THE TREATMENT OF CONGENITAL AND TRAUMATIC DISLOCATION OF THE RADIAL HEAD; ORIGINAL TECHNIQUE

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The normal stability and mobility of the proximal radial-ulnar joint is assured by the integrity of the annular and quadrate ligament (*Figure 1*).

This type of dislocation is defined as a loss of the normal relationship between the radial head and both the humeral epicondyle and the radial notch of the ulna.

This affliction is hereditary in nature and its presence in a great number of family members suggests a possible genetic etiopathogeny.

The dislocation is caused by dysplastic lesions of the two ligaments. It can be obvious at birth, when the dysplastic lesions are complete, or in the first years of life, when the dysplastic lesions are partial.

In rare forms, the dislocation occurs inside the womb and the dislocation seen at birth is accompanied by periarticular muscle contraction and retraction. These are teratologic dislocations which are usually accompanied by muscle malformations, vascular malformations, and severe deformations of the radius and also of the ulna, hemimelia or agenesis of the thumb or other fingers.

The lesion can be unilateral or bilateral. The frequency of unilateral involvement is higher, with a ratio of 6:4.

The gender distribution does not have any pathological significance and the statistics show a higher percentage of male subjects: 7 cases out of 10.

From an anatomic and clinical point of view there are 3 forms of dislocations:

posterior dislocations, present in 50 percent of the cases;

anterior dislocations in 40 percent of the cases;

lateral dislocations present in 10 percent of the cases.

Frequently, the congenital proximal radio-ulnar dislocation is accompanied by adjacent dysplastic lesions of the elbow or dysplastic lesions of other joints.

The most frequent association is with recurring patellar dislocation.

Often, in a child with congenital radial head dislocation, we can also diagnose Klippel-Feil syndrome, arthrogryposis, arachnodactyly or mesomelic dwarfism.

Teratologic dislocations are always accompanied by ulnar deformities. It can be induced by a distortion, by the presence of osteogenic exostoses, by Madelung's disease, and so on.

Clinical manifestations vary depending on the anatomic and clinical form of the dislocation. In the case of posterior dislocation, the anatomical skin dimple corresponding to the radial head is replaced by a protruding bony relief, identifiable and mobile during pronation and supination motion.

The long-term evolution of posterior dislocations induces a limitation of the extension motion of the elbow and deformation of the radial head.

In anterior dislocation, the humeral condyle impinges on the radius, restricting elbow flexion.

The spontaneous evolution, over a long period of time, of both anterior and posterior dislocation causes a valgus deviation and can be accompanied initially with paresis and then with paralysis of the ulnar nerve.

In severe lateral dislocations, paresis or paralysis of the radial nerve can be encountered.

On X-ray, the posterior, anterior or lateral displacement of the radial head is always apparent. Dysplastic lesions of the elbow may also be visualized; in older children periarticular osteoma can be seen, secondary to multiple and repeated trauma, which causes the damaged fibrous tissue to be transformed into metaplastic bone.

The radial head is usually distorted and hypertrophic compared to the opposite elbow.

Obvious dysplastic lesions may appear, and might be, surprisingly, noticed on the opposite side. These lesions should be evaluated periodically along with the growth and the development of the child, in order to take the necessary measures at the proper time.

The treatment is indicated preferably between the age of 1 and 3, and has to be differentiated according to the clinical form. The therapeutic arsenal comprises a series of surgical procedures.

Traumatic radial head dislocation is most often associated with the fracture of the ulna, a lesion known as a Monteggia fracture, but can also occur in isolation.

