DIFFERENCES BETWEEN THE OVERT AND CHRONIC INSTABILITY AND THE REFLECTION OF THESE DIFFERENCES IN THE TREATMENT

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“Senses are deceiving; it is only the mind that sees the reality, because the real being is unseen, untouched and unheard. Therefore, it cannot be perceived by our senses. It can only be comprehended by the mind.”

Parmenides

White and Panjabi (1) defined the concept of “clinical stability” as the ability of spine to limit the deformation examples to prevent damaging and irritation of the spinal cord and nerve roots by the spine under physiological loads and to prevent pain arising from deformation or structural changes. Spinal stability responds differently to various forms of physiological loading and provides the spine with support in variable levels depending on the condition. Therefore, spinal stability must be defined also depending on the condition. Although defining the stability is difficult, evaluation of instability is less so.

Instability is the inability to limit the excessive or abnormal spinal displacement. There are two basic instability concepts, namely, acute and chronic. Acute instability is divided into two subcategories: the “overt instability” and the “limited instability” (2). Likewise, chronic instability is also is divided into two subcategories: the “glacial instability” and dysfunctional segmentel movements” (Table 1).

Table 1: Classification of instability

<table>
<thead>
<tr>
<th>Acute instability:</th>
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<tr>
<td>Overt instability</td>
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<tr>
<td>Limited instability</td>
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<th>Chronic instability:</th>
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<tr>
<td>Glacial instability</td>
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<td>Dysfunctional segmentel movements</td>
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To optimize the patient management, the spinal surgeon must at first determine the type and level of instability. This is followed by the consideration of the neurological picture together with the symptoms of the patient, risks of further neurological disability and the wishes and worries of the patient. For example, let us consider a patient with medium-level unstable spine, and take a patient with legamentous injury and facet joint fractures documented with magnetic resonance (MR) imaging; however, without significant displacement, that is, let us take a case with limited instability. This patient is under a medium-level risk of the progression of deformity and delayed neurological disability. In this case, surgeon can recommend stabilization and fusion operation. If the patient has no medical conditions that would prevent operation and if s/he accepts operation, this procedure must be performed. On the other hand, let us now consider another patient with serious laxity in L5-S1 spinal movement segment (dysfunctional segmentel movement) while the symptoms allow to maintain his/her activities without operation. The decision for an operation must be considered carefully in such a patient. In the first example, operation is used as an option of preventing the possible risks. In the other example however, the patient has no risks similar to those in the first example despite the unstable spine; action is taken according to the symptoms, and surgery must be the last option.
Acute Instability
Overt Instability

“Overt instability” is defined as the inability of the spine to carry the body during normal activities (3). This is commonly seen following the traumas or surgical operations or in cases of neoplasms, advanced degenerative diseases or infections. Integrity of the spine is at stake in an overtly unstable spine, and preventing the sudden development of deformation or increase of deformation with medical measures will not suffice.

For the development of overt instability, the loss in the vertebral body following a compression fracture and/or discal integrity must be accompanied by the loss of integrity in the dorsal elements (Figure 1). The condition mentioned above will result in the loss of circumferential spinal integrity.

There are issues that must be considered during the clinical decision process. The surgeon must consider the level of damage in the ventral column when planning the surgical strategies; however, level of this damage will also differ regionally.

Likewise, rules that work for the thoracolumbar junction may not work for the lower lumbar region. Evaluation of the ligamentous injury with computerized tomography (CT) is difficult.

The expansion of the interspinous spaces in the plain x-rays gives rise to the suspicion of tears in inter- and supraspinous ligaments. The clinical examination is more useful when determining the level of dorsal column deterioration as compared to all the other imaging methods except for MR imaging. Being sensitive and painful in the palpation of the dorsal spine throughout the trauma level, deformation of the midline soft tissues, gibbosity and deterioration of the dorsal soft tissues indicate the instability of the dorsal spinal column.

Since the T2 sagittal images in the MR imaging show the injury of the ligaments and other soft tissues best, these are the most useful images as compared to others and clearly show the tears of ligaments and muscles; however, the axial images are not helpful for the surgeon to this extent.

