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# THE CLAP CONCEPT
# A CT-BASED CLASSIFICATION FOR DISTAL RADIUS FRACTURE

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**ABSTRACT** • Various classification systems exist for distal radius fracture with no clear direct application on surgical treatment. The CLAP concept for distal radius simple/complex fracture is a novel concept based on the anatomical shape of the distal radius articular surface analyzed on axial CT-scan. The articular surface could be divided into 4 quadrants : central, lateral, anterior and posterior. We introduce the central part of distal articular surface which is supported by 3 pillars : lateral, anterior and posterior. This new classification system has direct implication in the surgical treatment and tactics for reduction and fixation of the simple and complex distal radius fractures.

Keywords : distal radius fracture ; intra-articular fracture ; classification

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**RÉSUMÉ** • Il existe plusieurs systèmes de classification de la fracture du radius distal sans qu'il n'y ait une implication directe sur le traitement chirurgical. Le concept de CLAP pour les fractures simples ou complexes du radius distal est un nouveau concept qui se base sur la forme anatomique de la surface articulaire du radius distal analysée sur des coupes axiales du CT-scan. La surface articulaire peut être divisée en 4 quadrants : central, latéral, antérieur et postérieur. On introduit la partie centrale de la surface articulaire qui est soutenue par 3 piliers : latéral, antérieur et postérieur. Ce nouveau système de classification comporte une implication directe sur le traitement chirurgical et les stratégies envisagées pour réduire et fixer les fractures simples et surtout complexes du radius distal.

Mots-clés : fracture extrémité inférieure du radius ; fracture intra-articulaire ; classification

## THE CLAP CONCEPT THEORY

The distal radius fracture is classified using the four-corner concept of Brink and Rikli [1] which is a combination of the three-column model of Rikli and Regazonni [2] and Melone's four-part classification [3]. Their classification divides the distal radius into three fragments which are the volar, dorsal and radial but do not take into consideration a central fragment that is seen often in the complex distal radius articular fracture.

The CLAP concept is based on the anatomical shape of the distal radius articular surface. It could be anatomically divided into four quadrants on an axial CT scan : central, lateral, anterior and posterior (CLAP) (Figure 1). It is a novel concept for the understanding of the simple and complex distal radius articular fracture. It introduces the central fragment of the articular surface of the distal radius which is the central part of the lunate fossa. It is different from the dorsal and volar parts of the intermediate column and constitutes the essential element of the die-punch or central depression pattern seen in simple or complex articular fracture.

The central part of the distal radius articular surface is supported by three components which are the lateral, anterior and posterior pillars (Figure 2).

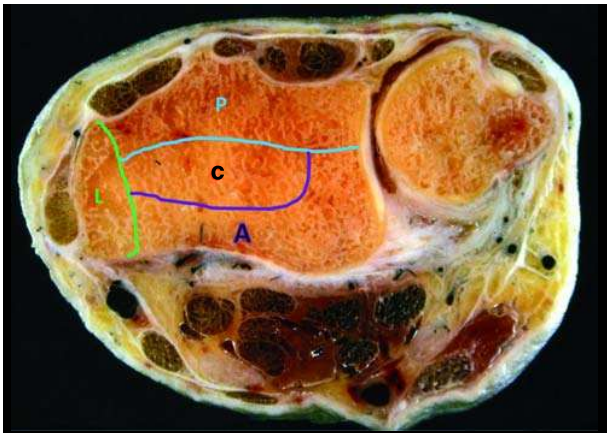


**Figure 1**
The four components of the axial distal radius articular surface.
(C) central portion (L) lateral pillar (A) anterior pillar (P) posterior pillar

The lateral part constitutes the radial styloid and scaphoid fossa which is responsible for radiocarpal stability and plays a major role in ligamentotaxis due to its strong attachments with the radiocarpal ligaments and the insertion of the brachioradialis tendon. The lateral fragment is the lateral pillar and often the main pillar on which we build the reduction of the other components of the CLAP.