History:

Proximal radio-ulnar ligament plasty using the extensor carpi radialis longus (ECRL) tendon was first performed in 1986 by G. Burnei at Mangalia Municipal Hospital in Romania. In September 1989, the scientific paper *"Ligamentoplastia radioulnară proximala în luxația congenitală a capului radial – procedeu original"* [Proximal Radio-Ulnar Ligament Plasty for the Congenital Dislocation of the Radial Head – Original Procedure] (G. Burnei, A. Faur, C. Dumitrescu, L. Mârza) was presented at the Iași International Congress of Pediatric Surgery and Orthopedics [1]. The paper showed the results obtained on 4 cases (3 congenital dislocations, aged 1 – 3, and one traumatic dislocation, aged 6), and demonstrated the technique's advantages. The congress organizers were apprehensive about the term "original procedure", and the congress documentation contained the simplified title "Proximal Radio-ulnar Ligament Plasty for the Congenital Dislocation of the Radial Head"; the presenter however mentioned explicitly that the procedure was original. The paper received the Polish Academy of Pediatric Surgery Award, bestowed by Prof. Dr. C. Z. Markiewicz (*Figure 2*)

The clinical experience gathered along the years on proximal radio-ulnar ligament plasty has been synthesized

in several scientific papers, presented at: Orthopedics Jubilee Meeting, 1 – 3 June 1994, Craiova, Romania[2]; The 11th SOROT National Congress of Orthopedics and Traumatology, October 19 – 21 2005, Bucharest, Romania[3]; The 29th Annual Congress of the European Pediatric Orthopedic Society (EPOS), April 7 – 10 2010, Zagreb, Croatia[4].

The latest paper[4], presented at the 29th Annual Congress of the EPOS by the authors, G. Burnei, S. Gavriliu, I. Georgescu, C. Vlad and L. Hurmuz, is based on 19 cases of radial head dislocation, 8 congenital and 11 traumatic, on which 20 surgeries were performed. The patients were aged between 3 and 14, on average 6.4 years old, at the time of surgery. The results were very good for 13 patients (14 surgeries – one patient was operated bilaterally), good for 4 patients and mediocre for 2 patients. 17 patients had less than 30° of supination deficit. The most frequent long-term complication recorded by the authors was radio-humeral arthrosis, diagnosed in 3 patients.

Surgical technique:

An incision is made on the dorsal side of the elbow, starting on the lateral side of the triceps tendon, reaching the cutaneous dimple corresponding to the radial head and heading laterally along the medial edge of the ECRL, ending at the tendon-muscle junction. After dissecting the subcutaneous tissue, the brachial fascia, articular capsule and the insertion of the aponeurosis of the epicondylian muscles are exposed.

The antebrachial fascia is exposed and incised to reveal the extensor carpi radialis longus (ECRL) and the extensor carpi radialis brevis (ECRB) muscles. Also, the ECRB and ECRL tendons are identified and isolated in the distal extremity.

The articular capsule situated above the epicondylian muscles is cut to reveal the humeral condyle and the head of the radius, dislocated ventrally, laterally or dorsally (*Figure 3*). The exuberant tissue that has grown in the radial notch of the ulna is excised, after checking for the presence of any remaining length of annular ligament; this may be present in traumatic downward dislocations of the radial head. Reduction of the dislocation is attempted and, if reduction is possible, a tunnel is drilled from lateral to medial.

A 2 cm incision is made at the base of the second metacarpal and the insertion of the ECRL tendon is identified, isolated and cut. The tendon is pulled up to the distal end of the proximal incision (*Figure 4*).

The last 2 cm of the free end of the tendon are tied with atraumatic suture thread using Cuneo type sutures.

The ECRL tendon is passed through a gap made through the ERCB below the tendon-muscle junction. The proximal end of the gap is closed with 1 – 2 suture points. The tendon is passed through the radial neck tunnel (*Figure 5*), then around the radial neck, under the muscular part, either posteriorly (*Figure 6*) or anteriorly, depending on the type of dislocation. The tendon is then passed under the strap in order to prevent recurrent dislocation and fixed to the ulna at the insertion points of the radial ring using an interference screw.

Final screw fixation to the bone must insure stability while testing flexion and extension, and allow normal prono-supination.

The subcutaneous layers are closed anatomically and the skin is sutured.

A long-arm splint is applied, with the elbow at 90°, and is kept for 2 -3 weeks, depending on the age of the child.