In conclusion, MR is rather useful in the evaluation of the overt instability, and clearly describes the soft tissue changes consistent with the trauma. As seen in Table 2, a digital system is provided for the surgeons to be used during the decision-making process. This system uses the MR results to determine the soft tissue deterioration related to the integrity of the spine. One important issue in the use of MR imaging is the power of the scanner. While scanners with high field power (1.0 to 1.5 T) provide high resolution for the determination of the spinal integrity, they provide relatively low contrast to differentiate the soft tissue types (inter-tissue contrast). On the other hand, while the low-power scanners (0.064 to 0.5 T) provide lower resolution, they provide higher contrast between the tissues. Ability of the scanners with low field power to display blood or edema and to differentiate between the damaged and undamaged tissues is rather useful for the surgeon. The disadvantages of the new high-power scanners with powerful software and hardware have been minimized, if not removed entirely. Figures taken from White and Penjabi (1) have been evaluated by Benzé (2) by taking care to avoid the repetition or overlapping of the digital criteria. Presence of the overt instability is indicated by a digit equaling or greater than 5.
Figure 1: Together with the drawing, the T2-weighted MR sections display both the fractured vertebra and the hematoma indicating the tear of the interspinous ligament and the soft tissue.

Table 2: Evaluation of the subaxial spine for acute instability

<table>
<thead>
<tr>
<th>Condition</th>
<th>Score</th>
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<tr>
<td>Loss of integrity of the anterior (and median) column (^a)</td>
<td>2</td>
</tr>
<tr>
<td>Loss of integrity of the posterior columns (^a)</td>
<td>2</td>
</tr>
<tr>
<td>Acute stationary translational deformation (^b)</td>
<td>2</td>
</tr>
<tr>
<td>Acute stationary angulation deformation (^b)</td>
<td>2</td>
</tr>
<tr>
<td>Acute dynamic translational deformation progression (^c)</td>
<td>2</td>
</tr>
<tr>
<td>Acute dynamic angulation deformation progression (^c)</td>
<td>2</td>
</tr>
<tr>
<td>Damage of the neural elements (^d)</td>
<td>3</td>
</tr>
<tr>
<td>Acute disc narrowing in the suspected level</td>
<td>1</td>
</tr>
<tr>
<td>Estimated hazardous loading</td>
<td>1</td>
</tr>
</tbody>
</table>

White and Panjabi based their evaluation of the instability scoring on the following criteria:

\(^a\) In case of missing evidence in the clinical examination, MR, CT or plain x-ray, 1 point can be assigned. For example, if the dorsal ligament injury is evidenced only by MR, that is, if only increased signal intensity related to dorsal soft tissue injury is seen only in the T2-weighted images, 1 point can be assigned. Columns have been defined based on the Studies of Denis and Louis.

\(^b\) The static evaluation of spinal changes related to a trauma is performed with postero-anterior and lateral x-ray taken with the patient in supine position. Including or excluding this criterion above varies with the surgeon and clinical conditions. Scoring that the evaluation is based on is made according to the scoring system of White and Panjabi.

\(^c\) Dynamic evaluation of the spinal changes related to trauma is made on the hyper-extension and hyper-flexion x-rays. Only, when there are difficulties in the evaluation of the other instability, the x-rays are taken under the supervision of the experienced specialist to uncover the instability or to make it overt. Scoring that the evaluation is based on is made according to the scoring system of White and Panjabi.

\(^d\) Three points are assigned to cauda equina, while two points are assigned to the spinal cord, and one point is assigned to isolated neural root involvement. Presence of neural injury indicate that serious spinal deformation has occurred and structural integrity has probably been damaged.
Limited Instability

Making the decision for surgical treatment is not very problematic in overt instable lesions. However, the limited instable lesions having a course with less damage create problems during the diagnostic stage and when making the decision treatment. The “limited instability” is defined as the disintegration of the ventral or the dorsal spine. The undamaged column can be relatively sufficient to support the normal activities, because, when integrity of both the ventral and the dorsal columns are impaired, overt instability can be the issue (4). The ventral type generally involves the body fracture or the isolated end plate fracture. Burst fractures must also be included in this group (Figure 2).

