Proposition of a New Classification for Scapholunate Instability

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Scapholunate (SL) instability is the most common pattern of instabilities in the wrist. If untreated or undiagnosed, it may lead to degenerative changes with SLAC (scapholunate advanced collapse) wrist. There are a few of well-known SL instability classifications. The one that takes into account a dynamic or static nature of SL instability is the most accepted and used. The arthroscopic classifications are also becoming more and more popular.

The aim of the study was the critical review of most popular classifications of SL instability, yet at the same time we proposed a new SL instability classification.

Results. The new classification was found to be very useful in the process of diagnosis and decision making concerning further treatment of patients with SL instability in our department.

Conclusions. The proposed new classification combines the opportunity of evaluating the scapholunate interosseus ligament (SLIL) tear and lesions of the secondary static stabilizers of SL ligament complex that can coexist with or without DISI deformity (Dorsal Intercalated Segmental Instability).

Key words: scapholunate instability, scapholunate ligament tear, scapholunate dissociation, rotatory subluxation of scaphoid, new classification

Scapholunate (SL) instability is the most common pattern of instabilities in the wrist. It occurs with SLIL tear, within its most important dorsal part that is also the most clinically relevant. It can be an isolated injury of SLIL or as an accompanied with other wrist injuries – most frequently with distal radial fracture. The visualization of SL dissociation (Terry Thomas sig) at the PA projection demonstrates the static nature of the instability. To be sure of the injury, a comparative X-ray of the opposite wrist must be done. If the injury is acute and incomplete or the static stabilizers of SL ligament complex are intact, the injury will have a dynamic nature that can be shown with the stress view of the wrist (clenched fist). If the static stabilizers of the scaphoid (mainly the volar ones) are not intact, the rotatory subluxation of the scaphoid (ring sign) can be visualized at the PA projection.

Secondary static stabilizers include:
- dorsal ligaments:
  a) radiotriquetral ligament – dorsal radiocarpal (RTq lig.)
  b) dorsal intercarpal ligament (DIC lig.)
- volar ligaments:
  a) radio-scapho-capitate ligament (RSC lig.)
  b) scaphocapitate ligament (SC lig.)
  c) scapho – trapezial – trapezoideal liga-ment (STT lig.)
  d) short and long radio-lunate ligaments (SRL, LRL)

If the ring sign of the scaphoid is shown at ulnar deviation (at least 13° of deviation), the instability is static. On the other hand, if the rotatory subluxation of scaphoid is present...
without a typical gap between the scaphoid and lunate (≥ 3 mm), along with extension of scaphoid in clenched fist view, it may demonstrate the incomplete lesion of SLIL with injury of the volar ligaments (RSC and SC) – with or without injury of LRL ligament – according to lunate position at the lateral view. As a consequence of the trauma, a SLAC wrist may occur. The static SL instability will lead to DISI deformity (Dorsal Intercalated Segmental Instability), with extension of lunate because of the effect of pulling on with triquetrum due to lunotriquetrum joint and ligament, that create the second most important complex in the wrist. During the final stage, a degenerative change may occur after radial styloid (SLAC I°), scaphoid fossa (SLAC II°), at the midcarpal joint (SLAC III°) and lunate fossa (SLAC IV°).

The most popular classifications of SL instability are based on the dynamic nature of the instability. The proposed new classification combines the opportunity of evaluating the scapholunate interosseous ligament (SLIL) tear and lesions of the secondary static stabilizers of SL ligament complex that can coexist with or without DISI deformity (Dorsal Intercalated Segmental Instability) (1-9).

The most popular SL instability classifications:

A. According to the time of injury

Scapholunate instability, depending on the time elapsed between injury until diagnosis is divided into:
1) Acute: 3 weeks after injury,
2) Subacute: 3-6 weeks after injury,
3) Chronic: over 6 weeks after injury.

This classification is useful and informs about the healing potential of the injured SLIL. The best healing potential occurs when the injury is acute or subacute. In case of acute SLIL tear, an internal fixation with “K” wires or a screw can be used after reduction of the scapholunate deformity for 8-10 weeks. In subacute ones, an arthroscopic capsulodesis or open reduction and fixation of an avulsed liga-

B. Classification in respect of dynamic nature of instability (radiographic classification)

1. Predynamic (occult) Instability: Partial ligament tear, X-rays are normal (including stress views), the injury can be seen with MRI or arthroscopy only. Cast immobilization for 4-6 weeks.
2. Dynamic Instability: Incompetent SLIL or complete SLIL tear with Abnormal changes in carpal alignment seen on stress X-rays. Plain radiographs are normal. Treatment depends on the injury of extrinsic ligaments injury.
3. Static Instability (Scapholunate dissociation): Complete SLIL and volar or dorsal extrinsic disruption, Scapholunate diastasis 3 mm or greater, and radioscaphoid angle greater than 45 degrees on normal X-rays. Tendon reconstruction procedures are recommended.
4. Dorsal Intercalated Segment Instability (DISI deformity): Complete SLIL and volar extrinsic rupture with secondary changes in radiolunate, scaphotrapezoid, and dorsal intercarpal ligaments. Scapholunate diastasis 3mm or greater (radioscaphoid angle greater than 45 degrees on normal X-rays, radiolunate angle >15 degrees, capitolunate angle >15 degrees). A salvage procedures (proximal row carpectomy, 4 corner fusion) can be applied.
5. Scapholunate Advanced Collapse (SLAC wrist I°-IV°): with degenerative changes as seen in radiocarpal and midcarpal joints (6-9).