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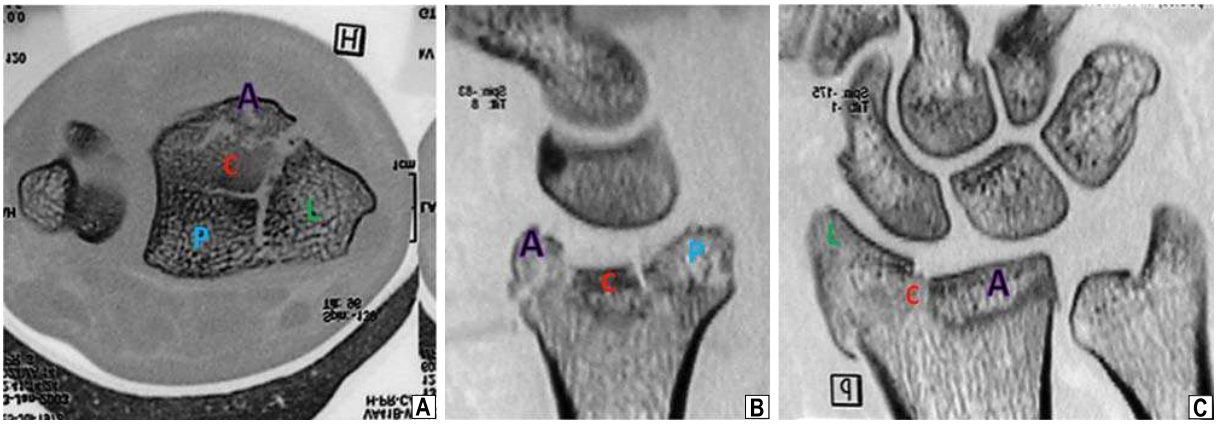


**Figure 2.** CT-scan of a complex distal radius fracture based on the CLAP concept.
**A**: An axial CT-scan of a distal radius fracture **B**: Sagittal reconstruction
**C**: Coronal reconstruction (C) central portion (L) lateral fragment (A) anterior fragment & (P) posterior fragment

The anterior fragment plays a major role in supporting the central lunate fossa due to its thickest cortical bone. The orientation of the displacement of this fragment and the degree of comminution will guide the treatment strategy.

This anterior fragment tends to dorsally tilt and translate anteriorly which creates a gap and distraction from the central part of the articular surface. This could lead to a dorsal tilt of the lunate (extension) and result in instability if it is not well reduced [4,5]. The degree of comminution of this anterior fragment will push the surgeon to reduce and fix it in a direct manner.

The posterior fragment constitutes the dorsal pillar of the lunate or central fossa and is also characterized by its thick cortical bone. It is comminuted more frequently than the anterior fragment because of the energy dissipated through the dorsal pillar of the articular surface and the impact of the carpal bone and their relatively stronger mechanical properties than their volar components [6]. The posterior pillar is frequently anteriorly tilted and posteriorly translated in contrast with the anterior fragment which is dorsally tilted. The opposite directions of the displacement of these two essential components of the articular surface will result, if the energy is high enough, in the creation of the central portion. The commonly depressed central fragment between the anterior and posterior displaced fragments will reduce the radiocarpal joint surface and will result in loss of wrist flexion-extension range of movement (ROM).

The central fragment is formed by the lunate fossa which is supported by the lateral, anterior and posterior pillars. This fragment is not constant. If the energy is high enough or the bone is osteoporotic enough, the central portion will detach from its lateral, anterior and posterior supports and either be depressed or present as a separate fragment. If the fragment is not seen on axial CT-scan, that means it remains attached to one of the three pillars. The fracture line will frequently pass through the central quadrant of the distal radius articular surface as the energy is dissipated harmoniously through the spherical configuration of the lunate fossa [7] and part of the central portion remains attached to the posterior fragment and the other part to its posterior pillar. Thus, the central portion will not present in this situation as a distinct fragment making the fracture less complex.

Finally, the distal radius fracture could present with comminution of each of the fragments described above. The classification could be applied on most of the distal radius fracture. If the fracture line is extra-articular, the distal radius fracture could be classified as E-CLAP (extra-articular). If the distal radius fracture line pass through the radial styloid, the fracture is classified as L-CAP. If all the fragments exist on the axial CT-scan the fracture would be classified as CLAP. If there is comminution in one of those fragments, the corresponding letter is written in lower case i.e. a comminution in the anterior pillar in a CLAP fracture would be classified as a CLaP.

