Diagnosis and management in of subacute and chronic triangular fibrocartilage complex injury with distal radioulnar instability

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INTRODUCTION

The term triangular fibrocartilage complex (TFCC) was coined by Palmer.[1] TFCC components are the articular disk, the dorsal and volar radioulnar ligaments, the meniscus homolog, the ulnar collateral ligament, and the sheath of the extensor *carpi ulnaris*.[2-5] Palmer classified traumatic injuries into type 1 (A-D) and degenerative conditions into type 2 (A-E).[6]

The Point-Counterpoint section presents two approaches to a single problem. In this case, we address the surgical resolution of subacute and chronic triangular fibrocartilage complex injury with distal radioulnar instability, according to Palmer's classification (the Atzei-EWAS classification was not considered as it considers only arthroscopic procedures).

1. *Clinically, which are the most sensitive semiological maneuvers to assess TFCC unstable injuries?*

Eduardo R. Zancolli (ERZ): At physical examination; I consider the most helpful factors to be: 1) focal tenderness; 2) the piano key sign; and 3) ulnar dorsal examination.

1) The points of focal tenderness are a) pain over the ulnar head dorsal aspect in TFCC dorsal injuries, and b) pin over ulnar styloid or the volar aspect of the ulnar head in foveal detachments.

2) The piano key sign: it should be performed in supination and pronation, comparing with the uninjured side as some patients present joint laxity. Besides the increased displacement of these injuries, the medical record should include whether the test hurts and whether any clack sounds are present during the tests (associated with fibrocartilage flaps between the ulnar head and the TFCC).

3) Ulnar dorsal examination: tenderness over the ulnar head at canal level. Visual examination may reveal increased displacement of the ulnar dorsal aspect during the pronation-to-supination movement. A maneuver that has proven to be of great help is placing the wrist in flexion and ulnar deviation (with the elbow resting on a horizontal surface) and asking the patient to perform a supination-to-pronation movement. We consider this maneuver to increase sub-dislocations and made them clearly visible.

Martín Caloia (MC): In terms exclusively of TFCC unstable injuries, and having ruled out other causes of pain on the ulnar aspect due to secondary stabilizers involvement, our standard practice includes: a) fovea sign test (Tay *et al*., 2007), which has a sensitivity of 95.2% and a specificity of 86.5% for palmar and dorsal lesions; b) piano key sign test for foveal avulsions; c) dimple sign test; d) ulnar carpal press test, of great value in articular disk lesions; e) press test, a simple and useful test to establish the distal radioulnar weight-bearing adequacy; f) ballottement test, which is incredibly useful in evaluating distal radioulnar stability and requires the wrist to be in neutral position, pronation and supination, always comparing and using the holding the carpal bone technique (Tadanobu Onishi *et al*., 2017). This same maneuver should be conducted under anesthesia in the operating room because it is crucial to rule out false-negative results due to the contracture of secondary stabilizers.

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2. Which complementary study for TFCC injury diagnosis do you consider to be the gold standard?

ERZ: We consider MRI with microcoils and distal radioulnar arthrography to be the most helpful. MRI microcoils most important sections are those of the T2-weighted fat-suppressed sequence as they show the presence of inflammatory fluid (synovitis) and bone edema (telltale sign over the ulnar styloid in ulnar dorsal aspect subdislocations). We examined transverse sections in supination to establish the dorsal ulnar joint instability at canal level. We do not use MR-arthrography as it fails to provide proper image of inflammatory fluid accumulations or bone edema.

Distal radioulnar arthrography evidences dye passage to the TFCC-carpal (and its location) and, in absence of passage, irregular "mammilla-like" formations between the head and the TFCC (indication of dorsal TFCC ruptures and fibrocartilage flap overlap).

MC: Anteroposterior comparative X-ray views of the wrist provides data on the distal ulnar variance. Although the recent development of MRI microcoils and MR-arthrography has increased detection and topography description sensitivity for TFCC injuries, healthy skepticism should be applied to their reports as they are operator-dependent studies; hence, their use calls for a trained MD radiologist working in coordination with the treating surgeon. Arthrotomography (Moritomo *et al*., 2015) has recently taken the stage, it is an imaging study of great specificity and sensitivity to detect TFCC unstable patterns and, although more economical than arthro-MRI, still required qualified and highly trained professionals for the result interpretation. To our understanding, the specific three-dimensional structure of the TFCC, described by Nakamura in 1996, leads to considering arthroscopy as the gold standard diagnostic tool as it allows for as assessment of TFCC components, and the type and extension of the injury.

3. What periods of time are considered to differentiate between acute, subacute, and chronic TFCC injuries? How long is it considered appropriate to wait until the evaluation for a conservative therapy in an unstable TFCC injury?

ERZ: The most common acute injury diagnosis is associated with radial fractures. We consider the importance of categorizing injuries into acute and the like to lie only in differentiating those which may spontaneously heal if managed with long-arm immobilization. Bone healing following the first two weeks is quite unlikely (although three weeks of waiting could also be considered).

To the best of our knowledge, any difference between subacute and chronic injuries is irrelevant in terms of both being subject to the same treatment and prognosis. Patients with non-acute injuries are managed with conservative therapy for, at least, a month. After that period, if the expected progression is not achieved, we perform a distal radioulnar diagnostic arthrography (complementing the previously performed MRI with microcoils), removing the contrast agent and injecting 1cm^3 corticosteroid at the end of the procedure. We wait a month for the clinical condition to improve. If not, we proceed with surgical management.

MC: Literature data on the evolution time is thin.

