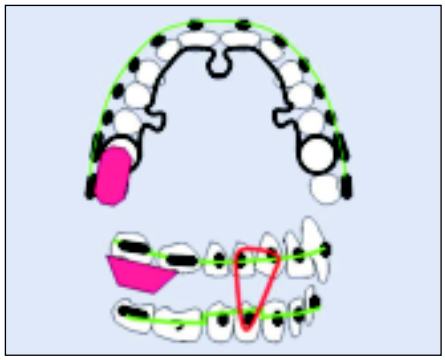

Fig. 10h - Straight wire treatment of Left Torsion. Maxillary arch is prepared as maximum anchor unit. Acrylic pad maintains maxillary correction and triangular elastics are used to elevate lower right teeth individually.

Fig. 10b - Full face view showing maxillary cant.

Fig. 10e - Pad to elevate the low side – right maxilla is low. First elastic placement, through the bite on the left externally rotated side.

Fig. 10c - Intraoral views pretreatment – note maxillary cant.

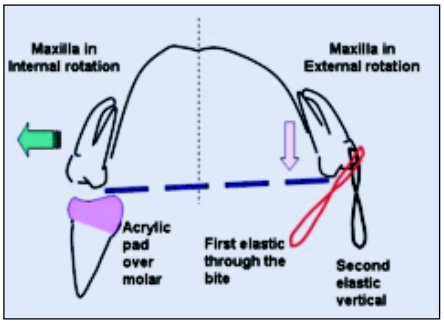

Fig 10 f - Dental configuration of posterior teeth in Left Torsion drawn from the anterior view. Elastic placement and sequence shown to treat internal rotation and bring the high Torsion side of the maxilla down.

internally rotated right quadrant. The through-the-bite elastic on the left serves two functions (fig.10e). It helps bring down the high left quadrant and it also acts as a brake preventing the left maxillary quadrant from expanding buccally. The expansile force is therefore effectively on the right side only. In the mandible, there is a unilateral pad over the mandibular right posterior quadrant. Figure 10f shows the sequential placing of the elastics first through the bite and then vertically. Once the maxilla had been levelled there is an openbite on the right quadrant (fig.10g). Full fixed appliances were placed at that point, but the mandibular right teeth were raised individually against a solid maxillary arch while the pad on the right mandibular six-year molar maintained the maxillary correction (fig.10h). This overall approach is designed to be compatible with active cranial movement. Minimal force was used throughout. Figure 10j shows the final occlusion. Figures 10k, l show the pre and post-treatment facial photos and the levelling of the maxilla. The temporomandibular joint dysfunction has also been corrected.

From a practical aspect, the possible presence of a torsion strain has first to be recognized. This demands appropriate modification of clinical examination procedures and record taking. To reiterate the points made earlier, in torsion there is a slope of the occlusal plane to the high or torsion side, the ocular plane and usually the floor of the nares also slope up to that side. There is usually external rotation of both the maxilla and occiput on the torsion side with internal rotation on the contra-lateral side.

Fig. 10i - Acrylic pad and straight wire finishing, followed by pad removal.

Fig. 10j - Finished occlusal position with maxillary cant corrected.

Fig. 10k - Full face view comparison after correction of maxillary cant.

Fig. 10l - Full face comparison after correction of maxillary cant.

From a treatment aspect, failure to identify the presence of a torsion may explain those cases where conventional treatment seems to fail or produce an undesired effect. As always, the body makes compensatory adaptation. These adaptations extend not only through the entire stomatognathic system, but may involve overall postural change. The possibility of a torsion strain being present demands that we examine our patients in all three dimensions and understand how appropriate treatment may bring about correction not just of the torsion, but of the dental, facial, cranial and postural anomalies associated with it.

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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.