Comments

A number of other authors have described surgical techniques for the reestablishment of normal relationships between the head of the radius and the radial notch of the ulna on the one hand, and the head of the radius and the capitellum on the other. Some of these are: annular ligament reconstruction using a tendon bundle from the triceps brachii (Bell Tawse 1965; Boyd and Boals 1969; Lloyd-Roberts and Bucknill 1977; Hurst and Dubrow 1983; Seel and Peterson 1999), a portion of the antebrachial fascia (Bell Tawse 1965; Boyd and Boals 1969), the palmaris longus tendon (Lloyd-Roberts and Bucknill 1977); the Varna procedure, using surgical thread to reconstruct the annular ligament; ulnar lengthening and angulation osteotomy (Lord and Roy-Camille 1962; Nishio et al. 1965; Lloyd-Roberts and Bucknill 1977); radial osteotomy (Yamamoto et al. 1976) and not least ligament reconstruction with ulnar osteotomy (Lloyd-Roberts and Bucknill 1977; Fowles et al. 1983).

Boyd and Boals stated: *Using a postero-lateral incision the radial head is defined and the capsular block exposed and removed. The radial head is then easily reducible without the need to divide the ulna. A new annular ligament is made by turning down a slip of the triceps tendon, leaving it attached to the ulna, and passing it round the neck of the radius from behind forward and securing it through a drill hole in the ulna.*[5]

Bell Tawse said:*Reduction, possible with the arm flexed, was impossible with the arm extended because of an apparent disparity in the length of the radius and ulna. It was reduced in the flexed position and held in place by making a new annular ligament.* [6]Bell Tawse (1965) used a central bundle from the triceps brachii tendon, which was lowered, passed through a tunnel through the olecranon, wrapped around the radial neck and then fixed to the lateral side of the ulna.

Lloyd-Roberts and Bucknill used, in some cases, the palmaris longus tendon in this surgical technique. Notably, they introduced two modifications to the Bell Tawse technique: they used a lateral triceps brachii tendon bundle that they lowered to the level of the radial neck in order to reconstruct the annular ligament, and they inserted a transcondylar K wirethat stabilizes the radial head, as demonstrated by Lambrinudi (1939). *Although satisfactory results were obtained with both methods we prefer reconstruction with the triceps tendon, for it confines the operation to one surgical field, and the preservation of the normal ulnar attachment inspires confidence in the viability of the refashioned ligament.*[7]

Hurst and Dubrow also lowered a central bundle from the triceps brachii tendon, but modified the Bell Tawse technique: *Further, it is important to strip the tendon*

of the proximal olecranon with a 2- to 3-cm segment of dorsal periosteum so that the attachment site of the newly reconstructed ligament will be parallel to the radial neck and not proximal to it. This alignment more closely approximates the normal anatomy of the annular ligament [8], unlike fixation to the olecranon.

Seel and Peterson described a method in which they drilled two holes in the proximal ulna, at the level of the origins of the annular ligament, in order to repair the original ligament or to reconstruct it using a tendon bundle from the triceps brachii, stabilized with two interference screws. They stated that using two points of fixation to the ulna greatly increase the stability of the radial head, compared to Bell Tawse's technique. *It secures the radial head in its normal position from any dislocated position. It also allows for osteotomy of any accompanying deformity of the ulna or radius.*[9]

T. Hirayama et al. (1987) were reticent about annular ligament reconstruction, considering it inadequate for the anatomical contention of the radial head and that redislocation would follow. *In addition, narrowing and restriction of rotation of the radial neck may be caused by excessive tension in the reconstructed ligament; In children, inhibition of growth of the radial head by the reconstructed ligament must also be considered.* [10] Regardless, most authors employed surgical techniques that included the reconstruction of the annular ligament, with or without an ulnar osteotomy.

