

Extensor Carpi Radialis Longus Tendon Transfer to Extensor Carpi Ulnaris: Does It Significantly Improve the Correction of Radial Deviation in the Rheumatoid Wrist?

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ABSTRACT

Introduction: Inflammatory arthritis can lead to caput ulnae syndrome with radial deviation of the wrist and metacarpals. Treatment includes salvage arthroplasty of the distal radioulnar joint and relocation of the extensor carpi ulnaris (ECU) tendon. However, the ECU may be too weak to correct the deviation. To strengthen the ECU, Clayton described the transfer of the extensor carpi radialis longus (ECRL) tendon to the ECU. The aim of this work is to compare the correction of the radial deviation of the metacarpals in patients with and without transfer of the ECRL to the ECU. **Materials and Methods:** Retrospective cohort study. Patients with rheumatoid arthritis and caput ulnae syndrome, treated with ECU tenoplasty with or without ECRL, were included. The patients were divided into two groups: ECRL to ECU transfer (group A) and no transfer (Group B). The correction of the metacarpal-radial angle (Clayton's angle) was calculated by comparing the measurements before surgery and at end of follow-up, and the results obtained were compared. **Results:** The average follow-up was 28 months. The preoperative Clayton angle was on average 44.54° (SD ± 7.52) in group A and 60.24° (SD ± 12.28) in group B ($p = 0.001$). The correction average was 6.57° (SD ± 4.11) and 0.95° (SD ± 9.17) for group A and B respectively ($p=0.026$). **Conclusions:** The level of correction obtained was higher in group A. However, although both techniques managed to improve the angle, the degree of correction could be subject to the magnitude of the preoperative angle.

Keywords: Rheumatoid arthritis; caput ulnae; tendon transfer; Clayton's angle.

Level of Evidence: IV

Transferencia tendinosa del primer radial externo al cubital posterior: ¿mejora significativamente la corrección de la desviación radial en la muñeca reumática?

RESUMEN

Introducción: La artritis inflamatoria puede conducir al síndrome de caput ulnae con desviación radial de la muñeca y los metacarpianos. El tratamiento es la artroplastia de rescate de la articulación radiocubital distal y la reubicación del tendón del extensor cubital del carpo (ECC). Sin embargo, puede ser débil para corregir la desviación. Clayton describió la transferencia del tendón del extensor radial largo del carpo (ERLC) al ECC. El objetivo de este estudio fue comparar la corrección de la desviación radial de los metacarpianos en pacientes operados con transferencia del ERLC al ECC o sin ella. **Materiales y Métodos:** Estudio de cohorte retrospectiva en pacientes con artritis reumatoide y síndrome de caput ulnae, sometidos a tenoplastia del ECC con ERLC o sin este procedimiento. Se formaron dos grupos: pacientes con transferencia (grupo A) y sin transferencia (grupo B). Se calculó la corrección del ángulo de Clayton comparando las medidas preoperatoria y del último control, y se compararon los resultados. **Resultados:** El seguimiento promedio fue de 28 meses. El ángulo de Clayton preoperatorio promedio era de 44,54° (DE ± 7,52) en el grupo A y 60,24° (DE ± 12,28) en el grupo B ($p = 0,001$). El promedio de corrección fue de 6,57° (DE ± 4,11) y 0,95° (DE ± 9,17), respectivamente ($p = 0,026$). **Conclusiones:** El nivel de corrección fue mayor en el grupo A. No obstante, si bien ambas técnicas lograron mejorar el ángulo, el grado de corrección podría estar supeditado a la magnitud del ángulo preoperatorio.

Palabras clave: Artritis reumatoide; caput ulnae; transferencia tendinosa; ángulo de Clayton.

Nivel de Evidencia: IV

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INTRODUCTION

Rheumatoid arthritis (RA) is a chronic inflammatory autoimmune disease that causes joint and extra-articular manifestations.¹ Most patients with RA develop structural deformities during the course of the disease. When it affects the hands, it is usually disabling and more than 90% of RA patients will end up with wrist involvement within 10 years of diagnosis.^{2,3} The distal radioulnar joint is usually the first site of involvement. One of the characteristic deformities is caput ulnae syndrome. Described by Backdahl⁴ in 1963, caput ulnae syndrome is the consequence of a progressive impairment of the ulnocarpal ligaments due to the synovitis characteristic of the inflammatory disease. Synovitis of the extensor carpi ulnaris tendon (ECU) causes incontinence of its sheath, allowing its volar dislocation from extensor to flexor and supinator of the wrist. This, associated with distal radioulnar synovitis and the consequent distension of its ligaments, causes volar dislocation of the radius, with dorsal protrusion of the ulnar head. The end of this pathophysiological pathway is the imbalance of the lateral forces of the wrist, with weakness of the ulnar side forces, and the progressive rotation and radial deviation of the wrist and metacarpals, often also with ulnar deviation of the fingers.⁵