Figure 2: Stable burst fracture and limited instability involving the second lumbar (L2) space in a) MR, and b) CT imaging.

The dorsal type involves the ligaments or bones (including lamina and facet fractures), or sometimes both. The initial approach in limited instability is mostly conservative if neural decompression is not required. However, surgery can be recommended if there is the risk of serious chronic instability. Overt instability is frequently confused with limited instability. Underestimation of the ventral or dorsal injury level in the spine can cause erroneous evaluation. CT is helpful when defining the bone damage, while MR imaging is helpful in soft tissue damages and plays an important role in the differentiation of the limited instability and the overt instability. Using the MR imaging widely minimizes the said error. Treating the overt instability as limited instability can cause late deformity. In this case, the overt instability can shift to the chronic stage (glacial instability).

Both the over instability and the limited instability have chronic forms. In case any of these instability types do not heal following the acute stage, instability can continue and shift to the chronic stage. MR can also be insufficient in the evaluation of the ligamentous damage following the healing of the acute changes in the soft tissues. Differentiating between the overt and limited instability can sometimes be difficult. Factors including the degree of the loss in body height and ligamentous damage can make this differentiation easier. The digital system given in Table 2 can help the surgeon in this issue. Disregarding the location of the damage in the subaxial spine, any digit equaling or greater than 5 indicates overt instability in
the said system. However, such digital systems must always be regarded cautiously, because despite all the efforts to obtain an objective result through scoring, the evaluation is made by the surgeon eventually, and individual differences of assessment are unavoidable. The meticulousness of the spinal surgeon in the clinical evaluation and his/her surgical experience are extremely important for accurate scoring.

In most of the cases, MR imaging together with clear plain spinal x-rays will be more sensitive for the defining of the unstable spine as compared to the other imaging approaches. MR imaging is particularly useful when determining the degree of the instability, and will help the surgeon to evaluate the integrity of the medial column as defined by Denis (5), see the neural injury and understand the cause. Together with this, one of the factors rendering MR important is that it is the only imaging method that provides information that whether or not there are any damages in the ligament and the level of the damage, if any.

**Chronic instability**

**Glacial instability**

“Glacial instability” is a non-overt chronic instability type. Here, there is no acutely occurring deformity or the quick progression of the existing deformity. If there is kyphotic, scoliotic or spondylolysthetic deformity in the spine, the change in the deformity will be too slow to be recognized in successive images taken, like the movement of an iceberg, progression of the deformity in the positive or negative direction can be differentiated only with images taken with long intervals. As a result, glacial instability is defined as the spinal instability with a very gradual degeneration and deformation (2-4). MR imaging fails to give the significant evidences of progression, although it shows the presence of the degeneration and deformation. However, both MR imaging and other radiologic follow-up studies can show the progression of the deformity in time (generally in months or years). This type of instability progresses slowly and can cause shifting in time and can transform into rotational or angular deformity (Figure 3).

Treatment of this condition includes all the options ranging from follow-up to surgical stabilization.

*Figure 3: Late kyphoscoliotic deformity related to a previous fracture in the third lumbar (L3) vertebra and chronic instability causing pain.*
Figure 4: It is seen in the T2-weighted MY images that normal lordose has disappeared related to the anterior shift of T4 and consequent infection in the L3-L4 distance and kyphotic deformity has developed.

The decision is made based on pain, neural compression and the created neurologic picture. Several factors including spondylosis, trauma, tumors, congenital disorders and infections can cause glacial instability (Figures 4 and 5). The most frequently seen glacial instability is caused by pathologies including degenerative, iatrogenic or isthmic type lumbar spondylolysis.

The involved segment can be excessively motile or the deformity can progress (progressive shifting). This indicates the presence of the dysfunctional segmental movements together with glacial instability. Progression of any deformity in the spine with any reason including trauma, tumor or infection will cause the undamaged vertebra right above to act like a long moment arm to increase the forces acting on the weakened segment and quicken the progression of the deformity. The dorsal ligamentous laxity initially seen in the segment with deformity increases the existing pathology even more, and can result in dorsal ligamentous instability.
In case of inability to limit rotation together with a tendency for flexibility, the progressive rotational deformity can be seen (Figure 6). Dynamic radiograms (hyper-extension and hyper-flexion) can be helpful in the diagnosis of a dysfunctional movement unit. This can also be seen in any abnormal motility in the spine (Figures 7 and 8).