Ulnar osteotomy, with or without annular ligament reconstruction, had been seen as an effective method to preserve the reduction of the radial head, but in many cases a high rate of postoperative complications was reported. F. C. Oner and A. F. M. Diepstraten (1984) published a study in which 7 patients with traumatic dislocation of the radial head were operated using Lloyd Roberts and Bucknill's technique of annular ligament reconstruction, without osteotomy. Four patients had a good outcome, two had a satisfactory outcome, exhibiting recurrent dislocation, and one child developed synostosis because of the lack of the use of a tourniquet. *Our results confirm that open reduction with ligament reconstruction by a triceps tendon slip is a reliable operation for anterior dislocations. In this group we had only one poor result, because of the development of a synostosis... Osteotomy is not without complications. Recently, Hirayama et al reported two broken bone plates in nine osteotomies and residual subluxation in one. Verneret et al (1989) described 11 good results in 14 patients but two had to be reoperated and two suffered neurological complications. Bouyala et al (1988) reported five cases of delayed union and loosening of the plate in 15 cases of post-traumatic, paralytic and congenital dislocations. We think that osteotomy is justified only in those cases in which stable reduction is not possible without it, or when the deformity may cause later subluxation such as occurs in anterolateral dislocation.*[11]

The first series of proximal radio-ulnar joint stabilizations done by the author included four cases and used the technical variant involving the reconstruction of the quadrate and annular ligaments (*Figure 7*).

In evolution, this variant has the disadvantage of progressive limitation of prono-supination, down to approximately 30°. Subsequently, other technical variants were used, depending on the type of dislocation.

Variant 2 is used in anterior dislocations. The tendon is passed through a tunnel drilled in the radial neck, wrapped around the anterior half of the circumference, under the strap, and fixed at the level of the posterior insertion of the annular ligament (*Figure 8*).

Variant 3 is used in posterior dislocations. The tendon is passed around the posterior half of the circumference and fixed with an interference screw at the anterior insertion of the annular ligament (*Figure 9*).

In Variant 4, the tendon is passed through a tunnel in the radial neck, from medial to lateral, divided in two equal strips, which are passed one anterior and one posterior and then fixed to the insertion points of the annular ligament. This fourth variant can be used in all forms of dislocation of the radial head (*Figure 10*).

Variants 2, 3 and 4 are advantageous in that the radial neck is only partially circumscribed, which avoids constriction of the radial neck during growth.

Conclusions

The Burnei procedure is an alternative for the treatment of radial head dislocation and is advantageous because of the use of a sturdy, well vascularized tendon, which allows, when needed, the complete reconstruction of the proximal radio-ulnar ligaments, or just the annular ligament, in order to stabilize the head of the radius within the elbow joint.

References:

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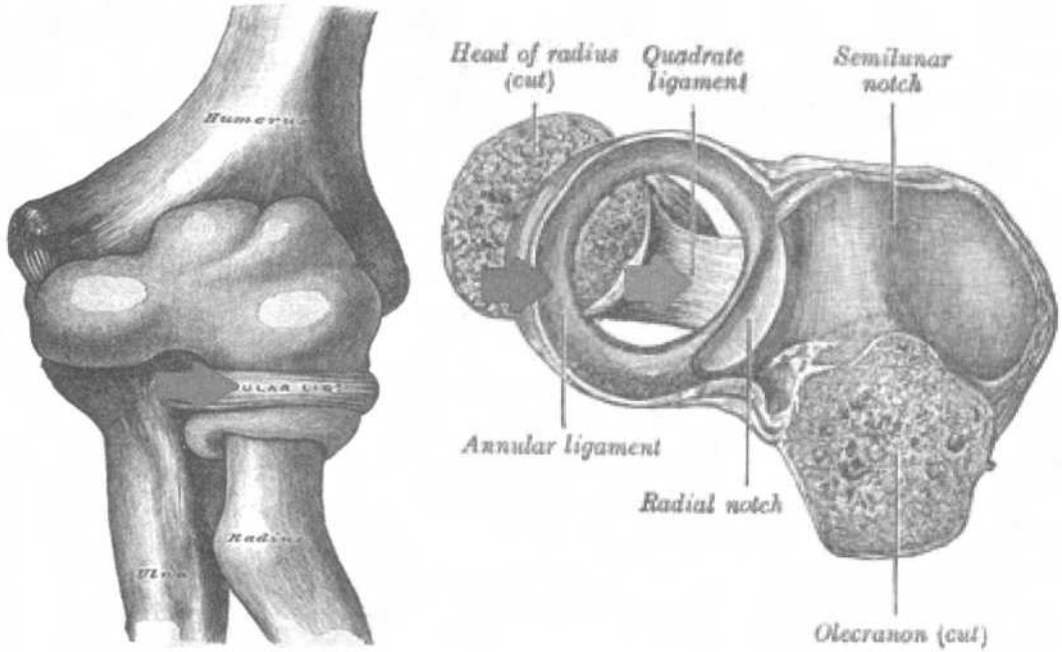

Figure 1. Anatomical elements ensuring the stability of the elbow: annular ligament (red arrow) and quadrate ligament (blue arrow) (*after Grey*).