In this classification there is no division into injury that contains injury of secondary static stabilizers of scapholunate ligament complex. It is assumed that damage of these stabilizers occurs later. Such lesion of static stabilizers can occur even with incomplete SLIL tear and with radioscaphoid angle greater than 45°.

C. Arthroscopic classification of scapholunate instability

In 1996 Geissler described the first arthroscopic classification for scapholunate instability:

Stage 1. Attenuation or hemorrhage of interosseous ligament as seen from the radiocar-

Space. No incongruency of carpal alignment in midcarpal space.
Stage 2. Attenuation or hemorrhage of interosseous ligament as seen from the radiocarpal space. Incongruency or step-off seen in midcarpal space. There may be a slight gap (less than width of probe) between carpal bones.

Stage 3. Incongruency or step-off of carpal alignment as seen from both radiocarpal and midcarpal space. Probe may be passed through a gap between carpal bones.

Stage 4. Incongruency or step-off of carpal alignment as seen from both radiocarpal and midcarpal space. There is a gross instability with manipulation. A 2.7 mm arthroscope may be passed through a gap between carpal bones (10).

D. Scapholunate instability classification according to M. Garcia Elias

In 2006 Marc Garcia Elias described a very interesting classification for scapholunate instability based on five posed questions:

1. Is the dorsal SL ligament intact?
2. If the dorsal SL ligament is disrupted, can it be repaired with good healing potential?
3. Is the scaphoid aligned normally with a radioscaphoid angle of 45° or less, indicating a normal STT capsule and ligaments?
4. Is the carpal malalignment easily reducible?
5. Is the cartilage at both radiocarpal and midcarpal joints normal?

<table>
<thead>
<tr>
<th>Scapholunate dissociation</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a partial rupture with a normal dorsal SL ligament?</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>If ruptured, can the dorsal SL ligament be repaired?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Is the scaphoid normally aligned (radioscaphoid angle ≤ 45°)?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Is the carpal malalignment easily reducible?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Are the cartilages at both RC and MC joints normal?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

1. Incomplete SLIL lesion: at this stage, the dorsal part of SLIL and the secondary stabilizers are intact. It correlates with the occult/predynamic instability. The pain occurs as a result of an abnormal movements in the joint caused by increased SL motion. The lesion can be seen with MRI or due wrist arthroscopy.

2. Complete SLIL lesion with good healing potential: at this stage the secondary stabilizers are also intact with no signs of rotatory subluxation of scaphoid – radioscaphoid angle ≤ 45°. It correlates with the dynamic SL instability.

3. Complete SLIL tear with no possibility of primary repair: weak healing potential of the injured SLIL. Secondary stabilizers are still intact and without signs of DISI deformity.

4. Complete SLIL tear with rotatory subluxation of the scaphoid and DISI because of DIC and LRL ligaments lesion. The present deformities are reducible.

5. SLIL complete tear with irreducible deformities but without degenerative changes of the cartilage.

6. SLAC wrist is present (11).

In this classification the Author excludes the possibility of coexistence of the incomplete SLIL tear with lesion of secondary stabilizers that may cause rotatory subluxation of the scaphoid. Such situations have been described and confirmed before.

E. The proposed new classification for scapholunate instability

The New classification of SL instability is based on combination and coexistence possibility of SLIL tear, secondary stabilizers lesion and DISI deformity. In this classification the presence of rotatory subluxation of scaphoid doesn’t exclude the possibility of good healing potential of SLIL lesion. It means, that we can qualify and treat some patients with this deformity with less invasive procedures like closed reduction and internal fixation of scapholunate ligament complex if the trauma is acute or subacute. In this classification the SL instability has been divided into:

I’a – incomplete SLIL tear with intact secondary stabilizers of scapholunate ligament complex: the lesion can be seen due MRI and arthroscopy. Conservative treatment is recommended (12, 13).
I°b – incomplete SLIL tear with lesion of secondary stabilizers of scapholunate ligament complex: a reducible rotatory subluxation of scaphoid (RSC, SC ligament lesions) with or without “acute” VISI (Volar Intercalated Segmental Instability) – lesion of LRL ligament. The lesion of volar ligament is crucial at this stage, we believe that this can happen without SLIL complete tear. In acute cases, a closed reduction with internal fixation for 6-8 weeks can be done, in chronic ones a modified Brunelli tendon reconstruction is recommended (11, 14, 15).