This condition, which combines caput ulnae syndrome with radial deviation of the wrist and metacarpals, requires rebalancing forces at the wrist, which includes arthroplasty or salvage arthrodesis of the distal radioulnar joint and repositioning of the ECU tendon to its normal dorsal position. However, the ECU tendon, in some cases, may be too weak to correct radial deviation and restore the essential balance that would restore the tendinous skeletal axis to the wrist, metacarpals and fingers.^{5,6}

In these cases, in order to strengthen the ECU, which is often very deteriorated and weakened by the disease, Clayton and Ferlic⁷ described the transfer of the extensor carpi radialis longus tendon (ECRL) to the ECU with the double objective of improving the balance of forces by strengthening the ulnar side of the wrist, and decreasing, in turn, the radial deflection force produced by both extensor carpi radialis tendons (ECRL and the extensor carpi radialis brevis) by taking one of them as a donor tendon.

The purpose of this study was to compare the correction of radial deviation of the metacarpals in patients who underwent surgery with or without a transfer from ECRL to ECU.

MATERIALS AND METHODS

After approval by the Ethics Committee of our institution, a retrospective cohort analytical observational study was carried out. Prospectively completed electronic medical records of all patients with rheumatic disease and wrist involvement who had been treated at our institution between 2010 and 2018 were reviewed.

Patients were included with: RA and caput ulnae syndrome, treated with a palliative distal radioulnar joint procedure and tenoplasty of the ECU to the ECRL or without the transfer. Patients with wrist arthroplasty, radiocarpal or intercarpal arthrodesis, wrist tendon transfers and less than six months of follow-up were excluded.

Demographic variables such as age and sex, affected side and duration of follow-up were recorded. Preoperative and postoperative AP radiographs of the hand were evaluated by measuring the Clayton angle.⁷ (Figure 1) defined as that formed between the axis of the second metacarpal and the radial inclination line on the articular surface of the wrist in the anteroposterior radiograph.

All had been operated on by the same team of upper limb surgeons. Caput ulnae syndrome has always been treated with Darrach's⁸ or Sauvé-Kapandji's⁹ inferior radioulnar arthroplasty, which involves relocating the ECU tendon in its sheath and reconstructing the sheath, reducing the tendon back to the ulna's dorsum in its proper canal. Furthermore, the ECU was strengthened in some cases with transfer from the ECRL to the ECU and not in others.

According to the technique, after the dorsoulnar wrist approach, inferior radioulnar arthroplasty, and reconstruction of the ECU sheath and its dorsal relocation, tendon transfer is performed in patients with radial deviation of the wrist. The transfer was performed according to the technique described by Clayton and Ferlic:⁷ through an approach at the base of the metacarpal, the ECRL tendon is sectioned at the insertion at its base; a second minimal incision is made on the same tendon about 5 cm proximal to the first one; the tendon is extracted through the second incision freeing it from the surrounding sheaths for its transfer; the ECRL tendon is passed under the cellular tissue and supra-aponeurotically and over the extensors of the fingers towards the dorsoulnar

approach to suture the ECU in a position of 30° of wrist extension, maximum pronation and ulnar deviation, proximal to the entrance of the ECU in its neosheath that was reconstructed in the same surgical procedure before the transfer (Figures 2 and 3).

Patients were divided into two groups: with transfer from ECRL to ECU (group A) and without transfer (group B). In each group, the correction of the metacarpal-radial angle (Clayton angle) was calculated by comparing the preoperative measurements and those of the last control, and the results obtained between the two groups were compared.



Figure 1. Radiographic measurement of the modified Clayton angle.



Figure 2. Pre-surgical clinical and radiographic imaging. Radial deviation of metacarpals and ulnar deviation of the fingers.



Figure 3. **A.** Tendon of the extensor carpi radialis longus prepared for transfer, already sectioned from the base of the metacarpal. **B.** Tendon of the extensor carpi radialis longus transferred to be sutured to the extensor carpi ulnaris through a dorsoulnar approach. **C.** Final correction of the deviation. **D.** Postoperative radiograph of the hand, AP view.