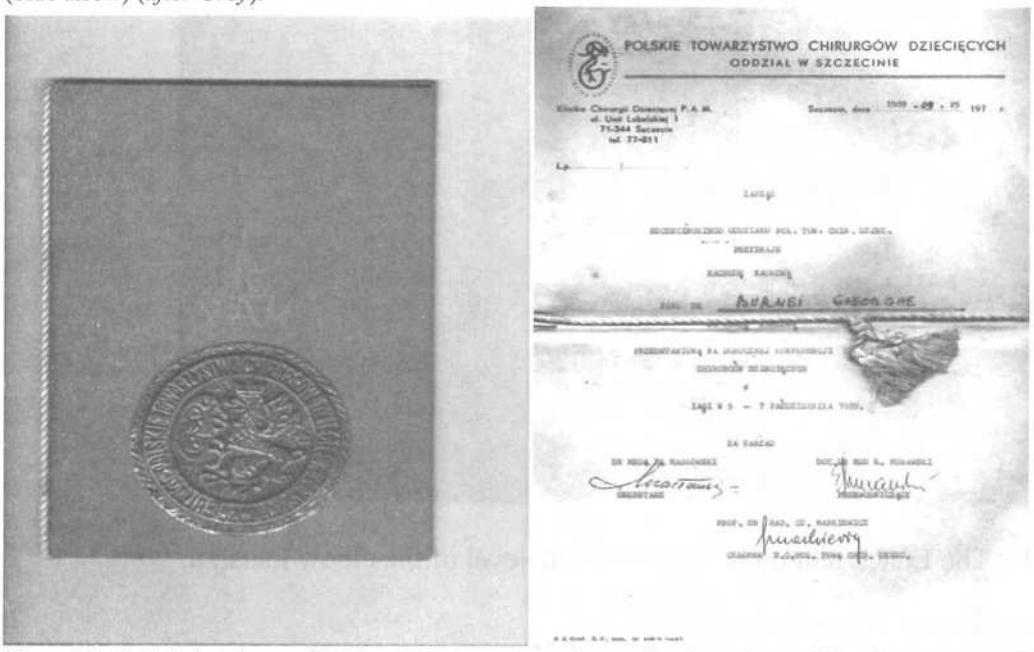

Figure 2 - Polish Academy of Pediatric Surgery Award, won by the authors of the first paper on the surgical treatment of radial head dislocation by ligament plasty using the tendon of the ECRL.