II°a – complete SLIL tear with secondary stabilizers of scapholunate ligament complex intact and without DISI deformity: in acute cases an arthroscopic or open capsulodesis/tenodesis or open fixation of an avulsed ligament with bone sutures can be done, in chronic ones a bone-ligament-bone procedure is recommended (11, 16, 17).

II°b – complete SLIL tear with lesion of the secondary stabilizers of scapholunate ligament complex: the secondary stabilizers lesion is shown as a reducible rotatory subluxation of the scaphoid. A modified Brunelli tendon reconstruction is recommended.

III°a – SLIL complete tear, no signs of rotatory subluxation of scaphoid but DISI deformity: if the deformity is reducible an arthroscopic or open capsulodesis/tenodesis can be done, if not a salvage procedures (PRC – proximal row carpectomy, partial wrist arthrodesis – STT, SC, 4CF) can be recommended. If STT – scaphotrapeziotrapezoidal – or SC – scaphocapitate – arthrodesis is the choice a radial styloidectomy must be done to avoid radioscaphoid impingement due radial deviation movements. The 4CF – four corner fusion is done with excision of scaphoid.

III°b – SLIL complete tear, irreducible rotatory subluxation of the scaphoid with DISI deformity, cartilage without degenerative changes: treatment as in the irreducible case of stage IIIa° (18, 19).

IV° – SLAC wrist.

In cases when SLAC wrist is present the recommendations are:

SLAC I – degenerative changes are present between the scaphoid and radial styloid, a styloidectomy with partial wrist (STT, SC, 4CF) arthrodesis is recommended.

SLAC II – degenerative changes are present at the scaphoid fossa, PRC or 4CF can be done for this stage.

SLAC III – degenerative changes are present in the midcarpal joint, 4CF is recommended, PRC can be done when the proximal cartilage of the capitate is free.

SLAC IV – degenerative changes are present at the lunate fossa. Complete wrist arthrodesis or wrist joint replacement are recommended.

<table>
<thead>
<tr>
<th></th>
<th>Incomplete SLIL tear</th>
<th>Complete SLIL tear</th>
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</thead>
<tbody>
<tr>
<td>SLAC Ia°</td>
<td>Without DISI</td>
<td></td>
</tr>
<tr>
<td>SLAC IIa°</td>
<td>DISI</td>
<td></td>
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<tr>
<td>SLAC IIIa°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLAC IV°</td>
<td></td>
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<tr>
<td>Secondary stabilizers intact</td>
<td></td>
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<tr>
<td>SLAC Ia°</td>
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<td></td>
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<tr>
<td>SLAC IIa°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLAC IIIa°</td>
<td></td>
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<tr>
<td>Secondary stabilizers not intact</td>
<td></td>
<td></td>
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<tr>
<td>SLAC Ib°</td>
<td></td>
<td></td>
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<tr>
<td>SLAC IIb°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLAC IIIb°</td>
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</table>

DISCUSSION

There is no evidence of deformity progress in cases of incomplete acute lesions of SL ligament. Some authors share the opinion that the symptomatic patients should be treated, whereas the coexistence of SLIL and secondary stabilizers lesions is an indication for treatment because of the instable nature of the deformity. This is why the rotatory subluxation of scaphoid can be seen with SL dissociation. This deformity can also be present in chronic cases of SL instability when the volar ligaments have become inefficient and dysfunctional because of chronically instable scaphoid. The most popular classification of SL instability have regarded the second possibility of rotatory subluxation of scaphoid in chronic cases of SL instability, at the same time patients with this deformity were candidates for more invasive treatment procedures like the modified Brunelli tendon reconstruction. In our new SL classification we believe that the coexistence of rotatory subluxation of scaphoid can be present at early stages of SL instability with good healing potential of SLIL in some patients who can be qualified only to closed reduction and internal fixation. This is the only classification that allows for the possibility of coexistence of rotatory subluxation of sca-
phoid with incomplete SLIL tear, on the condition that the volar ligaments that are holding lunate (LRL and SRL ligaments, ligament of Testut) are injured too. In this case the injury of secondary stabilizers of scapholunate complex seems to be more clinically significant than the SLIL tear. In those cases, there will be a good healing potential of both, the SLIL and the volar ligaments (10, 11, 20, 21).

**CONCLUSIONS**

1. The proposed new classification combines the opportunity of evaluating the SLIL tear and lesions of the secondary static stabilizers of SL ligament complex that can coexist with or without DISI deformity.
2. This classification in a practical way can be used for diagnosis and making decision in treatment at every stage of the injury.

**REFERENCES**