In 1997, Trumble *et al*. defined injuries as acute when treated within three months from the time of injury, as subacute if treated as from three months until one year, and as chronic if treated after a year of the injury. These time periods are directly associated with the healing capacity, 85% for acute lesions and significantly reducing for the rest (subacute and chronic). The setting for the evaluation of an unstable TFCC injury changes depending on the presence of a distal radius fracture because it results in a different healing capacity. Healing time for patients with isolated, unstable, subacute or acute injuries ranges from 4 to 6 months with conservative management; for patients with a distal forearm or radius traumatic injury, healing time ranges from 8 to 9 months.

4. What is your technique of choice for repairing subacute and chronic TFCC injuries? Do you consider its reproducibility and learning curve to be better than others'?

ERZ: My technique of choice is the one described by Eduardo A. Zancolli, a mini-open technique with a dorsal incision approach, similar to the one used in most arthroscopic techniques. This technique has some features that must be observed: 1) the dorsal retinaculum should be raised first, leaving it inserted on the ulnar side; 2) the *carpi ulnaris* tendon should not be opened; 3) perform a transverse dorsal capsulotomy of the distal radioulnar joint, 8mm proximal to the distal end of the ulnar head.

This technique allows for the placement of two bone anchors (one at the fovea and another one at the dorsal insertion just by the radial column of the *carpi ulnaris* ligament), depending on the joint instability and type of injury.

The learning curve is pretty short if compared with other techniques. In Cali, Colombia, 25 participants reproduced this technique in cadaveric models, achieving great levels of precision in their first attempt. Thus, a simple and reproducible technique. Performing the technique usually takes around 40 minutes.

MC: In patients with subacute or chronic injuries, and specific patients with acute injeries, we opt for an **arthroscopic approach**: debridement, thermal shrinkage, capsular suture or fovea reattachment, depending on the injury topography and the level of distal radioulnar instability. They involve reproducible techniques, requiring, as with minimally invasive surgeries, appropriate instrumentation and a sensible learning curve. Cadaveric hands-on courses have accelerated, especially for the new professional cohorts, the time and surgical dexterity required by this technique. Furthermore, and contrarily to open techniques, we consider they pose some potential advantages:

a. Less scarring and a lower infection rate thanks to smaller surgical incisions.

b. The use of magnification and of Brain "box concept" (2008), using dorsal-volar and foveal portals, allows us to improve the evaluation of surrounding soft tissue, of all relevant TFCC structures, the extension and location of lesions and the articular cartilage status.

c. An earlier and less painful recovery thanks to smaller approaches.

d. A faster return to full articular range of motion following surgery, owing to the isometric plasty procedures involving lower articular stiffness rates.

e. Lower impact on joint proprioceptive performance by avoiding excessive capsular approaches.

f. Fewer complications in comparison with open techniques.

5. ***According to your experience, what fixation method do you prefer? Transosseous suture, anchor fixation, graft reconstruction or some other method?***

ERZ: Our fixation method of choice is bone anchors (up to 2, as already mentioned). Bone anchorage is a far superior method to simple soft-tissue fixation.

MC: In our experience, we prefer transosseous fixation techniques (Nakamura-type) with extra-articular fixation suing an anchor system without knots. To our understanding and from a biomechanical point of view, they provide greater strength than open techniques and a lower complication rate. Graft reconstruction may be considered an option for chronic cases involving irreparable TFCC or poor quality, or for cases were there also exists a secondary stabilizers attenuation of the distal radioulnar joint, always considering there being a congruous joint and no joint deterioration.

6. ***How much time of postoperative immobilization do you recommend for these types of TFCC injuries and which method do you apply?***

ERZ: We prescribe a month of long-arm plaster cast immobilization. Then we change to a wrist immobilization splint and indicate patients to begin with flexion-extension exercises. Pronation-supination exercises are indicated as from 45 days after surgery. Splint removal takes place 2 months after surgery.

MC: We prescribe six weeks of immobilization, starting with three weeks using Long Sugar tong splint, which allows for the elbow flexo-extension movement and prevents wrist prono-supination rotation. Finally, three weeks using a removable wrist splint.

7. ***How long should patients wait until returning to their regular daily activities without limitations (sport, manual work, and so forth)?***

ERZ: According to each patient's evolution, as from four months after surgery.

MC: A sensible return time to work and contact sports is four months for patients with stable subacute injuries and six to eight months for patients the unstable chronic injuries.

8. ***How do you assess the administered treatment outcome in terms of distal radioulnar joint residual instability?***

ERZ: We chose this technique because healing time does not change irrespectively of the technique with use; thus, neither immobilization time nor dorsal capsulotomy results in articular stiffness. Approximately 90% of patients achieve painless and very stable outcomes and can return to high-performance sports activities (golf, tennis, polo) with neither mobility nor strength final loss.

MC: Our assessment of residual instability includes performing the ballottement test and the press test as well as using the DASH score, the visual analogue scale, the Modified Mayo Clinic Score, and measuring grip strength with a Jamar dynamometer.

9. Which are the most common complications associated with your treatment of choice?

ERZ: The most common complication is the potential adhesion of the scar or the dorsal cutaneous branch of the ulnar nerve. It is key to diagnose any other lesions associated with the ulnar side: dorsal sub-dislocations of the ulna, lunotriquetral instability, triquetral-pisiform instability, triquetral-hamate instability. Failure to treat associated conditions in the same surgery results in residual pain and prevents from achieving painless outcomes.

MC: The complications we have encountered in our practice are: transient lesion of the radial sensory nerve branch (due to manipulation or knot-related irritation, especially we using bone anchors at foveal level), complex regional pain syndrome and recurring pain, especially in injuries misconstrued as stable injuries. In addition, arthroscopy as a diagnostic tool has allowed us to diagnose other concomitant causes of ulnar aspect pain, which we were able to manage simultaneously and, thus, led to a decrease in the rate of postoperative pain.

Conflict of interests: Authors claim they do not have any conflict of interest.

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