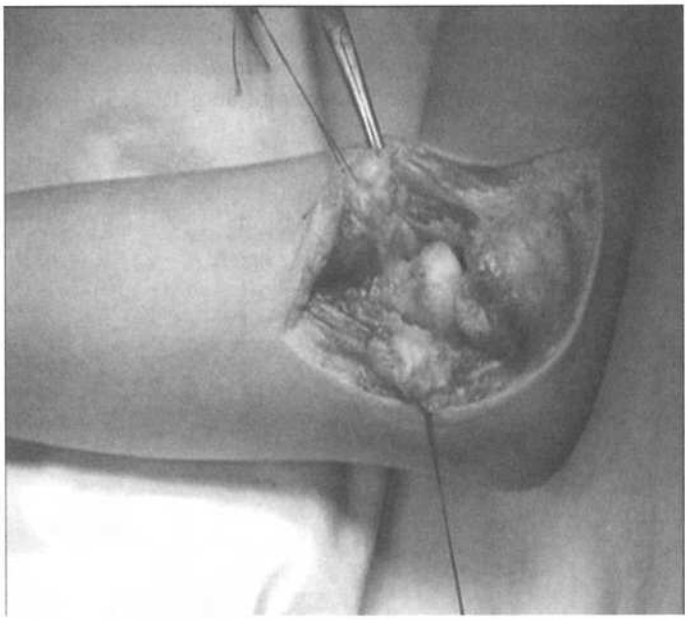

Figure 3 – The radial head is ventrally dislocated

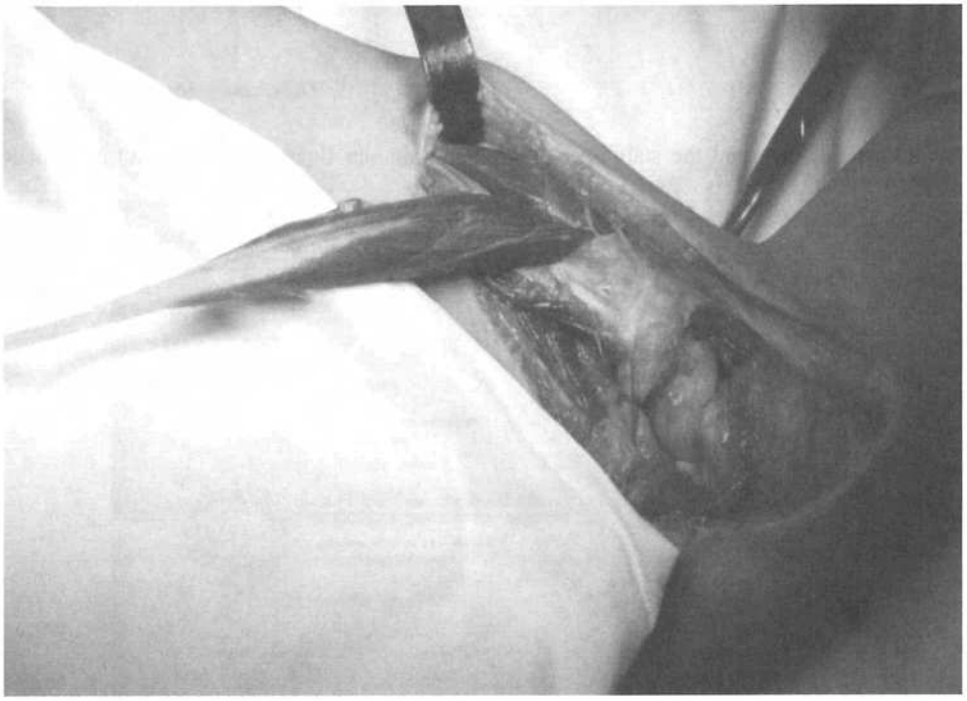

Figure 4 – The ECRL tendon is exposed at the level of the elbow incision.

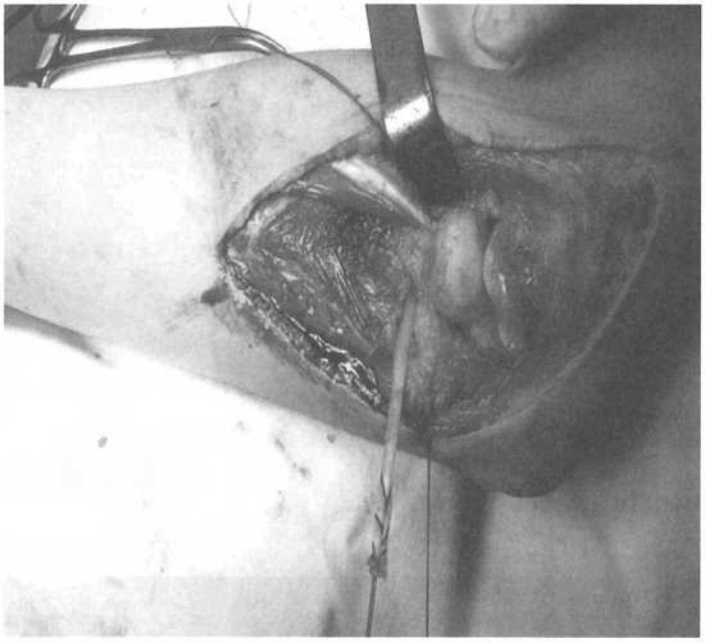

Figure 5 – The tendon is passed through the bone tunnel in the radial neck.