Statistical Analysis

Continuous variables are expressed as means with standard deviation or as median with interquartile range according to their normal or nonparametric distribution, respectively. Categorical variables are expressed as frequencies and percentages. Univariate analysis was performed between both groups according to their distribution using Student's t test and Mann-Whitney U test. The delta values between preoperative and final radiographic angles were compared with the t-test for paired samples. A p-value <0.05 was considered statistically significant. IBM SPSS v.26 (IBM Corp., Armonk, N.Y., USA) was used.

RESULTS

After applying the inclusion and exclusion criteria, 31 wrists in 31 patients were evaluated: 11 in group A (with ECRL transfer) and 20 in group B (without ECRL transfer). The demographic characteristics of the series and the univariate comparative analysis are detailed in Table 1. No statistically significant differences were found between the two groups for age, sex, side operated on and follow-up time (mean 28 months, standard deviation [SD] \pm 27.4).

Table 1. Demographic characteristics and univariate comparative analysis between the two groups

Variable	Series (n = 31)	Group A (with transfer; n = 11)	Group B (no transfer; n = 20)	p
Age (years)	52.97 (SD \pm 13)	57.36 (SD \pm 11.3)	50.55 (SD \pm 13.48)	0.166
Female sex	29 (93.5%)	10 (90.9%)	19 (95%)	1
Right side	18 (58.2%)	6 (54.5%)	12 (60%)	1
Follow-up time (months)	28.55 (SD \pm 27.44)	23 (SD \pm 20.24)	31.6 (SD \pm 30.75)	0.413
Preoperative Clayton angle ($^{\circ}$)	54.67 (SD \pm 13.14)	44.54 (SD \pm 7.52)	60.24 (SD \pm 12.28)	0.001

SD = standard deviation.

The preoperative Clayton angle measured, on average, 135.46° (SD \pm 7.52) in group A and 119.75° (SD \pm 12.28) in group B (p = 0.001). In group A, an average improvement of 6.57° (SD \pm 11.69) was achieved, with a postoperative angle of 128.89° (SD \pm 7.98). In group B, a correction of 0.95° (SD \pm 16.30) was obtained, with a postoperative angle of 118.8° (SD \pm 9.50) (Table 2).

Table 2. Comparison between preoperative and postoperative Clayton angle.

Grupo	Preoperative angle ($^{\circ}$)	Postoperative angle ($^{\circ}$)	p
Group A (with transfer)	44.54 (DS \pm 7.52)	51.11 (DS \pm 7.98)	0.092
Group B (without transfer)	60.24 (DS \pm 12.28)	61.2 (DS \pm 9.50)	0.796

DISCUSSION

Current treatment protocols for RA consist of an interdisciplinary clinical-surgical approach. Pharmacologic therapy has substantially decreased the incidence of hand deformities. However, surgery remains an essential therapeutic option to be considered for symptomatic patients, and it can be classified as preventive/prophylactic or reconstructive.¹⁰

Prophylactic procedures (synovectomy, tenosynovectomy, tendon balancing) aim to delay the development of deformities, while so-called reconstructive procedures (arthroplasty, tendon transfer/grafting) aim to correct already established deformities.¹¹

It is critical to note that the presence of a deformity is not an absolute indication for surgery, as many patients with hand deformities can still retain reasonable function. However, it is worth mentioning that the treatments proposed in this study have a window period to be indicated; radial deviation is usually irreversible in the presence of a substantial carpal collapse.

In the case of a Z deformity of the hand with radial deviation of the metacarpals, whether or not complicated with ulnar deviation of the fingers, the existing deformity causes an imbalance of forces in the tendon axes, resulting in progressive loss of function and normal anatomical axis and, thus, progressive functional inefficiency. In these circumstances, surgery should be performed as soon as the deformity is diagnosed to rebalance the traction and tensile forces of the wrist and fingers, preventing the Z deformity from worsening.

In this context, the surgery we evaluated is merely one component of a group of surgical treatments (inferior radioulnar arthroplasty, tenoplasty and ECU relocation, correction of dislocation of the extensors of the fingers, and so on) used to reconstruct and prevent abnormalities from worsening.

The main objective of this study was to compare the variation of radial metacarpal deviation achieved in patients operated with or without transfer from ECRL to ECU.

In our series, radial deviation correction was higher in the group with transfer from ECRL to ECU.