In addition to the dynamic radiograms, it is also possible to image the unstable movement segment in the coronal and sagittal planes in antero-posterior and lateral e-rays taken in supine and standing positions (Figure 6). As mentioned above, absence of the excessive motion in the dynamic imaging does not mean the absence of instability. It may not be possible to image the segmental movement dysfunction in highly muscular individuals, in reflex stabilization related to pain or spasm and in cases where the x-rays are poorly taken. This applies to all the chronic degenerative instabilities.

**Dysfunctional Segmental Movement**

Event the concept of “dysfunctional segmental movement” is controversial, and the diagnosis is generally conjectural. The instability related to this diagnosis is called the “mechanical instability”. Nevertheless, the “dysfunctional segmental movement” concept is used in this chapter, since this is less controversial and reflects the suspected pathologic condition more accurately. It is rather difficult to define the dysfunctional movement segment and to determine its level of instability. The characteristic form of pain is the deep and excruciating lower back pain that increase during activity (loading) and relived with the stopping of activity (unloading). This pain resembles the pain complained about in the glacial instability. This form of pain indicates that the activity of the muscles assigned for the provision of stability is higher than normal, and the muscular activity is hardly sufficient to ensure the stabilization of the spine.
**Figure 6:** See the roto-scoliotic instability, partial block and glacial instability in the AP lumbar myelogram in supine and standing positions.

**Figure 7:** Dysfunctional segmental movement, anterolysthesis and retrolysthesis are shown in the dynamic radiograms.
Table 3: Kirkady-Willis degeneration stages: Dysfunction, instability and re-stabilization

<table>
<thead>
<tr>
<th>Stages</th>
<th>Posterior joint degeneration</th>
<th>Intervertebral disc degeneration</th>
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<tbody>
<tr>
<td>Segmental dysfunction</td>
<td>Synovial reaction and degeneration</td>
<td>Radial and circumferential tears</td>
</tr>
<tr>
<td>Segmental hypermobility</td>
<td>Capsular laxity and subluxation</td>
<td>Internal tears</td>
</tr>
<tr>
<td>Re-stabilization</td>
<td>Osteophytosis and enlargement on the facet lamina</td>
<td></td>
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The pain defined initially appears when the changes related to the degenerative discopathies come together particularly with slowly-growing tumors, suppurative or non-suppurative infection with dysfunctional segmental movement. However, the lack of clear objective criteria in the data causes suspicion in the surgeon about the decisions made using these techniques.

The dysfunctional movement segment involves neither the overt spinal integrity impairment, not the progression of deformity.
Figure 8: See the pars fracture in the dynamic x-ray and CT, instability in flexion and chronic instability in a patient with degenerative disc disease and lower back pain intractable despite the treatment of long years.

It can be accepted that many patients with glacial instability have also dysfunctional movement segment (figure 8). As known, when the continuity of the existing degenerative process is considered for degenerative instability cases, appearance and progress of deformation is unavoidable. The treatment approach depends on the deformity reaching the surgical limits and the pain complaint of the patient.

Noteworthy Issues

- The terms of overt instability and limited instability are used for cases with acute instability.
- Overt instability is the inability of the spine to carry the body during normal activities. In this case, the integrity of the surrounding spine has been lost.
- The limited instability is defined as the impairment of the ventral or dorsal spine. The unimpaired column is relatively adequate for the normal functions.
- Glacial instability term is used for more chronic conditions.
- Glacial instability is confirmed with serial evaluations or with definite evidences. For example, in the presence of pain syndrome consistent with the deformation accompanying the translational deformity indicates glacial instability.
- Dysfunctional segmental movement applies to the conditions involving the presence of pain together with significant abnormal spinal movement and not involving overt or limited clinical instability.
References