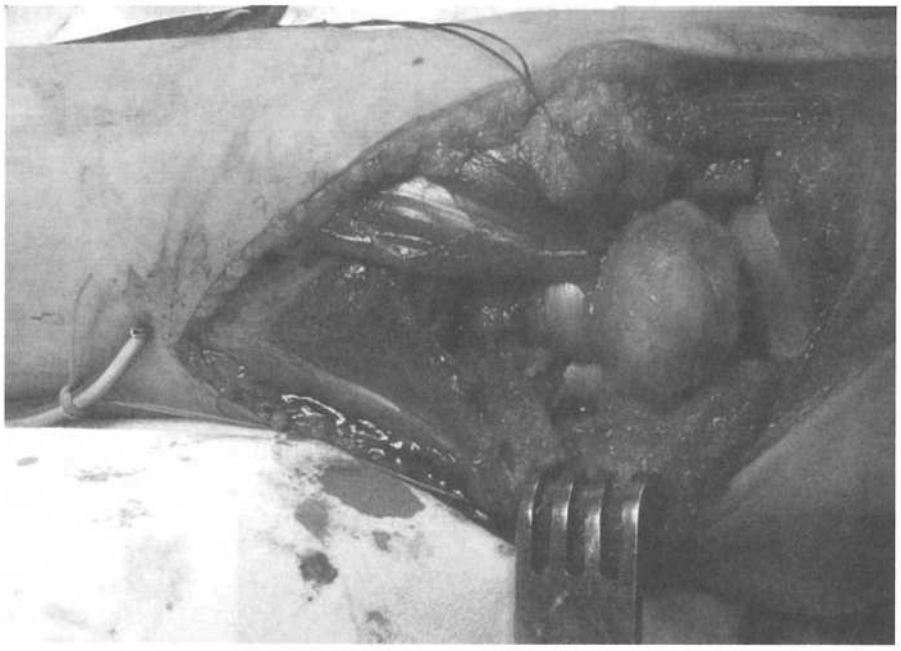

Figure 6 – Reconstructed annular ligament, fixed in the strap by the muscle belly of the ECRL. Radial head in a normal position relative to the ulna and humerus.

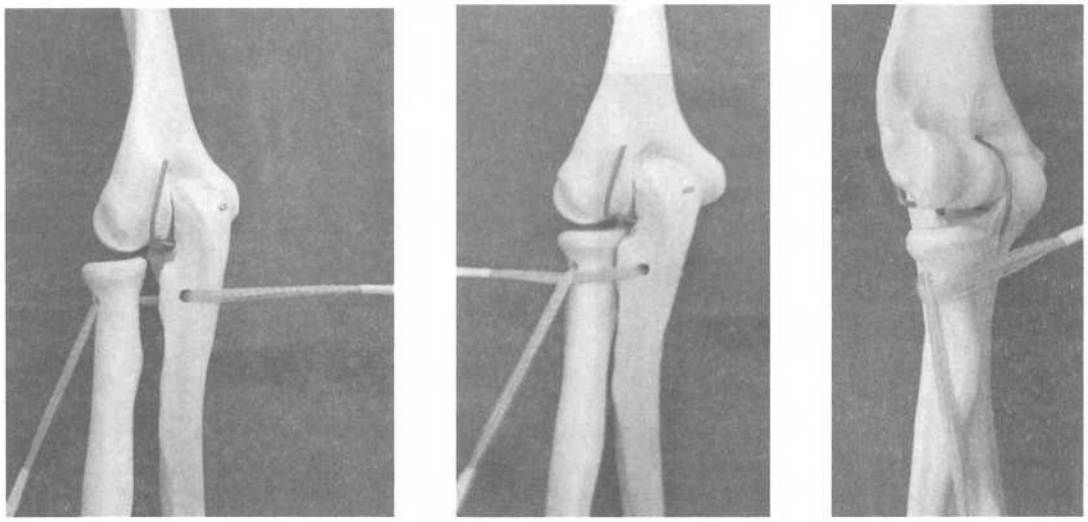

Figure 7 – Technique for the reconstruction of both ligaments.