## THE CLAP CONCEPT APPLICATION

Analyzing a distal radius complex articular fracture based on the CLAP classification will facilitate the tactic used by the surgeon to reduce the fracture. In a complex CLAP fracture, we always propose to reduce the lateral pillar which will constitute the main fragment of our reduction. Re-establishing the radial inclination and stabilizing the lateral pillar will form the angular cornerstone to our reduction. We achieve reduction and stabilization of this

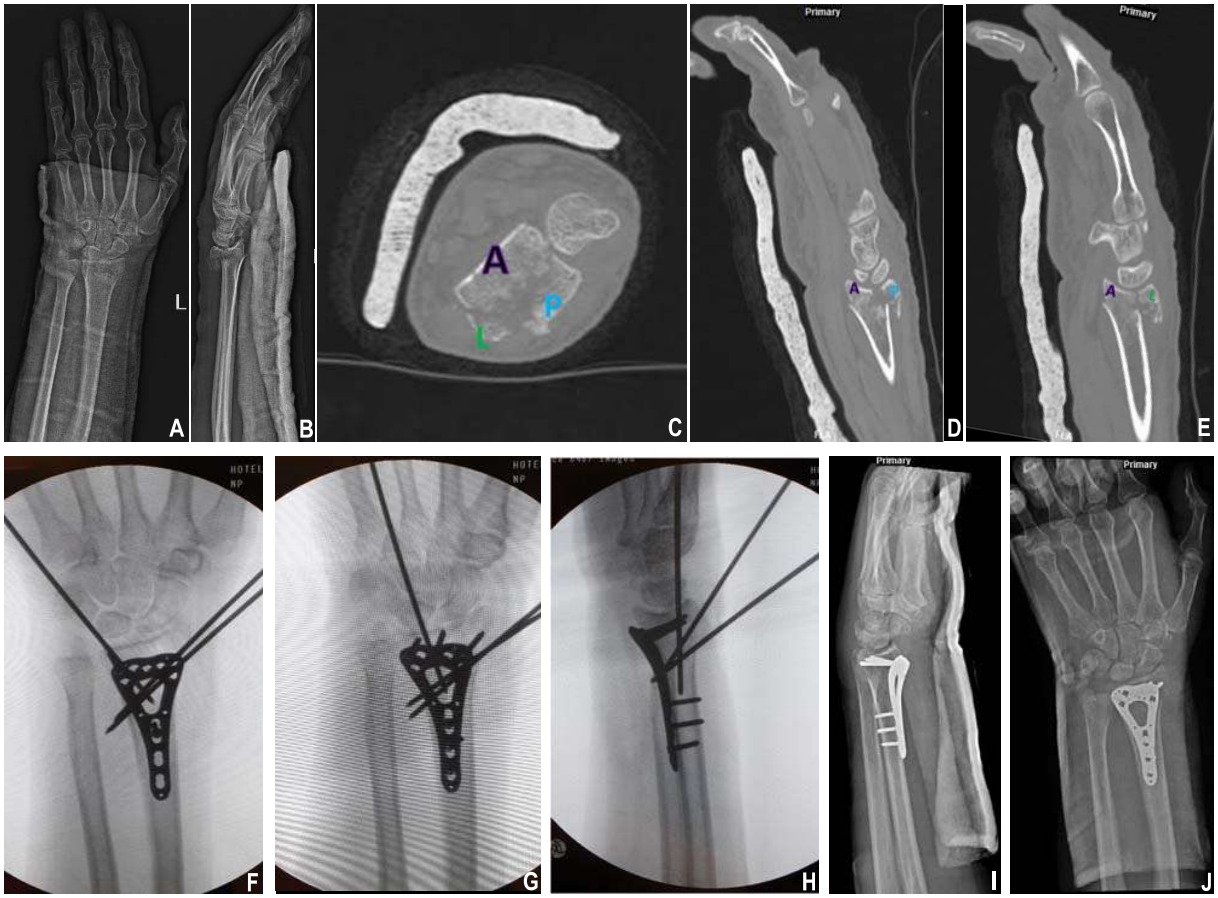


**Figure 3.** The CLAP concept application for complex distal radius fracture (A, B, C, D, E)
Reestablishing the lateral pillar through a radial K-wire (F, G) dorsal reduction of the dorsal fragment (H).
Reduction and fixation with a volar plate through a palmar approach (F, G, H)
AP and Lateral post-op radiograph (I, J)

pillar by an intrafocal K-wire (Figure 3 F, G). Then we propose to reduce the posterior pillar either manually or by posterior intrafocal pinning through dorsal mini incisions to avoid injury to the extensor tendons (Figure 3 H). Finally, we place the volar plate through a volar approach to fix all the fragments after reduction of the central and anterior fragments respectively (Figure 3 H, I & J). If the central part is not well reduced, a direct reduction and fixation through an intra-articular approach will make us achieve the reduction and fix it anteriorly through the plate.

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