Although the literature on this subject is scarce, the results obtained using the transfer technique are comparable to those reported in other series. Clayton and Ferlic,² who originally described this technique, applied this procedure on a series of 14 wrists, and achieved a mean preoperative and postoperative variation close to 17°. Ito et al.¹² published a 10° improvement in radial deviation using the same technique in 28 wrists. These authors also compared whether these results were reproducible in the different stages of radiocarpal osteoarthritis, and concluded that radioulnar deviation after surgery was reduced even when the patient had radiocarpal joint ankylosis.

On the other hand, the correction achieved in group B (without transfer) was approximately 1°. The difference between the two groups could be attributable to a number of factors, including the surgical approach itself, which, as previously stated, aims to produce a better balance of forces and a larger correction of radial deviation when utilizing the ECRL. However, given that patients in this group start from lower preoperative values, i.e., with less metacarpal deviation from its normal axis, this could be a limitation to achieve greater postoperative variation. This difference between the two groups can probably be attributed to the surgeon's choice of technique, who, in order to correct larger deviations, opted for the transfer technique which, from a biomechanical point of view, seems to offer greater resistance.

This study has various limitations. First, as previously stated, the starting point of the preoperative values in radial deviation differed; nevertheless, the demographic characteristics did not differ.

Although the number of patients is not large enough to draw statistical conclusions, this case series contributes to a casuistry on a subject with limited published studies.

We believe that studies with homogeneous and long-term case series are necessary to improve the level of evidence.

CONCLUSIONS

Based on the results obtained, we consider that both techniques improved the Clayton angle. Although the degree of correction achieved in this series was greater with the ECRL transfer technique, the values could be contingent on the magnitude of the preoperative angle.

Conflict of interest: The authors declare no conflicts of interest.

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REFERENCES

1. Smolen JS, Aletaha D, McInnes IB. Rheumatoid arthritis. *Lancet* 2016;388(10055):2023-38. [https://doi.org/10.1016/S0140-6736\(16\)30173-8](https://doi.org/10.1016/S0140-6736(16)30173-8)
2. Rizzo M, Cooney WP 3rd. Current concepts and treatment for the rheumatoid wrist. *Hand Clin* 2011;27(1):57-72. <https://doi.org/10.1016/j.hcl.2010.09.004>
3. Ilan DI, Rettig ME. Rheumatoid arthritis of the wrist. *Bull Hosp Jt Dis* 2003;61(3-4):179-85. PMID: 15156823
4. Backdahl M. The caput ulnae syndrome in rheumatoid arthritis. A study of the morphology, abnormal anatomy and clinical picture. *Acta Rheumatol Scand Suppl* 1963;5:1-75. PMID: 13965955
5. Kozlow JH, Chung KC. Current concepts in the surgical management of rheumatoid and osteoarthritic hands and wrists. *Hand Clin* 2011;27(1):31-41. <https://doi.org/10.1016/j.hcl.2010.09.003>
6. Papp SR, Athwal GS, Pichora DR. The rheumatoid wrist. *J Am Acad Orthop Surg* 2006;14(2):65-77. <https://doi.org/10.5435/00124635-200602000-00002>
7. Clayton ML, Ferlic DC. Tendon transfer for radial rotation of the wrist in rheumatoid arthritis. *Clin Orthop Relat Res* 1974;(100):176-85. PMID: 4838397
8. Darrach W. Habitual forward dislocation of the head of the ulna. *Ann Surg* 1913;57:928-30.
9. Sauvé LKIH. Nouvelle technique de traitement chirurgical des luxations récidivantes isolées de l'extrémité inférieure du cubitus. *J Chir (Paris)* 1936;47:589-94.
10. Blazar PE, Gancarczyk SM, Simmons BP. Rheumatoid hand and wrist surgery: Soft tissue principles and management of digital pathology. *J Am Acad Orthop Surg* 2019;27(21):785-93. <https://doi.org/10.5435/JAAOS-D-17-00608>
11. Ghattas L, Mascella F, Pomponio G. Hand surgery in rheumatoid arthritis: state of the art and suggestions for research. *Rheumatology (Oxford)* 2005;44(7):834-45. <https://doi.org/10.1093/rheumatology/keh608>
12. Ito J, Koshino T, Okamoto R, Saito T. Radiologic evaluation of the rheumatoid hand after synovectomy and extensor carpi radialis longus transfer to extensor carpi ulnaris. *J Hand Surg Am* 2003;28(4):585-90. [https://doi.org/10.1016/s0363-5023\(03\)00202-8](https://doi.org/10.1016/s0363-5023(03)00202-8)