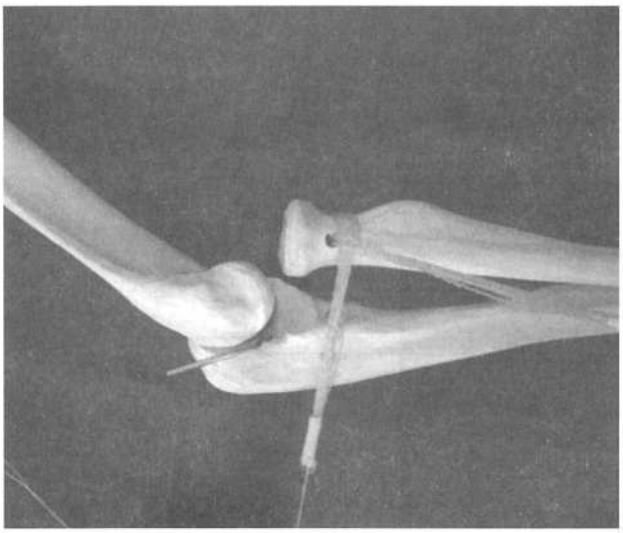

Figure 8 – Ligament plasty technique for anterior dislocation.

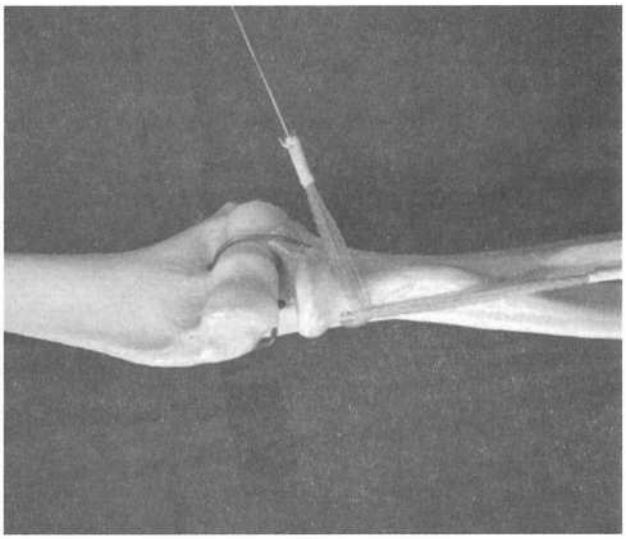

Figure 9 – Ligament plasty technique for posterior dislocation.

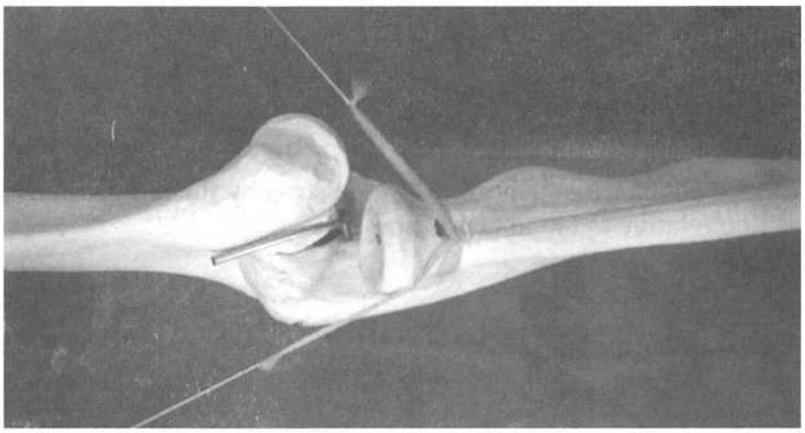

Figure 10 – Ligament plasty technique for lateral dislocation; it may be also used for the other forms.