Carpal Instability — A Review

JAMES H. DOBYNS

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Introduction

The concept of carpal instability has been discussed for many years [1–12] but it has assumed greater importance as it became obvious that many management problems were directly related to instability [1, 3–5, 7, 8, 10–16]. The unique anatomy, kinetics, and kinematics of the wrist joint [9, 14, 17–38] have intrigued many generations of investigators. In an attempt to simplify the pathomechanical mechanisms of injury, the wrist has been likened to a series of interdependent, roughly parallel joint systems, lying transversely in the coronal plane [19–24, 26, 27, 31, 36–38]; they include a series of columns which assist thumb function radially, flexion-extension centrally, and forearm rotation ulnarly [11, 12, 29]; a ring of bones, the proximal and distal carpal rows, with potential instability between each bone and between the rows [12, 39], and combinations of all these mechanisms [1, 12, 14]. Historically, little attention was paid to problems of carpal instability because they were not recognized except sporadically [2, 9, 29, 40, 41], particularly as they affected the healing of the very common fracture of the scaphoid [4, 5, 42]. Dislocations with and without fractures were recognized as being unstable, but their residual instabilities and the similar instabilities that developed without obvious dislocation were identified by few investigators [2, 5, 9, 29, 41]. Beginning in the 1970s, a few articles [3, 4, 6, 7, 21, 28, 34, 43, 44] attracted attention; a torrent of anatomic, laboratory, and clinical investigation has resulted worldwide. It even became apparent that the oldest problem of all, that of scaphoid delayed, non- and mal-union was commonly associated with instability [1, 4, 10, 11, 13, 45]. The first instability, not due to fracture or dislocation, was the ligamentous analogue of the scaphoid fracture, scapholunate dissociation [2, 3, 6, 7, 28, 34, 43, 46]. Other specific instabilities were swiftly identified [1, 8, 10–12, 15, 39, 47–50]. Since the wrist appears to function and to dysfunction in all the ways suggested, some investigators [1, 14] have tried to classify them by naming the emerging clinical entities by their unique characteristics and anatomic sites, and by fitting them into the old classic categories of fracture, sprain, dislocation, and fracture-dislocation. This will be presented later in table form, but first, with a new terminology having been gradually developed, the author’s definitions of the terms used in this review will be given.

General Terminology and Definitions

Carpal Instability

This refers to the loss of natural relationships, anatomic or kinematic, of carpal bones to each other or to the skeletal elements just proximal or distal to the carpus. The following are injuries that may cause carpal instability.

Fracture: a discontinuity of trabeculae, either cortical or cancellous. Most instability seen with a fracture is due to associated or to pre-injury ligamentous laxity or damage. However, a fracture with sufficient loss of bone or of configuration may lead to immediate instability of the carpus. Even if originally stable, secondary loss of bone substance or bone configuration may lead to secondary instability; furthermore, chronic

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1The Hand Center of San Antonio, 7940 Floyd Curl Drive #900, San Antonio, TX 78229, USA
inflammation at the fracture site may lead to capsuloligamentous attentuation, which will also lead to secondary instability.

**Sprain:** a discontinuity of ligamentous fibers. Like fracture, the damage may be insufficient to cause immediate instability or it may be sufficient to immediately change the relationships of the carpal elements to any degree less than dislocation. Like fracture, pre-existing damage or laxity or secondary attenuation will affect the presence and degree of instability. Instability developing from a sprain is called a subluxation or partial dislocation.

**Dislocation (luxation):** also a discontinuity of ligamentous fibers, but with sufficient instability that two or more normally related and congruent joint surfaces have lost contact and alignment.

**Fracture-dislocation:** similar to a dislocation except that one or more major fracture fragments (>5 mm in greatest dimension) are present. The anatomical locations of carpal instability are: radiocarpal (RC), perilunate (pL), mid-carpal (M-C), axial (AX), axial-radial (AX-R) and axial-ulnar (AX-U). The collapse positions or positions of deformity are:

1. **Dorsal intercalated segment instability (DISI):** an extension position of the lunate or of the entire proximal carpal row (PCR). If all elements of the PCR are linked normally and are in extension as a group, the deformity is classified as CIND-DISI; if the PCR elements are dissociated, the deformity is CID-DISI.
2. **Volar intercalated segment instability (VISI):** a flexion position of the lunate or of the entire proximal carpal row. As with DISI, this deformity may be a CIND-VISI or CID-VISI.
3. **Ulnar translation (UT):** an ulnar shift of the lunate position vis-à-vis the radius (the normal percentage of the lunate articulating with the radius is about 80% according to Razemon [30] although the spectrum of normal may range as far as 50% — this should be judged by the opposite wrist). The lunate and triquetrum of the PCR may shift in isolation, leaving the scaphoid in its standard position, UT with SLD, or the entire PCR may shift in unison.
4. **Dorsal translation (DT):** a dorsal shift of the entire proximal carpal row, usually of the entire carpus.
5. **Palmar (or “volar” or “ventral”) translation:** a palmar shift of the proximal carpal row, usually of the entire carpus.

**Other Descriptive Terms That Are Often Used**

**Static:** an abnormal relationship of the carpal elements, as visualized on standard PA and lateral X-rays, present at rest as well as with motion or other stress.

**Dynamic:** an abnormal relationship of the carpal elements as visualized by any imaging method, provoked by any stress, i.e., from motion, gripping, compression, etc.

**Carpal Instability Dissociative (CID):** loss of the natural relationships of individual carpal bones to each other. Although not exclusively, this is usually seen in the PCR as either scapholunate dissociation (SLD) or triquetrolunate dissociation (TLD), or both.

**Carpal Instability Non-Dissociative (CIND):** loss of the natural relationships of proximal or distal carpal rows to each other or to the skeletal elements, just proximal or distal to the carpus. The usual deformities seen are excessive extension or flexion, but others are possible, i.e., translational or rotational. The most common problems are seen at the radiocarpal or midcarpal level or both. Except for a few references [1, 14, 47], the literature discusses these problems as some form of midcarpal instability [11, 39, 40, 49, 50], but exactly the same deformity; CIND-VISI, CIND-DISI or alternating between the two, can be produced by radiocarpal instability or a combination of RC and M-C instability. Severe radiocarpal lesions, however, nearly always have some degree of ulnar translation as well.

**Carpal Instability Combined or Complex (CIC):** many carpal injuries, either initially from the severity of the stress or secondarily from increasing ligament attenuation, show elements of more than one category of wrist injury, such as CID and CIND or CID and UT. Indeed, current research suggests that the late or extreme stages of most carpal instabilities show such combined damage [15]. Nevertheless, an understanding of the characteristic damage responsible for the early deformity of each lesion is well worth knowing for both diagnostic and treatment purposes.

**Carpal Instability Potential (CIP).** There are certain higher risk factors to be found in many wrists. These include the “lax” wrist, whether accompanied by generalized systemic laxity or only involving certain joints, many osseous developmental differences, such as ulna positive or...